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DEFENSE FORECAST

DUAL-USE APPLICATIONS OF INFRARED SENSITIVE MATERIALS

BARRY M. BLECHMAN AND SCOTT C. LUSH

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APPENDICES

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High performanc infrared focal plane arrays amde from snsitive materials such as mercury cadmium teluride grown on a substrate of cadmium zinc telluride have been proposed for use in an extensive vaqriety of military equipment for over a decade, ranging from early-warning satellites to missile seekers. In this report, we decscribe and quantify the potential dual-use markets for such detectors.

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Appendix A

Current Military Programs to Develop Sensitive Infrared Detector Technologies With Dual-Use Potential

As table A-1 illustrates below, there are nearly 20 DoD funded programs to either develop second generation MCT-based focal plane arrays or their components, or to integrate such sensors into operational systems. Although some programs address essential producibility issues such as PACE II and SHIELD, others are nearing initial production runs, including the Thermal Weapon Sight and AN/AAS-42. All together, total military demand for IR arrays in the 1990s could reach 300,000 units or more, resulting in a market worth about $6 billion, at today's prices. In response to this rising demand, manufacturers have developed more than 65 types of IR focal plane arrays (see tables A-2 and A-3).

Amongst this broad range of development programs, four have particular potential to advance the potential of IR sensitive detectors for dual-use applications: Javelin missile, Thermal Weapon Sight (TWS), Standard Advanced Dewar Assembly (SADA), and the Infrared Materials Producibility Program. Each can make a unique contribution to the commercialization of IRFPAs. We describe each program below, and report the opinions of program officers, contractors, and outside commentators on its commercial potential. Most importantly, we analyze both the advantages which each program could offer in the development of detectors with dual-use potential, and the commercial limitations of each.

Javelin Missile Program

The US Army and Marine Corps plan to procure about 67,000 second generation FPAs for the Javelin missile program, at affordable prices. If any military program can bring down the costs of IRFPAs through economies of scale, automation, batch production, and other volume related manufacturing gains, it is the Javelin. Although the eventual cost of the IRFPAs being used in the Javelin missile is highly uncertain, most estimators believe that the total cost will exceed one-half billion dollars over the next ten years.

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Table A-1. Development Programs for Second Generation IRFPAs

Weapon System	Prime Contractor	Supplier of IRFPA	Size of Array Bandwidth	Material Used	Notes
TRIGAT anti-tank missile	SAT	EURODIR (jont venture of SOFRADIR and AEG)	288x4 LWIR (thermal sight for long range version)	MCT	To be placed in ground based launchers, Tiger/Tigre helicopter, and as aircraft's piloting aid.
"	"	EURODIR	48x4 LWIR (thermal sight for medium range version)	MCT	
"	"	EURODIR	32x1 LWIR (for seeker for long range version)	MCT	
MICA air-to-air missile	MATRA	SOFRADIR	64x1 MWIR (for seeker)	MCT	
Follow-on Early Warning System (FEWS)	Lockheed Missiles and Space	SBRC	?	MCT	
Brilliant Eyes Dem/Val	TRW	SBRC	?	MCT	
Javelin anti-tank missile	TI/MM	SBRC	64x64 LWIR (for seeker)	MCT	
"	"	TI	240X1 LWIR (for CLU)	MCT	

Weapon System	Prime Contractor	Supplier of IRFPA	Size of Array Bandwidth	Material Used	Notes
Second Generation Tank Sight (SGTS)	Hughes Electro-Optical Systems	SBRC	460X4 LWIR	MCT	
Thermal Weapon Sight	Hughes Electro-Optical Systems	SBRC	40x16 MWIR	MCT	TEC cooled. First second generation device to be off the blocks.
FEWS Bid	TRW/Grumman	Loral Infrared Imaging Systems (LIRIS)		MCT	
Ground Based Interceptor	MM/Lockheed	LIRIS	480x380 PtSi CCD 128X128 (for sight) LWIR (for seeker)	MCT	
Electro-Optic Sensor System for RAH-66 Comanche	MM	LIRIS	480X4 LWIR for Electro-Optical Target Acquisition/Designation System for Night Vision Pilotage System	MCT	
Multi-Sensor Target Recognition System	MM	LIRIS	480X4 LWIR	MCT	
Advanced IRST	MM	LIRIS	480x4 LWIR	MCT	A candidate to equip Lockheed's F-22 fighter and other aircraft under a US $50 m contract from US Air Force's Wright Laboratory
FLIR and Automatic Cuer Technology Insertion into the LANTIRN	MM	LIRIS	480x4	MCT	Under test by US Air Force, to replace the standard first-gen FLIR in the LANTIRN targeting pod with an FPA-based imager.
AN/AAS-42	MM	GE Aerospace (purchased recently by MM)	256x1	MCT	For US Navy F-14Ds. The first production application of second-generation long-wave arrays.

Weapon System	Prime Contractor	Supplier of IRFPA	Size of Array Bandwidth	Material Used	Notes
FEWS bid	Grumman Space & Electronics Group	Rockwell International Electro-Optical Center	MWIR LWIR	MCT	
Helicopter Extended Range Laser Illuminating Sight	Rockwell International Tactical Systems Division and SFIM (France)	Rockwell International Electro-Optical Center (EOC)	MWIR 256x256	MCT	
SDI Miniature Seeker Technology Integration	Rockwell	?	?	MCT	
Infrared Materials Producibility Program	Johnson Matthey Electronics-led Consortium	N/A	Various	MCT	
Standard Advanced Dewar Asemblies		TI	240x4 480x4	MCT	Potentially used in Improved TOW Acquisition Sight, TI's own Combat Behicle Tank Thermal Sight, and an ungrade to the Commander's Independent Thermal Viewer for M1A2
Silicon Hybrids with Infrared Extrinsic Long-Wavelength Detectors (SHIELD)		Rockwell EOC	128x128 256x256	Extrinsic silicon	From USAF Phillips Laboratory. Will use blocked impurity band technology developed under the HYWAYS producibility effort to provide arrays for several SDIO programs, including Brilliant Eyes and GBI.

Weapon System	Prime Contractor	Supplier of IRFPA	Size of Array Bandwidth	Material Used	Notes
Producible Alternative to Cadmium Telluride for Epitaxy (PACE I)	Rockwell EOC	Rockwell EOC			Uses MCT deposited on a sapphire substrate to produce circular wafers. Rockwell says that this approach, with which it has made dramatic strides in the past year, allows it to produce the highest-quality detectors available and to achieve a yield significantly above norm
PACE II	Rockwell	Rockwell	LWIR staring and scanning	MCT on GaAs	Has not progressed as fast as had been hoped and has been returned to laboratory status for further research. The next approach to reach production is expected to be PACE III, using MCT on silicon

Table A-2. MCT-based IRFPAs for Military Applications

Company	Infrared Focal Plane Array			Known Uses
	Array Format	Bandwidth	Material	
GEC-Marconi Infrared (formerly Phillips Components)	Formats up to 1,024x1	?	MCT	Development for Marconi Radar and Control Systems, funding from UK Defense Research Agency (DRA).
"	128x128	?	MCT	"
Loral Infrared and Imaging Systems	240x1	LWIR	MCT	CLUs for Javelin second source.
"	?		MCT	For the TRW/Grumman FEWS candidate.
"	480x380	Visible	CCD, PtSi	Sight for the MM/Lockheed team for the Ground Based Interceptor bid.
"	128x128	LWIR	MCT	Seeker for GBI bid.
"	480x4	LWIR	MCT	For MM's Electro-Optic Sensor System (EOSS) to equip the US Army's RAH-66 Comanche helicopter. This includes two Flirs: the Electro-Optical Target Acquisition/Designation System (EOTADS) and the Night Vision Pilotage System (NVPS). Also for ARPA's Multi-Sensor Target Recognition System to develop technology for the autonomous attack of high-value mobile targets such as tactical ballistic missile launchers. Also for Advanced IRST under development by MM as candidate for Lockheed F-22 and other aircraft. Also for FRACTIL (FLIR and Automatic Cuer Technology).
Martin Marietta (formerly GE Aerospace Electronics Laboratory	256x1	LWIR	MCT	AN/AAs-42 IRST being supplied for US Navy F-14Ds, the first production program for LWIR IRFPAs.
"	512x1	LWIR	MCT	Prototype.
"	1,024x1	LWIR	MCT	Prototype.

Company	Infrared Focal Plane Array			Known Uses
	Array Format	Bandwidth	Material	
"	480x4 TDI	LWIR	MCT	Part of sensor suites successfully demonstrated by MM for the RAH-66 Comanche that can discriminate between targets 50-60 percent better than its predecessor on the AH-64 Apache. Two second-gen FLIRs are to work in conjunction with the Comanche's "Two Bar Scan" target acquisition system, and aid in navigation.
Hughes' Santa Barbara Research Center	?	LWIR	MCT	For Lockheed Missiles and Space Company for its FEWS (Follow-On Early Warning System) bid.
"	?	LWIR	MCT	For TRW on Brilliant Eyes Dem/Val Program.
"	64x64	LWIR	MCT	Seeker for TI/MM Javelin missile.
"	128x128	LWIR	MCT	Hughes Aircraft Co.'s Missile Systems Group is planning to propose use of an imaging infrared seeker on the possible successor to the Sidewinder air-to-air missile, currently known as the AIM-9X, which would use this IRFPA.
"	480x640	LWIR	MCT	Believed to be largest MCT array. Possible applications are as sensors on the future Navy AX aircraft and the next generation M-1 tank, and a number of low-cost commercial security systems.
"	480x4	LWIR	MCT	To Hughes EOS for Second Generation Tank Sight (SGTS) technical demonstrator for NVEOD.
"	40x16 TDI	MWIR	MCT	To Hughes EOS for AN/PAS-13 Thermal Weapons Sight (TWS).
"	960x4	LWIR	MCT	Developed under DARPA's Infrared Focal Plane Array program, and recently delivered to TI for implementation in a forthcoming helicopter electro-optic system.

Company	Infrared Focal Plane Array			Known Uses
	Array Format	Bandwidth	Material	
SOFRADIR (France)	288x4	LWIR	MCT	Adopted for the British/French/German TRIGAT. Will form heart of SAT thermal sight for the long-range version of TRIGAT, both in ground-based launchers and aboard Tiger/Tigre helicopter, and will be used as an aircraft's piloting aid. Also chosen by nine manufacturers in seven countries for basis of FLIRs and IRSTs. SAGEM doing the most with them for submarine periscopes. Also purchased by Kolsman and Texas Instruments.
"	32x1	LWIR	MCT	Seeker for long-range TRIGAT. Seeker for Norwegian missile undergoing flight trials.
"	288x1	LWIR	MCT	
"	1,152x1	LWIR	MCT	
"	480x4	LWIR	MCT	
"	48x4	LWIR	MCT	Thermal sight for medium range version of TRIGAT. Also sold to TI for FLIR in Loral Vought System's LOSAT hypervelocity anti-tank weapon.
"	288x4	MWIR	MCT	
"	64x1	MWIR	MCT	Prototype. For seeker that SAT is developing for the Matra MICA air-to-air missile.
"	64x64	LWIR	MCT	Prototype.
"	128x128	MWIR	MCT	Prototype.
Texas Instruments	TDI family of 240x2 480x4 960x4		MCT	Designed to fit into SADAs. Potential applications include the Improved TOW Acquisition Sight (ITAS), TI's own Combat Vehicle Tank Thermal Sight (CVTTS), and an upgrade to the COmmander's Independent Thermal Viewer (CITV) installed in the M1A2 tank. TI has bought TDI arrays from SOFRADIR as an interim measure.
"	240x1	LWIR	MCT	For CLUs for Javelin

Table A-3. Non MCT-based IRFPAs for Military Applications

Company	Infrared Focal Plane Array			Known Uses
	Array Format	Wavelength Band	Material	
Amber Engineering (A Raytheon company)	128x128	LWIR	InSb	For insertion into Amber's Series 4000 and 5000 cameras.
	512x512	LWIR	InSb	Advanced Large-area Infrared Transducer (ALIRT) program sposored by SDIO. Builds on success with 128x128 and 256x256 arrays.
	256x256	LWIR	InSb	Put into prototype imager by Marconi Radar and Control Systems for UK Defence Research Agency for FARSIGHT demonstrator progam. The imager will be installed in a high-performance aircraft to evaluate its usefulness for applications including piloting aids and detection of airborne and ground-based targets. Also for DRA's program on autonomous seekers for air-to-surface weapons. Existing array should be replaced with another Amber 512x512 later on. Marconi also considering offering a new system using the same array for retrofitting in tank sights.
Cincinnati Electronics	160x120	LWIR	InSb	
	256x256	LWIR	InSb	Prototype.
David Samoff Research Center	640x480	MWIR	PtSi	May be upgrade using iridium silicide detectors manufactured under contract to the Rome Laboratory.
	?	LWIR	Germanium Silicide	In collaboration with Jet Propulsion Laboratory and Princeton University.
Eastman Kodak	640x480		PtSi	Kodak is sellings its PtSi camera business to companies in Europe and the US, but is continuin with development and manufacture of the arrays themselves for their industrial camera business.
Honeywell/ Alliant Techsystems		LWIR	Microbolometers	For Army's Low-Cost Uncooled Sensor Prototype (LOCUSP) program.
Hughes Technology Center	640x480		PtSi	Potential use in the NLOS-CA missile program.
Laser Aeronutronic	256x256	MWIR	PtSi	For possible use in missile seekers, airborne surveillance pods, and thermal weapon sights.

Company	Infrared Focal Plane Array			Known Uses
	Array Format	Wavelength Band	Material	
Loral Fairchild Systems	640x480	MWIR	PtSi	For B-52 retrofit program to replace the standard AN/AAQ-6 FLIR in the navigation and targeting system aboard the B-52G/H planes. May also be used for Loral Thermal Sight System (LTSS), intended to replace the image-intesification elbows in M32, M35 and M36 periscopes abaord armored vehicles such as the LAV-25. Also may be in Loral Gunner's Sight (LGS).
Loral IRIS and Fairchild	?	MWIR	PtSi	Seeker to perform acquisition, tracking, and aim-point selection for the Theater High Altitude Area Defense (THAAD) missile system. System incorporates a Loral Fairchild system two-axis gimballed camera (using PtSi array), integrated with an intertial measurement unit employing ring laser gyros.
Mitsubishi Electric	1,040x1,040	MWIR	PtSi	Uses proprietary charge-sweep device (CSD) technology which provides a greater amount of detector material in a given area than those using conventional CCD multiplexers. This array has demonstrated a 53 percent fill factor, compared with 38-50 percent for competitors' arrays. Has pixels that are 17 microns rather than usual 25 in diameter. Has licensed technology to THomson-CSF in France.
	256x256	MWIR	PtSi	Used in M300 thermal camera.
	512x512	MWIR	PtSi	Used in IR-M500 camera.
Rockwell Electro-Optics Center	128x128 256x256	LWIR	Extrinsic Silicon	Award from USAF's Phillips Laboratory for the SIlicon Hybrids with Infrared Extrinsic Long-Wavelength Detectors (SHIELD) program. Will use blocked impurity band technology developed under the HYWAYS producibility effort. For potential use in several SDIO programs, including Brilliants Eyes and GBI.
Santa Barbara Focalplane	128x128	LWIR	InSb	Put into ImagIR thermal camera system, with multiplexers supplied by partner company Westinghouse.
	320x256	LWIR	InSb	
	256x256	LWIR	InSb	

Company	Infrared Focal Plane Array			Known Uses
	Array Format	Wavelength Band	Material	
Semi-Conductor Devices (Israel)	128x1	LWIR	InSb	Company jointly owned by Tadiran and Rafael. Array for use in the seekers of air-to-air missiles and ni thermal imagers. SDC has also developed LWIR MCT arrays with very smaller detector elements.
Texas Instruments			Ferroelectric	For Army's Low-Cost Uncooled Sensor Prototype (LOCUSP) program.

The Javelin is a hand-held, man-portable "fire-and-forget" anti-tank weapon intended by the Army to replace the M-47 Dragon. each of its two main components requires a second generation focal plane array. The first, called the Command Launch Unit (CLU), is an infrared telescope weapon sight used by the operator to spot a potential target. The second component is the actual missile round. The missile cone contains an IR focal plane array which can lock on to a potential target chosen by the operator in under ten seconds, and continue to track the target until impact. During flight, the missile is connected to the CLU on the operator's shoulder by an electrical umbilical cord. As soon as the missile's IRFPA locks on to a target, however, the missile's image is transmitted back to the CLU, at which point the operator can disengage and take cover. The CLU is reusable, while the missiles are not, so the current plan is to procure twelve times more missiles than CLUs.

The Command Launch Unit and missile round each use a second generation forward looking IR detector. The CLU uses a LWIR, MCT-based, 240x1 scanning array, cryocooled to 77°C. The CLU scans an image bi-directionally, with 120 pixels reading in one direction while the other 120 scan in the opposite direction. The unit operates at a rate of 30 Hz, and produces a 240x480 display. Although the image is viewed through an eyepiece, it also can be read out digitally to other display units or video equipment through a port on the unit's side.

The IR detector in the CLU operates in the LWIR for two reasons. First, the high energy of photons in the 8-12 micron window make detection easier at longer distances. In fact, any detector with ranges greater than about a kilometer needs to operate generally in the LWIR to achieve the sensitivity necessary to image objects at those distances.[1] Second, the LWIR is not attenuated or filtered as much as the MWIR by moisture, fog, dirt, or rain. Any ground-based IR system intended to operate under battlefield conditions can make better use of the LWIR than the MWIR.[2]

Texas Instruments is the primary source of the CLU scanning array. TI's novel architecture makes use of the company's Vertically Integrated Photodiode (VIP) approach. The sensor incorporates a front-side illuminated n-on-p doped MCT wafer which is essentially glued on to a silicon read-out circuit. TI claims the VIP technique can be cheaper than conventional IR detectors which are indium bump-bonded. But TI only turned to the VIP technique after failing the manufacture cheaper and better IR arrays by another innovative technique called

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[1] Programs to develop space based infrared sensors have used doped silicon as the excitor material, to achieve even longer-wave detection, up to about 100 microns.

[2] The Navy, by contrast, has preferred infrared sensors which operate generally in the MWIR because they are said to perform better in maritime environments. This is discussed further below.

Appendix B

Uncooled Pyroelectric Detectors Are a Formidable Competing Technology

Uncooled infrared detectors, also called pyroelectric detectors, differ fundamentally from advanced infrared detectors based on MCT, InSb, or PtSi. Uncooled focal planes are two-dimensional arrays of infrared pixels that are thermally isolated from their surroundings by insulating material. Rather than detecting photons directly, as MCT-, InSb- and PtSi- based systems do, uncooled detectors respond to incoming radiation by changing their temperature. Read-outs of signals from up to 80,000 pixels are then multiplexed and sent for processing, just as in sensitive, cooled IR detectors.

Two-dimensional staring arrays of uncooled infrared materials, such as barium strontium titanate (BST) and silicon-based microbolometers, operate at room temperature, in the long-wave infrared (LWIR) at 8-12 microns. They require no more than a single-stage, low-power thermoelectric cooler to smooth temperature fluctuations in surrounding ambient air. By comparison, the MCT-based IR system with the least cooling requirement is the MWIR staring array being developed for the Thermal Weapon Sight (TWS), which requires six-stage

thermoelectric cooling.

Texas Instruments and Honeywell are the leading developers of pyroelectric devices.

Texas Instrument's approach uses ferroelectric, BST-based arrays. The detectors are fabricated from a ceramic material, barium strontium titanate. The polarization and dielectric constant of BST pixels change with temperature, resulting in a change in charge on a capacitor as the target scene varies. The pixels are diced by the same process as MCT-based arrays. The read-out circuit chip is hybridized onto the read-out chip, just as with MCT-based arrays, using indium bump bonds. The detector looks alternately at the target scene and a background reference temperature to sense change. The incoming infrared scene is AC-coupled by a rotating mechanical chopper. Without a chopper in the system, the surface charge would dissipate and cause the scene contrast to decrease to zero, resulting in fade-out of the scene, except for any moving objects. Rows and columns of the array are read out in sequence by sending voltages along a two-dimensional switch matrix. The signals are then sent through an amplifier, a multiplexer, and an analog/digital converter prior to further signal processing. Gain and offset correction are applied to remove the fixed-pattern noise due to the non-uniformity of response of up to 80,000 detectors. Dead pixels are corrected by substituting information from adjacent pixels.

By comparison, Honeywell's approach uses two-dimensional arrays of bolometers. The

resistance of each pixel changes about two percent per degree change in temperature. Vanadium Oxide is the tempera'ure-sensitive resistor material, suspended on a bridge of silicon nitride that is thermally isolated from the substrate containing the read-out electronics. As with TI's BST-based arrays, Honeywell's bolometers use a single-stage thermoelectric cooler. As a voltage is applied to each row of gates in sequence, a bias current flows through all of the detectors in the row, and they are read out in parallel via the column leads to a high-speed multiplexer at the base of the columns. This row of information is then multiplexed before the next row is read. Since there is no AC coupling of the incoming thermal radiation, no mechanical chopper is used. The only moving part is a shutter that is periodically closed momentarily for the system to recalibrate. As with BST-based arrays, the signals are conditioned with gain- and offset-correction to remove non-uniformities, and dead-cell correction is applied.

Miiitary Development of Uncooled Detector Technology

US Army and DARPA funds helped develop pyroelectric detector technology to the point where commercial spin-offs are within grasp. Specifically, the Night Vision and Electro-Optics Directorate (NVEOD) and Balanced Technology Initiative (BTI) division of DARPA have funded basic research in uncooled infrared detectors mostly for night vision systems, and helped TI and Honeywell move a long way toward commercializing their pyroelectric technologies. TI, in particular, is venturing into commercial applications for its BST-

based system as defense funding for BST declines. It is aggressively developing a high volume production facility, fielding prototypes, and developing close relationships with potential end-users. TI executives reason that, at worst, the commercial market will tide their BST-based detector line over until other military programs using BST-based detectors come on-line. At best, Texas Instruments expects large sales in the commercial sector within the next decade.

Four military programs fostered uncooled detector technology over the last 15 years. TI began to develop BST-detector technology in the mid-1970s, whereas Honeywell only began to develop resistance bolometers in 1985.

The Short Range Thermal Sight (SRTS) was the first military system to use BST-based detectors, and demonstrated the potential of BST-based detectors for moderately demanding applications. Texas Instruments' rough prototypes integrated a two-dimensional, 100 X 100 pixel array. Although the mosaic array offered good sensitivity, the resolution was extremely poor, and each pixel measured four millimeters square, much larger than competing infrared systems.

The Army then followed-up with the Small Pixel Program (SPP), also awarded to Texas Instruments. That program doubled the resolution of the BST arrays to 100 X 200 pixels, and halved the pixel size to two square millimeters. Resolution therefore doubled while the array remained on a chip of the same size as the SRT. This demonstrated that BST-based arrays were on the road to reaching the staring potential of more expensive and more sensitive infrared

materials. From this program forward, military development efforts stressed two goals for BST-based detectors: To increase the pixel density to approach television resolution and smaller pixel sizes so entire chips could be less than one inch square.

A third Army and BTI/DARPA funded technology development program, the High Density Array Development (HIDAD), is the major reason for the current capabilities of both BST- and microbolometer-based detectors. The program was active from 1987-91, with awards to both Texas Instruments for BST technology and to Honeywell for its bolometer arrays. The goal was to procure "breadboards," table-top assemblies with accompanying racks and power supplies, designed to demonstrate the technology rather than produce fieldable prototypes. The BST-based array grew to 240 X 328, which met the goal of TV-compatible RS-170 video output. Sensitivity on those units reached about 0.2°C, from 0.3°C at the start of the HIDAD program. This is still far from the .02°C sensitivity of advanced MCT-based systems, but is acceptable in less demanding military applications and sufficient for many commercial applications. Honeywell's bolometer technology, however, did not fare as well and produced brassboards which never performed to spec and were unreliable. Honeywell took until December 1989 to demonstrate a reliable brassboard with a 240 X 336 array for HIDAD.

The most recent program to foster BST-based detector research is the Low Cost Uncooled Sensor Prototypes (LOCUSP), which is a two-phase program to deliver fieldable prototypes of four different systems for a variety of military applications. These prototypes incorporating the

uncooled HIDAD arrays described above, would meet varying performance specifications. Texas Instruments and Alliant Techsystems (with Honeywell as a subcontractor to provide microbolometer arrays) were awarded contracts for BST- and bolometer-based technologies.

Phase I of LOCUSP, which ended in early 1993, developed a medium-range thermal imaging weapon sight and a thermal sensor for surveillance applications. TI manufactured 23 fieldable prototypes for that phase. They included six for the Air Force for security surveillance of airstrips containing the B-2 Bomber, one to the Naval Research Lab for reconfiguration into a fire fighter's helmet for vision through smoke, and six to the Immigration and Naturalization Service (INS) as a surveillance aid atop police vans. TI was able to increase the average sensitivity to .08°C, with a distinction of .065°C possible at a higher cost. The systems cost $100,000 each to manufacture, which of course is far more than they would cost in volume production. Alliant Techsystems, however, has not yet developed a working prototype that achieves all the milestones. Most officials we contacted attributed this to Alliant/Honeywell's late entry into the uncooled market. Their technology is still immature, and will take two to three years to catch up to Texas Instruments'.

Phase Two of the LOCUSP program would procure fieldable prototypes of sub-munition seekers and missile seekers, and require detectors which meet more stringent parameters. Sensitivity would need to be better than 0.1° C. The sub-munition environment would challenge system design because of the jolt and stress on electronics during launch from a howitzer.

Although both contractors met the performance requirement of 0.1°C, which was the required NETD (sensitivity) for the modified HIDAD program, funding cut-backs have prevented NVEOD from authorizing the contractors to begin Phase II of the LOCUSP program. The hold-up appears to be more due to realignments within DARPA itself as it takes the BTI office under its fold than wholesale loss of interest in uncooled technology.

Representatives from the Army, Marines, Air Force, Navy, INS, Sandia National Laboratories, and other government agencies have been following progress on the LOCUSP program closely, because system prototypes have many potential applications outside of sub-munitions and surveillance cameras. The Air Force and Navy, in particular, were not part of the original review sessions but have joined and purchased prototypes because of their interest in LOCUSP. The small size, light weight, low power requirement, and availability of video output from the weapon sight of Phase I prototypes make them particularly useful for portable applications, and for commercial spin-offs.

The development of uncooled detector technologies has not been funded by Army and DARPA decision-makers since fiscal year 1991, however, and these technologies are beginning to lose their footing in the infrared market. According to industry and military officials, the next logical step in development would be a program to design a monolithic architecture for the BST-based detector. The Army's Thermal Weapon Sight (TWS) program, for example, could have further honed BST-detector technology, but performance requirements all but ruled out uncooled

technology. For example, the TWS program intends to acquire at low cost about 20,000 rifle sights operating in three standard ranges: 550 meters, 1,100 meters, and 2,000 meters. BST-based detectors could currently meet the short and medium, but not the longest range requirement for the TWS. BST-based systems also require about one watt more of electricity, and weigh about a half pound more, than is specified for the TWS. For these reasons, Texas Instruments was not awarded a TWS development contract, losing out to Santa Barbara Research Center (SBRC) for MCT-based detectors using thermo-electric coolers (TECs).

Advantages and Disadvantages of Uncooled IR Detectors

Uncooled detectors offer substantial advantages which make them attractive in night vision equipment, thermal weapon sights, sub-munitions and missile seekers, and surveillance equipment, and also give them strong commercial potential. Most importantly, the absence of a cryocooler and dewar saves up to $10,000 per unit. Uncooled detectors also have very modest power needs at about three watts, and can run for long periods without recharge, about 24 hours with standard military batteries. Since they do not need frequent topping off with liquid nitrogen, uncooled detectors are more portable, as well. Even a closed-cycle cryocooler needs to have its hydrogen recharged every 800 hours, reducing portability. Uncooled staring detectors also do not have the optics used in scanning infrared detectors, and are therefore an additional several thousand dollars cheaper and easier to maintain. They have virtually no moving parts, which

increases reliability, reduces maintenance, and system costs. TI's BST-based detectors have one moving part, which is a simple mechanical chopper. Honeywell's bolometers have no moving parts at all.

These advantages of uncooled infrared detectors are tempered by several disadvantages.

• The largest drawback is that uncooled detectors are an order of magnitude weaker than MCT- or InSb- based systems in resolution, fill factor, and quantum efficiency. Pyroelectric materials offer only moderate performance, a weakness inherent in their physical properties.

• Second, TI's BST-based detectors in particular have a degree of signal crossover which causes bright spots in an image to spill over into adjoining pixels. This is inherent in BST-based detector architecture, and can not be overcome. TI's detectors use diced and thermally isolated BST cubes, covered by a silicon signal processor which is both a ground for the common electrodes and a thermal pass. As a result, though, electrons leak to read-outs from neighboring pixels, producing an image which is less crisp. This problem is not found in Honeywell's bolometers, which have a bridge structure that supports the sensor and is thermally well isolated from adjacent detectors, preventing any thermal cross-talk.

• Third, uncooled detector arrays cannot measure absolute temperatures in each pixel of view because they do not have advanced gain and offset correction as MCT-based systems do.

However, advocates of pyroelectric detectors note that uncooled detectors could make absolute temperature measurements if simple signal conditioning technologies were developed (or adapted from MCT-based detector technology). That capacity has not been developed in the past because thermal weapon sights and night vision equipment, the devices for which uncooled detectors were developed, do not require radiometric measurements.

In summary, uncooled IR detectors offer cost advantages that are offset by performance drawbacks. The potential markets for pyroelectric detectors, therefore, are applications for which neither sensitivity nor absolute temperature measurement are paramount issues. These areas of application require infrared detectors which are easy to maintain, operate at moderate scan rates (about 30 Hz), maintain sensitivities of about 0.1∘C, and do not require radiometric readings. If uncooled IR detectors can be manufactured for less than $3,000, as producers claim can be achieved, they could likely overtake competing IR materials for such less sophisticated applications as non-destructive evaluation of buildings and structures, food inspection, underground remote sensing, pipeline and gas leak detection, driver's vision enhancers, and IVHS components.

Texas Instruments Considers Commercialization

Officials at Texas Instruments state that BST-based detectors now meet two criteria for entry into the commercial detector market: 0.1∘C sensitivity, and resolution fine enough for a

television screen. Both standards had been met by detectors manufactured for the HIDAD program, and refined for Phase I of the LOCUSP program. Texas Instruments has turned its efforts, therefore, toward meeting a final criterion for entry into the commercial market: drastic cost reductions.

TI fabricated BST-based detectors in a laboratory-style environment for the HIDAD program. Production was in low volume with a high fraction of the cost attributable to manual labor. BST wafer yields were as low as five percent for the early HIDAD detectors. TI's first priority, therefore, was to construct a new facility which integrated automated processes in a high volume production line. That facility is still being put together, having cost $10 million over the last two years and still in need of $5 million to $10 million over the next year before completion. The center has been designed to produce 1,000 uncooled detector units a month.

TI took several innovative steps to design this facility to produce cheap BST-based IR detectors for the commercial market. The facility was designed to be about ten times cleaner than TI's other infrared production facilities, because impurities are a leading problem in bringing up the yields of BST-based arrays. A statistical process control system has also been set up to increase yields. Also, although the silicon wafer industry has advanced to about 8-inch square wafers, TI utilizes in its new facility some older, silicon processing equipment which makes cheaper 4-inch square wafers. Those wafers are used for signal processing and hybridized with the BST wafers to make the detector. That silicon processing equipment had become obsolete

to TI's integrated circuit board business, but produces wafers which are cheaper and satisfactory for hybridization with BST wafers bound for the commercial market. Without the need to make silicon wafers for hybridization to military specs, one executive at TI estimates that the new boards could be made at one-hundredth their military cost. Slice processing also reduces recurring labor cost, because forty to fifty detectors are processed simultaneously, instead of one-by-one.

TI has embarked on a sophisticated marketing effort for its BST-based system. Early-on, the company decided to focus on four prospective commercial market segments: surveillance, all-weather and night vehicle vision, predictive maintenance, and remote sensing. About ten people at TI work full-time researching these potential segments, talking with prospective customers, taking market surveys, and discussing needs with prospective end-users. This market-oriented approach is much different from the classical technology-directed commercial attempts being made by several other US military contractors. Test units have been sent out to users in key industries, and feedback is sought on how well the BST-based pilot installations meet customer needs. For instance, a TI uncooled specialist explained that the commercial trucking business could use infrared detectors to aid in night vision and collision avoidance. When a trucking company executive saw TI's prototype unit, according to an official at TI, he suggested they create a model to test the brake pads of trucks. Truck drivers are sued for millions of dollars each year for accidents caused by brakes which overheat and fail, and there are no quick and reliable non-destructive testing techniques short of dismantling brakes. So TI is now developing

a thermal vision system to meet that application also. By working closely with end-users, TI is developing systems which meet customer needs and helping design altogether new applications. No one else in the military infrared business appears to have tried these pilot installations, or solicited so much feedback from prospective customers.

Executives at TI claim that BST-based detectors will fall in price to about $5,000 each when their facility begins operation in 1994, and that many commercial applications can be met at that price. The eventual goal is to reach about $500 a unit, which would enable very large scale production in the tens of thousands of units per year. The foremost high-volume application which TI is reportedly seeking is placement of BST-based detector in cars as a night-vision aid. Development of the truck prototypes is expected to help reach economies of scale. There are reports from executives outside of TI that BST-based arrays will be purchased in great numbers by Hughes and General Motors for placement in Cadillac-model cars as early as 1995, but more likely by 1997. Amid industry reports that both the Japanese car manufacturers and BMW are interested in placing similar head-up displays in their cars after 1995, the transportation market could be extremely profitable. Placement of BST-based detectors in the Cadillac would certainly be a breakthrough for TI and the commercial infrared market. Hughes is widely acknowledged by outsiders as the unspecified "large defense contractor" with which TI is teamed in the BST-detector business, but executives at TI have not gone public with the name of its teaming partner.

Executives at TI stressed that their extensive development of BST for the commercial market will feed back positively into their ability to compete in the military infrared market as well. If the Army and DARPA have confidence in TI's extensive BST-based detector experience, according to TI executives, they will be more likely to give the go-ahead for Phase II of LOCUSP and design all together new programs around BST-based detectors. They even contend that TI will be able to compete for lower-end infrared applications which could use MCT, PtSi, and InSb-based detectors in three particular military programs.

First, the Driver's Vision Enhancer (DVE) program plans to procure 19,225 infrared detector units beginning in 1998 for Army wheeled vehicles. Operation Desert Storm highlighted the need for night vision equipment on all Army vehicles; tanks outfitted with night vision equipment advanced during the night but had to leave support vehicles behind with supplies, equipment, and food. BST-based detectors could reportedly meet the DVE's specifications, but would have to compete directly with more sensitive and more expensive cooled detectors. A request for procurement is expected to be released during the first half of 1993.

Second, DARPA's Flexible Manufacturing Program may have about ten percent of its funds fenced off for uncooled detector technology, but TI executives believe they could meet the specs for cooled IR detectors as well. Third, TI believes it could be an attractive recipient for DARPA's dual-use funds because it is cultivating a technology with clear military and civilian uses.

In summary, Texas Instruments is keeping its BST-based detector unit in "fighting shape" for military programs which may potentially use ferroelectric detectors. Without its sustaining commercial effort, TI contends that its BST production facilities and expertise would be idle. The synergies between Defense and commercial applications are apparent.

Appendix C

Annotated Bibliography Database

(i) Basic Scientific Primers

Arams, F.R., Infrared to Millimeter Wavelength Detectors (New York: Artech House, 1973). A collection of reprints.

Cenn, G.K.T. and D.G. Avery, Infrared Radiation (Boston: Van Nostrand, 1966)

Dereniak, E.L. and D. Crowe, Optical Radiation Detectors (New York: Wiley, 1984)

Ghys, R., Thermaographic Medicale (NY:Somabec Ltee, 1973).
On the clinical aspects of infrared thermography.

Hadni, A., L'Infrarouge lointain (Paris: Presses Universitaires de France, 1969).

Holter, M.R., S. Nudelman, G.H. Suits, W.L. Wolfe and G.J. Zisses, Fundamentals of Infrared Technology (New York: Macmillian, 1962).

Hudson, R.D., Infrared System Engineering (New York: Wiley, 1969).
Probably the best of the group for a general introduction. It comes from a collection of design experience at Hughes. It has been around for a while, as is evident by the date, but the fundamentals do not change. It is also distinguished by a very fine literature search, including much material that appeared in patents. The last part has a nice collection of discussions of various infrared applications.

Hudson, R.D. and J.W. Hudson, Infrared Detectors (New York: Dowden, Hutchinson and Ross, 1975).
A collection of reprints.

Jamieson, J.A., R.H. McFee, G.N. Plass, R.H. Grube and R.G. Richards, Infrared Physics and Engineering (New York: McGraw-Hill, 1963).
This was a very early book in the field. It is similar to Kruse and Seyrafi, with a slightly different emphasis. Jamieson is strong on statistics and detection theory.

Johnson, R.B.and W.L. Wolfe, Selected Papers on Infrared Design (Bellingham, WA: SPIE, 1985).
A two-volume collection of papers devoted to various aspects of infrared design.

Kemp, B., Infrared (City: Sams, year unknown)

Keyes, R.J. Optical and Infrared Detectors, Topics in Applied Physic (New York: Springer Verlag, 1980).
A collection of chapters, written by authorities, just like the two Willardson books.

Kingston, R., Detection of Optical and Infrared Radiation (Springer Verlag, 1978).
A well organized and minimalist book (read: short and small) which leaves much of the derivation development to the reader. It is a good book for those who are already technically prepared.

Kroger, F.A. The Chemistry of Imperfect Crystals, 2nd rev. ed. (Elsevier, New York, 1974).
A classic on semiconductor crystal growth which explains techniques, types of defects, and epitaxial growth. "Essential reading" on crystal science.

Kruse, P.W., L.D. McGlauchlin and R.B. McQuistan, Elements of Infrared Technology (New York: John Wiley and Sons, 1962).
Best of the older books on detectors, and the "purple peril" is the best introduction

Lloyd, J.M. Thermal Imaging Systems (New York: Plenum Press, 1975).
The best of the lot on the design of thermal imaging devices, and comes from the collected wisdom of Honeywell and the Night Vision Lab. It includes excellent discussions of the use of modulation transfer functions, when they were still new to the infrared field. It is also a fine treatise on the properties of the eye as it relates to the sensitivity of real-time infrared systems.

Morten, F.D., T.J. Jarratt, P.R.D. Coleby, R.A. Lockett, M.H. Jervis, R.J. Hutchinson, Applications of Infrared Detectors (City: Mullard, 1971).

Rhines, F.N., Phase Diagrams in Metallurgy: Their Development and Application (McGraw Hill, New York, 1956)
A classic on wafer and epitaxial growth which explains the fundamentals on MCT and semiconductors which still apply today.

Seyrafi, K., Electro-optical Systems Analysis (Electro-Optical Research Company, Phoenixville, PA, 1973).
Although published by his own company (and therefore not receiving the benefit of outside review), a thorough treatment of the details of system design in the visible and the infrared.

Simon, I., Infrared Radiation (New York: Van Nostrand, 1966)

Spiro, I.J. and M. Schlessinger, Infrared Technology Fundamentals (Toronto: Marcel Dekker, 1989)
The newest addition to the seminal pieces; the authors have spent much time at Aerospace. It has a spacey flavor, and it incorporates modern considerations of staring systems.

Vanzetti, I, Practical Applications of Infrared Techniques (New York: Wiley, 1972).
as good insights into present (in 1972) and future applications for infrared technology at the back of the book in which it lists and discusses applications.

Wallace, J.D. and C.M. Cade, Clinical Thermography (Boston: CRC Press, 1975).
Largely on the medical use of thermal imaging, which is a burgeoning field using infrared scanners.

Willardson, R and R. Beer, Semiconductors and Semimetals Volume 5 (1970) and Volume 12 (1977), Infrared Detectors (New York: Academic Press, 1970).
Detailed treatments of the physical properties of detector materials.

Wolfe, W.L. and G.J. Zissis, The Infrared Handbook (Ann Arbor, MI: Environmental Research Center, 1985).
Not meant to be tutorial, but has much data. Will serve as a dependable reference piece.

(ii) Overviews of Technological Trends

Ballingall, R.A. "Review of Infrared Focal Plane Arrays," (SPIE Paper 1320-11) 1990.
General technological discussion and introduction into varieties of arrays, technologies and concepts.

Balcerak, Raymond and Lynette Brown, "Mercury Cadmium Telluride Material Requirements for Infrared Systems," J. Vac. Sci. Technol. B (Jul/Aug 1992), 1353-1358.

Discusses primarily how the choice of infrared detecting material in second generation photovoltaic IRFPAs and its quality affect nearly all the other design requirements in an IRFPA, from signal processing, to cooling requirements, to processing electronics. It stresses that by boosting uniformity, reliability, and size of wafers, primarily MCT, will cut the overall system cost. There is a discussion of ways to improve on MCT epitaxial quality.

Botts, S.E., "New Horizons for IR FPA," Photonics Spectra (July 1988), pp. 125-28.
A bit dated, but explains that infrared systems utilize light-sensitive devices for the conversion of thermally generated photons into electronic signals that are amplified and processed to perform a variety of functions including targeting, tracking and imaging. As the technology matures, so do the integrated circuits that read out the infrared signals from the detectors and the parallel processors that operate on the signals. This article is an overview of second-generation detectors, integrated readout circuits, focal plane configurations and parallel processing.

Cross, E.F., and T. Reese, "Figures of Merit to Characterize Integrating Image Sensors: A Ten-Year Update," (DTIC: Sept 1989), 34p.
A ten-year update is presented on performance criteria and measurement techniques to evaluate integrating image sensors. The integrating image continuously monitors the field of view and an electronic mechanism that sequentially reads out the integrated signal on each resolution element. Ten years ago, camera tubes were the integrating imager of interest; today, staring focal plane arrays have supplanted camera tubes as integrating imagers. The adaptability of the 1978 figures of merit to the new staring devices is reviewed and, when indicated, modified.

Director of Defense Research and Engineering, DoD Key Technologies Plan, (Department of Defense, Washington: DC) July 1992.
A yearly document on key technologies which DoD considers critical to the national defense. Printed to fulfill the requirement of the National Defense Authorization Act of FY 1990 and 1991.
Extensive discussion of passive sensors, trends, technologies, producers.

Elliot, C.T., "Future Infrared Detector Technologies," Fourth International Conference on Advanced IR Detectors and Systems (London June 5-7 1990), pp. 61-68.
Trends in infrared detectors are toward larger, electronically addressed arrays and higher operating temperatures. This will lead both to higher performance and to smaller, lighter, more affordable systems. Three detector technologies are discussed: electronically addressed thermal detector arrays, Schottky barrier devices, and CMT FPAs. IR detectors based on low dimensional solids are considered briefly.

Gillham, J.P., "Materials and Technology Research in Uncooled Ferroelectric IR Detector Arrays," Fourth International Conference on Advanced IR Detectors and Systems (London June 5-7 1990), pp. 69-77.

A technical piece on the key areas of technological advancement in ferroelectric IRFPAs which may render them very useful in industrial applications. The emphasis is decidedly on technical research rather than applications. This is a good piece on emerging IRFPA materials.

Hartung, C., Mueller, J. "Sensitive Detection of Infrared Radiation, the Optothermal Detector and its Application," Infrared Physics (May 1989), pp. 279-284.
The development of thermal detectors has reached a high technological level. The main characteristics such as detectivity, sensitivity and noise equivalent power are near the theoretical limits. The way to future development of detectors will be their specialization, especially their combination with other physical effects. Recent developments of room temperature infrared detectors, especially considering the coupling of the detectors with absorption in gaseous media, ie. optothermal detection, is discussed.

Hoelter, Ted. "Testing Second- Generation IR Focal Planes," Photonics Spectra (July 1992), pp. 105-108.
Modern 128X128 and 256X256 FPAs are constructed by indium-bump-bonding a Si readout device to the InSb detector array. Testing must be done on both the individual components and the completed, bonded device. McCoy, Joseph R., "FPA Packaging: A Second Generation," Photonics Spectra (January 1992), pp. 99-100.
The second generation of FPAs, called integrated detector/cooler assemblies, offers higher performance, less weight, and less expensive infrared systems for sale on both the military and commercial markets. Improvements were made possible by databanks on expansion of key materials under varying temperature, as well as analyses of predicted stress areas on the FPAs. Although the U.S. military is committed to an effort to make this second generation of FPAs commercially available and standardized, several key parameters vary on the market, making standardization difficult.

Jamison, J.A., "Infrared Technology: Advances 1975-1984," (SPIE Vol. 510, 1984) pp. 56-68.
Extremely informative historical piece on the major technological issues which were overcome in that period. Jamiesen is a strong believer in the ability of MCT to overcome producibility issues which have plagued it since the PC scanning arrays first entered into R&D.

Leech, D.P., et. al., "Industrial Base Analysis of Infrared Detector Industry," Air Force Task Command February 1991.
Systematic analysis of every facet of the military IRFPA market, with an accent on MCT-based IRFPAs. Including market structure, market size, production techniques, materials issues, and areas where technology is still in need of research.

Leech, D.P. , "The US Infrared Detector Industry: Prospects for Commercial Diversification," (SPIE Vol. 1683, 1992) 11pgs.
Industry appears to be groping to identify solid commercial applications for its more advanced technologies. Government representatives are no doubt anxious about potential erosion of the industrial base. The author suggests that some serious thought be given to innovative intra-industry or government-industry activities focused on lowering cost and providing useful information about dual-use applications.

Marchee, P.P., "New Generation Infrared Camera," (SPIE Paper 1320-18) 1990.
Work done at Thomson-TRT Defense, France on advanced IRFPA based cameras. Discussion of applications and novel technologies used to produce the camera.

Mundie, L.G. and K. J. Hofmayer, Infrared Focal Plane Array Cost Considerations in the SDI Environment (Rand National Defense Institute, August 1990), 52 pgs.
Begins with a brief background on focal-plane theory and manufacturing technology which may be very useful. It then proposes a new manner of evolving cost-estimating relationships for IRFPAs. Cost estimates have hitherto been a large problem due to the uncertainty of many cost factors (especially the array and dewar cooler)

Silverman, Jerry, et al., "Infrared Video Cameras," Scientific American (March 1992), pp. 78-83.
This is the renaissance man's introduction to IR cameras. Similar to home video cameras, these devices can "see" thermal radiation. This emerging technology offers a host of applications, including night vision, visualization of heat flow and medical analysis. There is a discussion of architecture and applications which is at the common-man's level, but little on the materials aspect.

Scribner, Dean A. et al., "Infrared Focal Plane Array Technology," Proceedings of the IEEE (January 1991), pp. 66-85.
In 20 pages, the authors give a detailed discussion, from the layman's to arch-technical level, of all major design considerations in IRFPAs. Requirements for IRFPAs are discussed and an overview is given of different IRFPA architectures. Applications are hardly discussed.

Stahl, K.J., "IR- Detectors: State-of-the-Art, Future Trends," Photonics Spectra (September 1989), pp. 95-98.
Infrared detectors are key components for systems that are used for such things as radiometry, guidance, thermal imaging, telemetry, and communication. Starting with WWII, developments were concentrated on detectors for military applications, e.g. weapon guidance, reconnaissance and thermal imaging devices. In the past ten years, however, IR detectors have become more and more important in earth-bound, air and spaceborn systems for spectral earth mapping, environmental contamination control, meteorology, volcanism study, agricultural research, resources exploration, planetary and space research and star mapping. For military applications, the spectral band form 0.9 to 14 microns is sufficient, whereas for the other mentioned applications the spectrum between 0.9 and 300 microns (and beyond) is of interest. Detecting mechanisms and future trends are considered.

Tebo, Albert, "Infrared Imaging: Detector Arrays," OE Reports (May 1992), pp. 1,13.
This is a short survey article on what technological advances are emerging in second generation IRFPAs. It discusses new architectures, matrices, materials, and the leading companies. It does not discuss applications.

Tennant, William, et. al, "Key Issues in HgCdTe- Based Focal Plane Arrays: An Industry Perspective," Unpublished Paper, 27pgs.
Technological limits rather than fundamental issues are the only barrier keeping MCT from completely dominating almost all IR applications. The paper highlights some of the more vexing and as yet unsolved A thorough review of MCT's advantages, product source purity, lattice mismatch due to nonuniformity, MIS devices, alternative substrates, nucleation, thermal expansion differential mismatch, longevity, comparisons of different production techniques, etc. The theme is that several problems once considered limited, have either been dismissed because the problem was circumnavigated, or hitherto unimportant obstacles have become major sticking points (ie. purity)MCT materials science and engineering problems that the authors see as being important.

Wanstall, Brian and Doug Richardson, "Towards Lower-Cost Focal Plane Arrays," Interavia Aerospace Review (November 1989), pp. 1123-1126.
A thorough, albeit dated, article on the factors contributing to the expense of FPAs and research being conducted to overcome those hurdles to lowering cost. It talks about IRFPAs for military use, but the concern is cutting cost, which applies to any IRFPAs. Discusses the different military powerhouses' ideas on what IR wavelength to use, which material and substrate, and architecture.

(iii) Trends in IR Materials

Ackerman, Robert K., "Quantum Well Designs Shed Light on Infrared Sensors," Signal (January 1992), pp. 55-58.
An extremely important article which discusses the advantages GaAs detectors built by quantum well techniques have over conventional, MCT ones. Quantum well design incorporates a detector on the surface of a microchip, decreasing size and weight while raising efficiency. A molecular beam epitaxy technique is used to deposit materials on the surface of the GaAs virtually one atom at a time to yield extremely thin, sensitive, and uniform detector layers. The tradeoff in quantum well GaAs technology is between uniformity (quantum well's strength) and sensitivity (which is MCT's strength). The technology is fairly mature and will soon be available at prices competitive with, if not cheaper than, MCT arrays.

Ashley, Steven, "New Life for Solar: Photovoltaic Power Systems," Popular Science (May 1989), p. 117.
Reports on how a hybrid solar cell of one layer of gallium-arsenide and one crystalline-silicon has reached a thirty-one-percent efficiency level.

Bailey, Robert B., et. al., "256 X 256 Hybrid HgCdTe Infrared Focal Plane Arrays," IEEE Transactions on Electron Devices (May 1991), pp. 1104-1109.
Hybrid 256 X 256 MCT IRFPAs have been developed using either sapphire or silicon for the detector substrate to meet the sensitivity, resolution, and field-of-view requirements of high- performance medium-wavelength infrared imaging systems. The special substrate eliminates the thermal expansion mismatch to the silicon readout circuit which had been a major cost factor due to cracked rejections. This may be considered a major breakthrough.

Beck, W.A. and G.D. Davis, "Overlayer Growth on HgCdTe," Journal of Vacuum Science and Technology A (May-June 1988), 9p.
The interactions between both cleaved and ion-sputtered MCT and deposited overlays are reviewed. The overlayers are classified into four groups: ultrareactive, reactive, intermediate reactive, and unreactive-based on the relative heats of formation of the overlayer telluride and HgTe and CdTe. Ultrareactive overlayers react with both HgTe and CdTe to form an interfacial metallic telluride and elemental Hg and Cd (which are lost from the interface), while reactive overlayers react only with HgTe components. Once the HgTe is depleted from the surface region, further deposition results in growth of a metallic film. Unreactive metals, on the other hand, do not react with the surface, but form a stoichiometric interface. Finally, the extent of interactions between intermediate overlayers and MCT depend on other factors, substrate material, the heat of cation alloying and the propensity of the overlayer element to diffuse into MCT.

Bicknell-Tassius, "Growth of CdTe- CdMnTe heterostructures by Molecular Beam Epitaxy," (SPIE paper 1484-02) 1991.

Brau, Maurice J. "Ultra-high-Purity Starting Materials for Infrared Detector Crystal Growth," Colorado Research Lab, December 1991, 38p.

Bubulac, L.O. "Ion Implantation and Diffusion for Electrical Junction Formation in MCT," (SPIE Paper 1848-10).
Description of work going on at Rockwell Science Ctr in this area.

Cabanski, W.A. "Electronic and Optical Properties of Silicide/ Silicon IR Detectors," (SPIE Paper 1848-12).
Description of work at the university of Erlangen in Germany on silicon/ silicide arrays.

Childs, A. etc. al. "Manufacturing Technology for Mid-Wavelength HgCdTe," Rockwell International Electrical Optical Center, May 1991, 317p.
Final Report

Chow, K., et. al., "Source-Coupled HgCdTe Staring Hybrid Focal Planes for Tactical Applications," SPIE (Vol. 267 1981) 6p.
Staring infrared IRFPA with epitaxial MCT epitaxial MCT photovoltaic detectors coupled to surface channel CCD multiplexers have been fabricated and characterized. A source-coupled input circuit with background suppression is utilized. The MCT backside-illuminated detector arrays have bandgaps suitable for operation in either the 3-5 or 8-12 microns region. Performance characterization of the multiplexer will be given at cryogenic temperatures. Charge transfer efficiency, subthreshold transconductance, threshold voltage, etc. will be presented. These measurements will be compared with ideal models. Characteristics of the hybrid IRFPA have been measured in a wide variety of background.

Cockrun, C.A. et. al., "Development of LPE HgCdTe for Common Modules, Interim Report" November 1982, Santa Barbara Research Center, 109p
A 24-month research and development contract between the SBRC and US Army Night Vision and Electro-Optics Laboratory to develop LPE growth techniques for 0.1ev MCT to the point where standard photoconductive arrays can be produced with high yield.

Conner, A.D., et. al., "Manufacturing Technology, Interim Report," January 1990, Hughes, Santa Barbara Research Center
Extensive producibility and yield data under MANTECH contract. A major article on cost cutting measures on IRFPAs.

Cooper, D.E. et. al., "Spectroscopic Techniques for the Analysis of CdTe Substrates Used for the Growth of MCT," (DTIC Report #AD-A214-545, September 1989) 27p.
Photoluminescence and electron paramagnetic resonance are powerful techniques for both fundamental studies and potential materials screening of CdTe substrates for MCT growth. Certain extended defects that are common in epitaxial CdTe have distinctive PL signature that correlates with X-ray measurements of crystallinity. Bulk samples with prominent subgrain structure also have this PL feature, and cathodoluminescence images show that the defect is localized to the subgrain boundary regions. PL and EPR are very sensitive techniques, and specific impurities such as Fe or Ag have been observed in some nominally pure samples. PL and EPR spectroscopy can also detect changes associated with thermal annealing treatments, which alter the stoichiometry of CdTe by varying the number of Cd vacancies and interstitials. These findings illustrate the versatility of PL and EPR as nondestructive techniques to assess the quality of substrates for IR detector materials.

Crarey, P.E. and Cathleen M. Farley, "Modeling the Cost and Producibility of INFRA Operability," (BDM International, Inc., 1991) 10pgs.
Extensive mathematical modeling of how IRFPA specifications can drive IRFPA cost and yield. Specifically, IRFPA operability affects IRFPA producibility in two ways, each having an opposite impact. Operability improvements resulting from purer, more perfect materials (fewer defects) become increasingly difficult to achieve as the operability reaches 100 percent. On the other hand, IRFPAs with higher operability have a greater probability of meeting system specifications for defective pixels, and thus final test yields are better. This paper reports on efforts to quantify the latter effect.

Dereniak, E. and Robert E. Sampson, Infrared Detectors and Focal Plane Arrays II, (SPIE: WA) APril 1992.
The proceedings include discussions on topics ranging from basic device physics to novel applications. Papers report recent advances and developments in the field, with an emphasis on new concepts. Infrared detector materials such as InSb, MCT, PtSI, GaAs are discussed. Other topics include superlattices, strained superlattices, superconductors, planar hybrid array, z-plane array technology, hybrid input circuits, infrared sensor systems, FPA data processing, cryogenic electronics, and on-FPA signal processing.

Faurie, Jean-Pierre, "Evaluation of the Feasibility and the Cost of HgCdTe Epitaxial Layers Grown by MBE on CdTe, CZT, and GaAs substrates," (DTIC report #AD-A238-602, Jan. 1991) 19p.
In this contract which has been awarded to EPIR Ltd, two tasks were assigned. The first one was related to the evaluation of the cost MCT epitaxial layers grown by MVE on various substrates. The substrates which were supposed to be considered were CdTe, CZT, and GaAs. In addition, EPIR has also analyzed the cost on silicon substrates since Si is currently considered to be the most important substrates for IR photodiode technology. The second task was related to the feasibility of growing a few MCT epilayers by MDE with at least one exhibiting standard specifications.

Faurie, Jean-Pierre, "MBE Growth, Characterization and Electronic Device Processing of MCT, HgZnTe, Related Heterojunctions and MCT-CdTe Superlattices," (DTIC Report #AD-A197-752, December 1987) 42p.
A report is made on growth at the University of Chicago and characterization of high quality MCT epilayers, MBE growth and characterization of two-inch diameter p- and n- type MCT films on GaAs 100 substrate. The n-type intrinsic and extrinsic doping is discussed. The incorporation of As has been photo assisted using a Nd-YAG pulsed laser. X-Ray photoemission of Hg clusters on MCT surfaces has been studies. Direct measurement by XPS and electrical determination of MCT valence band discontinuity give values of 300-400 meV at 300K. Silicon has been used as a n-type dopant to grow a homojunction which electrical characteristics are presented in the paper.

Felix, P. et al., "CCD Readout of Infrared Hybrid Focal Plane Arrays," IEEE Trans. On Electron Devices, (Vol. SC-13, NO. 1, February 1980)
Excellent discussion of a now-mature technology at the outset, namely CCD processing.

Freedman, A. "Patterned Etching of Infrared Detector Arrays," (DTIC Rpt #Ad-A236-124. March 1991) 25p.
The authors attempted to develop a patterned etching technique for infrared detector arrays based on photo-induced processes. The technique is based on the efficacy of methyl radical etching of II-Vi compounds such as MCT and CT. Methyl radicals were produced in a pattern above a MCT substrate for photodissociation a radical precursor such as acetone or nitromethane using an excimer laser operating at 193 nm. Neither optical nor scanning electron microscopy could confirm the presence of any etching action. The failure of the proposed technique is ascribed to surface scavenging and/or reaction quenching mechanisms.

"Gallium Arsenide Comes of Age," Financial Times (May 14, 1991), p. 29.
Silicon continues to rein supreme in the market for computer chips, although GaAs offers inherent speed and power advantages, while GaAs transistors consume less energy than silicon transistors. However, working with GaAs has been more difficult and expensive than expected. The DARPA funds for GAAS research may allow breakthroughs in working with the materials (not discusses) and several major manufacturers, including Motorola, are jumping into the market.

Ghandi, S.K. "Research on Mercury Cadmium Telluride," (DTIC Report #AD-A197-238, June 1988), 127p.
This report summarizes work done during the third year of a program entitled Research on MCT. CdTe studies were extended to the DLTS of both n- and p- material. The wide gap materials effort was expanded with the growth of Zinc Selenides, which is lattice matched to GaAs. Significant (200-300 times) improvement in the photoluminescence of GaAs was demonstrated by the use of a pseudomorphic ZnSe layer. The new reactor is fully operational, and is capable of growing HgCdTe with a Cd composition control of +- 0.002 across a 1cm X 1cm slice. In addition, significant improvement in MCT quality was obtained by the use of CdTeSe substrates. Work with CdTeZn substrates was also carried out during this year.

Gurary, A., et. al., "Vapor Transport Epitaxy (VTE), A Novel Technique for Compound Semiconductors," Journal of Vacuum Science and Technology A (July/August 1992) p.1453-1457.
Report from EMCORE Corporation and Rutgers University. An advanced VPE technique for depositing compound semiconductors is described. The technique operates using elemental, gas, or metalorganic sources. The resolving of several problems common to MBE, Chemical-beam epitaxy, and MOCVD systems has been the motivation for investigation of this technique.

Kosnocky, W.F. "State of the Art in Schottky-Barrier IR Image Sensors," (SPIE Paper #1685-01), 19pgs.
Reviews the progwerss in the development of infrared image sensors with Schottky-barrier detectors. At the present, they represent the most advanced technology for large-area high-density focal plane arrays for many SWIR and MWIR applications. The article is an updated and abbreviated version of recent reviews by the author on progress in the development of infrared image sensors with Schottky-bvarrier detectors.

Jindal, Bal K. "High Quality Large Area Wafers of Mercury Cadmium Telluride," Xacton Corporation, March 1992, 180p.

Kozlowski, L.J., et. al., "640 X 480 PACE MCT FPA Development for High performance FLIRs," (ROckwell International Science Center, February 1991) 11pgs.
A hybrid 640 X 480 PACE MCT FPA is being developed to meet the needs of many applications including missile seekers and FLIRS. The device will offer full TV resolution with sensitivity much superior to PtSi, having over one-quarter million pixels. The hybrid is comprised of a PACE MCT detector array having nominal 5 micron cut-off wavelength, mated to a high speed CMOS readout having high charge-handling capacity.

Kozlowski, L.J. et. al., "MWIR 256 X 256 PACE-1 MCT FPA: Performance Assessment," Proceedings of the IRIS Specialty Group on Detectors (Naval Postgraduate School, Monterey CA) 14-18 August 1989.

Kozlowski, L.J. et. al., "Large Staring IRFPAs of HgCdTe on Alternative Substrates," SPIE International Symposium on Optical Applied Science and Engineering" (San Diego: July 1991). 12pgs.
A report on hybrid MCT 256 X 256 IRFPAs developed at Rockwell International Science Center to meet the sensitivity, resolution, and field-of-view requirements of high-performance medium wavelength infrared imaging systems. The hybrid, also used in a 640 X 480 array still in research, has a MCT detector array mated to silicon-based multiplexers.

Kozlowski, L.J. et. al., "Reproducible High Performance LWIR MCT Staring Focal Plane Arrays," Proceedings of the National IRIS (Johns Hopkins University, Laurel, MD) 12-14 June 1990.

Kozlowski, L.J. et. al., "128 X 128 PACE-I HgCdTe Hybrid FPAs for Thermoelectrically Cooled Applications"
Kramer, G., etc. al., "Infrared Focal Plane Arrays: A Strategic Defense Initiative Technology Monograph," Jamiesen Science and Engineering, June 1991, 264p.
This monograph describes the insights, analytical results, cata, and new science and technology that have been created or advanced by six years of R&D applied to sensors FPAs in the context of the Stated Defense Initiative.

Linden, K.J., "MOCVD: Expanding the Range of Photonic Materials," Photonics Spectra (February 1991) 4pgs.
Recent research in the semiconductor area has yielded major improvements in device performance as well as new structures based on electron confinement mechanisms resulting in quantum effects. Two methods discussed of epitaxial growth generally used to synthesize such structure are MOCVD and OMVPA, and molecular MBE. More recently developed methods discussed that incorporate elements of both of these

technologies is Chemical Beam Epitaxy (CBE), or Metallorganic Molecular Beam Epitaxy (MOMBE). Reviews significant advances in photonic devices structure achieved by MOCVD.

Lockwood, A.H., et al., "Photovoltaic HgCdTe Hybrid Performance," SPIE (Vol. 267, 1981) 4p.
At the Santa Barbara Research Center, second generation infrared imaging systems require high density focal plane arrays for staring applications. To meet this need, a focal plane structure using MCT photodiodes for detectors and Si CCds for signal processing has been developed. Although conventional ion-implanted hybrid arrays have successfully been interfaced to CCD multiplexers, hybrid arrays fabricated on LPE layers offer some inherent advantages with respect to performance, processing, and yields. It has been determined that heterostructure diodes fabricated by a Hg infinite melt LPE technique give superior performance relative to conventional ion-implanted devices. Data is presented on devices fabricated for both 8 to 12 microns and 3 to 5 microns applications.

Marciniac, J.W., "Hybrid PV HgCdTe Detectors: Technology Reliability and Failure Physics Program," (DTIC Rpt #AD-A226-675, 1988) 29p.
MCT IRFPAs are finding greater application in systems designed to operate in the MWIR and LWIR. Prior to those IRFPA being deployed in the field, it is important to understand the potential failure mechanisms to permit high reliability units to be built. Indium bump is a widespread method for providing electrical interconnect and mechanical support to these focal planes to circuit boards or silicon multiplexers. This program was designed to evaluate the effect of the hybridization process on MWIR focal planes, as well as assess their long term stability.

McArthur, S.B., "Low-Cost Cooled CCDs Open Doors," Photonics Spectra (January 1992) pp. 92-93.
Discusses how these new CCDs have applications in a broad range of fields for scientists, researchers and engineers.

Moazed, K.L., "MBE Growth of HgCdTe," (DTIC Report #AD-A207-218, June 1980) 21p.
The II-VI compound MCT is a material of considerable interest as a semi-conductor, for optical devices, particularly in the infrared spectral regions. Solid solutions appear to exist for all values of x, and for values of x between about 0.2 and 1.0 the material behaves as a semiconductor with a variable bandgap between 0.05 ev and 1.53 ev at room temperature.

Myers, T.H. "Advanced Infrared Focal Plane Concepts," GE Aerospace, March 1992, 180p.
This report describes the results of research carried out under the US Air Force contract "Advanced INFRA Concepts." The overall ogjective of the program was to advance the state-of-the-art of IRFPA technology through the development of molecular beam epitaxial growth of MCT alloys and HgTe-CdTe superlattices for novel multilayer detector structures for LWIR applications.

National Materials Advisory Board, "Process Challenges in Compound Semiconductors," (DTIC Report #AD-A204-868, August 1988) 154p.
Compound semiconductors, such as GaAs, InP, and MCT, are essential components in future photonics and microelectronics technologies. If the US is to be competitive in these technologies, attention must be directed to the reproducible and affordable processing of these materials. This report assesses the current status of compound semiconductor processing technology and identifies factors that limit the ability to fabricate advanced electronic and optoelectronic devices. Emphasis is placed on current and near-term devices, but the process technology discussed are generic to future components and systems based on these materials.

Niedziela, T. and J. Piotrowski, "Ultimate Performance of CdHgTe Photoelectromagnetic Detectors of Middle and Far Infrared," Journal of Technical Physics (no. 3, 1987), pp. 289-296.
Photoelectromagnetics effect (PEM) finds important applications for ambient temperature IR detectors due to its advantages including no need of electrical supply, the wide response frequency band, absence of low frequency noise and the weak sensitivity on ambient temperature. An attempt was made to evaluate the ultimate performance of the middle and far IR PEM detectors, made of homogenous (Cd, Hg) Te assuming Auger 7 as the dominant recombination mechanisms.

Razeghi, Manijeeh, Optoelectronic Materials and Device Concepts (SPIE: WA) November 1990.
The past decade of research and development in optoelectronics has been a continuous interplay between materials improvements and advances in devices, circuits, and system technology. There has been much creative activity in new materials that has led to substantial improvements in devices and systems, and at the same time, the need for newer and better materials having specific properties has been recognized. Contents: Compound semiconductors, strained layer epitaxy, impact of semiconductors on optoelectronic technology, device applications, quantum phenomena, organic materials for optoelectronics, 1990 optoelectronics semiconductors issues, better materials.

Reynolds, R.A., "The II-VI Compounds: 30 Years of Acceptor Dopants in MCT Alloys," Journal of Vacuum Sci and Tech A (Vol. 269, 1989)

Reynolds, R.A., "The II-VI Compounds: 30 Years of History and the Potential for the Next 30 Years," Journal of Vacuum Science and Technology A (March/April 1989) p.269-270.
The past thirty years of progress in II-VI compounds is briefly summarized. Existing problems with both the materials and methods for their production are noted. The probable future uses of the II-VI compound is in infrared sensors and photonics. Possible applications are discussed.

Roberts, C.G. and S.R. Borrello. "Monolithic MCT Focal Plane Array Structures," SPIE (Vol. 217, 1980) 8p.
Sophisticated infrared imaging systems require complex focal plane device structures to perform the basic functions of detection, time delay and integration (TDI), multiplexing, and possible scanning in large array formats with minimal on-focal plane power dissipation. Monolithic MCT charge transfer device structures are promising candidates for many focal plane requirements. CCDs are the natural structure for scanning system IRFPAs which utilize TDI. Charge injection devices (CIDs) are directly applicable to staring system focal plane requirements. This paper discusses the applicability and design considerations of various devices which have been developed using this technology.

Santa Barbara Research Center, "NRL Hybrid Reliability: Physics of Failure Initial Study," (DTIC Report #AD-A217-986, Jan 1990) 71p.
The objective of this program was to identify the failure mechanisms associated with the thermal cycling of MCT hybrid IRFPAs from room temperatures to cryogenic temperature (typically 77K). There is a concern in the IR community that the long-term reliability of IRFPAs may be in question due to defects being formed as a result of the hybridization process and/or thermal cycling of the arrays from room to cryogenic temperatures.

Schetzina, J.F., Device Processing of II-VI Semiconductor Films and Quantum Well Structure (DTIC: March 1991), 4p.
The objective of this program was to develop a device processing technology necessary for proper utilization of Hg-based heterostructures and superlattices in device applications. The specific focus or long term goal guiding the direction of the program was to develop the devices and processing technology required for an

IR focal plane integrated with on-board signal processing electronics.

Schorrocks, N.M., et. al., "Uncooled Infrared Thermal Detector Arrays," (SPIE paper 1320-12).
Excellent review of uncooled IRFPAs, raises issue of strong commercial potential for uncooled arrays because they save money on the cryocooler, a significant cost component.

Scribner, D.A. and Ray Balcerak, Infrared Focal Plane Array Producibility and Related Materials (SPIE: WA) April 1992.
The increasing demand for infrared focal plane arrays for advanced imaging systems has led to several major producibility programs. The proceedings discusses solutions to producibility problems with an emphasis on new concepts and techniques for manufacturing improvements. Production planning and integration are the topics of several papers, including computer integrated manufacturing systems, in-situ process monitoring, and analysis of criteria selection for production. Other topics include packaging and cooling, high throughput testing for improved producibiity, and related new materials and their potential with respect to the production of advanced IRFPAs.

Sher, A. Tsigelman, A Eger, D., "Growth of HgZnTe Layers by LPE Technique," (DTIC Report #AD-A198-368, March 1988) 47p.
Report on work at Israel Atomic Energy Commission Yavne Soreq Nuclear Research Center. Solid solution mixtures of a wide band gap II-VI compound with one constituent being the semimetal HgTe may be tuned to yield narrow gap semiconductors, suitable for the fabrication of infrared photon detectors. Among this groups of solid solutions, MCT is at present the most commonly used material for photon detectors. In spite of the scientific and technological achievements difficulties still exist, generally attributed to the instability of these alloys. Thus, theoretical prediction about the relative stability of HgZnTe, reported recently, stimulated experimental research into the narrow band gap range of this solid solution. In the present work the LPE of HgCdTe was studied, focusing on the evaluation of this technique as a tool for achieving epitaxial layers of the "new material" the solid solution HgZnTe, with morphological, crystalline, and electrical properties comparable with those of MCT epilayers.

Smith, L.M., et. al, Integrated Technology in MCT/ GaAs and MCT/ Si for Medium and Long Wavelength Infrared (DTIC: May 1990), 54p.
MCT layers gave been grown by MOCVD on CdTe, GaAs, and GaAs/Si for device processing. Both 111 and 100 MCT have been grown on GaAs and the relative merits of the two orientations are discussed.

Stringfellow, G.B. Oragnometallic Vapor-Phase Epitaxy: Theory and Practice (Academic Press San Diego, 1989).
Excellent review of VPE, and a full discussion of the problems with LPE that pushed VPE to be developed.

Tennant, W.E. "HgCdTe Mid-Wavelength Infrared (MWIR) Epitaxial Mosaics for Tactical Applications," SPIE (Vol. 267, 1981) 5p.
Epitaxial MCT/ CdTe, combined with ion implantation technology, has proven ideally suited for proposed photodiode focal plane array applications. State of the Art performance planar photodiodes have been fabricated in epitaxial materials of all wavelengths. Important applications of these arrays are in tactical defense missions employing MWIR arrays operated at 77K and near 195K. A critical issue for these devices is stability through the bakeout required for the sealing off of dewar packaging. This report presents measurements of ion-implanted MCT/CdTe device and arrays which have broadband spectral response and high RoA values.

Tennant, W.E., et. al., "Key Issues in MCT-Based IRFPAs: An Industry Perspective," (Unpublished article transmitted by author).

The best survey article available on the materials issues confronting the IRFPA industry. Discusses all facets of materials technology which need to be addressed by government funding and proposes innovative ideas for reshaping government spending to spur second generation IRFPA development.

Tong, F.M., Yuan Haoxin and Yang Xiuzhen, "HgCdTe Photovoltaic Detectors and Some Related Aspects," (SPIE Paper #1685-21) April 1992, 11pgs.
Recent developments in HgCdTe photovoltaic detector technology are reviewed. The status of related area in China are introduced. Some aspects of research work on device physics and technology conducted in authors' laboratories are discussed. These include the performance of HgCdTe photodiodes for IR fiber communications, the effects of field-enhanced generation-recombination and imperfections of the pn junction on HgCdTe photodiode I-V characterstics; an analysis of the dependence of energy gap of MCT on temperature compositions.

Tower, John R., "Silicon-Based Imaging: Extending Performance on All Fronts." Photonics Spectra (April 1992), pp. 165-167.
This article discusses how silicon-based sensors are penetrating the market in all sectors from visible wavelength, to UV, to infrared. In the platinum silicide Schottky-barrier market, thermography is a growing business area for industrial process control, energy management, and medical diagnostics (no specifics mentioned). Since John Tower is a manager at the David Sarnoff Research Center, this is mostly an ad for Sarnoff's ability to produce sensors for all IR wavelengths.

Tower, John R., "Staring PtSi IR Cameras: More Diversity, More Applications, " Photonics Spectra (February 1991), pp. 103-106.
A thorough review of the technological diversity and applications of PtSi IR cameras which employ PtSi Schottky-Barrier IRFPAs. There is no comparison with MCT or other materials. Discusses the major architectural approaches at the David Sarnoff Research Center for: high frame rate cameras (to aid in understanding failure modes in power semiconductors), multispectral cameras (still in prototype stage), thermography, and infrared acquisition and tracking systems (military)

Tsaur, Bor-Yeu, et. al., "PtSi Schottky-Barrier Focal Plane Arrays for Multispectral Imaging in Ultraviolet, Visible, and Infrared Spectral Bands," IEEE Electron Device Letters (April 1990), p162-164.
PtSi Schottky-barrier detectors, which are conventionally used in the back-illumination mode for thermal imaging in the 3-5 micron infrared spectral band, are shown to exhibit excellent photoresponse in the near-ultraviolet and visible regions when operated in the front-illuminated mode. For devices without antireflection coatings, external quantum efficiency in excess of 60% has been obtained for wavelengths between 400 and 800 microns. The efficiency decreases below 400 microns but is still about 35% at 290 microns.

Voeiker, Jeffrey, "Dual-Band Focal Plane Array Trade Studies," General Electric Company Electronics Lab, January 1992, 23p.
Details results of a study that examined the current state-of-the-art of two IRFPA technologies: InSb 3-5um, and PV HgCdTe 8-12. Advanced techniques, such as MBE, MOCVD, and to a lesser extent LPE offer the promise of greater uniformity, operability, and detectivity, but wide-spread use of devices fabricated in these ways are currently cost prohibitive. The principal focus of this effort centerd on characterizing the ilmitations imposed by current growth and process techniques on the ability of devices to function radiometrically.

Vu, TT et al., "Integrated GaAs Readout Multiplexer and Preprocessing Electronics for Infrared Sensors," IEEE International Symposium on Circuits and Systems (New Orleans, LA May 1-3 1990), pp. 3093-3096.

A thorough, technical report on the use of gallium arsenide technology for IRFPA sensors. GaAs's characteristics, circuits, and architectures for readout multiplexer and preprocessing electronics are described for the first time in open literature for both scanning and staring arrays.

Vural, Cadri, "Mercury Cadmium Telluride Hybrid Focal Plane Array Technology," Proceedings of the SPIE Conference on Lasers and Electro-Optics (April 25-29 1988), pp. 28-29.
The MCT hybrid FPA, microelectronics chip architecture that emulates in the IR the function of Si visible imagers is discussed. As MCT is an alloy semiconductor whose bandgap can be varied from greater than 1 eV to less than 0.1eV, a hybrid FPA can be made with an IR long-wavelength cutoff from 1 to less than 10 microns. The development is reported of large arrays in two spectral bands: 1-2.5 microns (SWIR) and 3-5 microns (MWIR). The SWIR FPA has its principal application in earth resources and astronomy, while the MWIR FPA is useful in passive thermal imaging. The architecture and performance of the arrays are reported.

Vural, Cadri and L.J. Kozlowski, "256 X 256 MCT IRFPAs for the Hubble Space Telescope," (SPIE Paper 1320-14) 1990.
Excellent article on specifications and technological techniques for the most advanced and reliable MCT IRFPAs produced.

Watton, R., M.A. Todd, and J.P. Gillham, "Materials and Technology Research in Uncooled Ferroelectric IR Detector Arrays," IEEE Transaction Papers (Date Unknown), pp. 69-77.
An extremely technical piece which proposes an altogether new material for IRFPAs, using iron based material. The technology for the fabrication of large hybrid pyroelectric (thermasense) arrays has been established using the lead compound perovskite ceramics. These IRFPAs would operate at ambient temperature, and the absence of cryogenic requirements eases the operation, particularly in remote situations. The major drawback of the technology, expense, is not explained because the ferroelectric proposal is still in the prototype stage.

West, S.A., et. al., "Producible MWIR MCT Detector Array Program Intermediate Production Performance," August 1989, Rockwell International.
Interim report on Rockwell's MANTECH program. An essential document on yield and producibility technologies.

Williams, G.M., "Development of LPE HgCdTe for 305 Micron by PV Diode Arrays," Rockewell International Science Center, August 1988, 134p.
Final Report

Williams, T.L. and B. Newton "In Situ Testing of FLIRs and other Thermal Images," (SPIE Paper 1320-50) 1990, 9 pgs.
Discusses work at Sira, Ltd, in United Kingdom on reducing costs of FLIR testing by using in situ testing to determine faults as they occur so that material can be modified in situ instead of being discarded. This is a technology to watch closely.

Woolaway, James T, "New Sensor Technology for the 3- to-5 Micron Imaging Band," Photonics Spectra (February 1991), pp. 113-119.
The author discusses tradeoffs in IRFPAs operating in the 3-5 micron or the 8-12 micron band. He explains that sensors in the 3-5 micron range offer higher contrast, but receives more solar noise, and has lower radiance, particularly at low background temperatures. By contrast, the 8-12 micron range has a higher radiance, and higher thermal derivative (ie. it reacts faster to light). Since the 3-5 micron band offers

potentially better resolution, technological efforts are focused on imaging systems which can better filter the background noise, and elucidate the image better.

Yasuta, Brian, "Tower Video Signal-To-Noise Ratios of TICM II and Mitsubishi 512X512 PtSi Sensors," Wright Lab, Wright Patterson AFB, March 1992, 198p.
The PtSi Sensor Program reports on comparisons of these PtSi detectors with MCT and InSb detectors. PtSi sensors are evaluated for their potential as a low cost alternative to HgCdTe and InSb detectors for imaging applications. To accomplish this goal, these sensors are compared in the laboratory and under a variety of weather conditions in the field (tower) to determine the capabilities of the PtSi sensors for Air Force missions in all environments.

Zanio, K.R., "Hg CdTe on Si for Hybrid and Monolithic FPAs," (SPIE Paper 1308-14), 1990, 15pgs.
Discussion of work underway at Ford Aerospace on MCT using silicon as an alternative substrate.

(iv) Applications of IR Sensitive Materials in Biomedical Thermography

Afromowitz, et. al., Multispectral Imaging of Burn Wounds: A New Clinical Instrument for Evaluating Burn Depth," IEEE Trans Biomed Eng (1988:10) 842-849.
Predecessor to Hejazi study. Found that multispectral imaging could help determine absolute temperatures of skin, independent of emissivity.

Alfano, R., Ping P.Ho and K.M. Yoo, "Optical Imaging vs. X-rays for Breast Cancer Screening," Photonics Spectra (October 1992), p.109-13.
A professor at City College of the City University of New York discusses the novel technique of using infrared scanning as an alternative, safer, and higher resolution technique than x-rays (the conventional technique) for breast cancer screening.

Allen, R.C., et. al., "Localized Scleroderma: Treatment Response Measure by Infrared Thermography," Thermology (1987:2) pp. 550-553.

Amalric, R., et. al., "Prognostic Use of Thermography in Breast Cancer," International Congress of Thermology (August 1992).
Found that breast cancer with temperature increases of more than 3°C had a high failure risk, and "deserves systematic additional medical treatment."

American Medical Association, "Thermography in Neurological and Musculoskeletal Conditions," Reprinted in Thermology (1987:2) pp. 600-607.
Very conservative study which approved positively of thermography but concluded that thermography was not useful in directly measuring pain, and that more studies were needed to support its use.

Anbar, M. "Objective Assessment of Clinical Computerized Thermal Images," Processings of SPIE Medical Society V: Image Processing SPIE Proceedings (1991; 1445) pp. 845-847.
Echoes Anbar's main theme, that quantitative thermography will overtake biomedical thermography applications. Also notable because is written in public forum, rather than the "trade journal," Thermology.

Anbar, M., "Recent Technological Developments in Thermology and their Impace on Clinical Applications," (Unpublished), 13 pgs,
Reviews three new major technological developments in thermology: quantitative thermology, dynamic thermology, and absolute temperature thermology. Concludes absolute temperature thermology will prevail. becase it provides quantitative thermological info fre from artifacts associated with the measurement of infrared flux at a single wavelength band. It also measure the emissivity of the skin, which may have independent diagnostic applications, especially in the field of dermatology.

Anbar, M. D'Arcy, S.J. "Localized Regulatory Frequencies of Human Skin Temperature Derived from the Analysis of Series of INfrared Images" Proc. of the 4th Annual IEEE Symposium on COmputer Based Medical Systems (CBMS '91) (1991) 184-191

"A New Method for Detecting Cervical Cancer," Photonics Spectra (February 1992) p.106
A promising new method for detecting cervical cancer is currently being developed and tested at the NeW York Hospital-Cornell Meical Center and Canada's National Research Council. THe method, which employs infrared spectroscopic analysis of human cervical cells, may eventually lead to a new, rapid diagnostic test for the disease.

Clark, R.P., "Medical Thermography: Current Status," (SPIE Paper 1320-27) 1990.
ALthough the discussion revolves around thermography, almost all of these applications are suffering without IRFPAs, and this article highlights areas where IRFPAs would be extremely helpful because of their window of IR imaging, and resolution quality.

Clark, R.P., Goff, M.R., and Culley, J.E., "High Resolution Thermography in Medicine," The Journal of Photogaphic Science (Vol. 37, 1989), pp. 168-171.
Explains advancements in biomedical diagnosis made possible by a high resolution medical thermal imaging sytem using an 8 element SPRITE detector.

Clark, R.P., et. al., "Thermography and Pedobarography in the Assessment of Tissue Damage in Neuropathic and Atherosclerotic Feet," Thermology (3: 1988), pp. 15-20.
Discusses application of thermography in these two disciplines.

Croissant, P.D., et. al., "Neurological Clinical Procedure Review," Joint Council of State Neurosurgical Societies of the American Association of Neurological Surgeons and the Congress of Neurological Surgeons (June 1988) 4 pgs.
This is the lukewarm endorsement of thermography by the technology assessment committe of the American Assoc of Neurological Surgeons. It concluded thermography was safe and effective, but is to be considered an adjunctive test and not solely diagnostic except in cases of reflex sympathetic dustrophy.

DeMey, F., and R. Vermeir, "A Turtorial of Infrared Thermography," Meeting of International Congress of Thermology (August 1992).
Offers general overview of IR thermography, starting from basic physical principles, the mechanics of IR equipment, and emissivity correction.

Fujimasa, I., "Current Status of Medical Thermography in Japan," International Congress of Thermology (August 1992).
Discusses evolution of machines used and diseases diagnosed with thermography since 1968 in Japan.

Goodman, P.H., "Cost-Effective Analysis of Thermography and Venography in the Diagnosis of Deep Vein Thrombosis," Thermology (1989:3), pp. 113-120.

Argues that thermography should be used before taking expensive chemical or surgical procedures to remove deep vein thrombosis, because it could possibly save patients thousands of dollars by corroborating or sometimes contradicting diagnoses made by other, more prevalent equipment.

Handelsman, H., "Thermography for Indications Other Than Breast Lesions," Office of Health Technology Assessment, US Department of Health and Human Services (1989).
A negative review which argued that thermology is not effective in medical diagnoses.

Hejazi, S., Wobschall, D.C., Spangler, R.A., and Anbar, M. "Scope and Limitations of Thermal IMaging Using Multi-wavelength Infrared Detection," Optical Engineering (November 1992), pp. 2383-2393.
Reports on a single experiment which successfully determined absolute temperatures of surfaces by their blackbody emissions, by simulteneous acquisition of infrared emissions at different wavelengths.

Hubbard, J.E., "Neuromuscular Thermography: An Analysis of Criticisms," Thermology (1990:3) pp. 160-165.
Examines the critical points and issues raised by the criticisms of the AMA, Joint Council of State Neurosurgical Societies, the Office of Health Technology Assessment, the the American Academy of Neurology.

Hubbard, J.E., "Pain Evaluation in 805 Studies by Infrared Imaging," Thermology (1986:1) pp. 161-66.
Compares diagnostic precision of IR thermography with CT scans, EMG, and myelography for evaluation of pain in lumbar, cervical, thoracic, and facial areas. Found that IR thermography is clinically useful in pain evaluation as an indicator of peripheral nerve patho-physiology.

Jankel, W.R., Uematsu, S., "Thermography in Neurological Evaluation," Curr Ther Neurolog Surg (1989:2) pp. 331-34.
Very positive, objective review of usefullness of thermography in these diagnoses.

Jones, C.H., Ring, E.F.J., and R.P. Clark, "Biomedical Thermography," in Burney, S.G., Williams, T.L., Jones, C.H.N., Applications of Thermal Imaging (Adam Hilger: Philadelphia) 1988.
Discusses both technical aspects of biomedical IR, and all major areas in which their use has been proposed.

LeRoy, P. and R. Filasky, "Thermography," in J.J. Bonica, J.D. Loeser, C.R. Chapman (eds.), The Management of Pain, 2nd edition. (Lea & Febiger: Philadelphia) 1990, Volume 1, pp. 610-621.

Mohr, F.W., et. al., "Thermal Coronary Angiography: A Method for Assessing Graft Patency and Coronary Anatomy to Coronary Bypass Surgery," Ann THorac Surg (1989:47) pp.441-449.

Montoro, J.C., Anbar, M. "Visualization and Analysis of Dynamic Thermographic Changes," Proc. of the First Conference on Visualization in Biomedical Computing. (1990) pp.486-489.
Discusses reading and understanding clinical information embedded in absolute temperature thermal scans of bodies.

Montoro, J.C., Hershey, LA and Anbar, M., "Enhancement of Interpretation of Thermograms Through On-Line Software" Thermology (1989;3) pp. 121-124
Explains how radiometric readings and dynamic diagnoses can be made through the softwre available currently.

Nyirjesy, N., et. al., "Clinical Evaluation, Mammography and Thermography in the Diagnosis of Breast Carcinoma,"

Thermology (1986:1) pp. 170-173.
Concludes that the three major techniques used to evaluate the state of health of the mammary gland, namely clinical evaluation, mammography, and thermography, have inherent inaccuracies and cannot be used alone, either in screening or in diagnostic examinations. Recommends using IR thermography in conjunciton with other these other methods.

Ohashi, Y., etl. al., "Significance of Dynamic Thermography in the Diagnosis of Breast Cancer, "International Congress of Thermology (August 1992).

Pavot, A.P., Ignacio, D., and Gargour, G, "Use of Thermography in the Diagnosis and Management of Reflex Sympathetic Dystrophy," International Congress of Thermology (August 1992).
Authors found that IR imaging, with its characteristic abnormal temperature pattern, is very useful in confirming the diagnosis of RSD. Technique also found useful in monitoring sypmathetic nerve blocks and determining the adequacy of sympathectomy, both of which are used commonly in treatment of the disease.

Pochaczevsky, R., "Status of Thermography: 1989," Thermology (1989:2) pp. 97-100.
Good overview of potential applications. Emphasizes that thermology images the heat produced by body processes, rather than the imaging the processes directly; author contends this misunderstanding has led to low confidence of medical public in thermography.

Pochaczevsky, R., "The Value of Thermography as a Clinical Imaging Diagnostic Test: A Review of and Response to the 1989 Office of Health Technology Assessment Report of Thermography for Indications Other than Breast Lesions," Thermology (1991:4), pp. 227-233.

Pochaczevsky, R., "Thermography in Posttraumatic Pain," Am J of Sports Medicine (1987:15) p.243-250
A how-to article targeted at physicians interested in thermography and its applications to sympathetically maintained pain, resulting from sports injuries.

Ring, E.F., "Thermography in Rheumatology," Thermology (1986:1) pp. 149-153.
Pioneering experiment, using late-model IR machines, to diagnose and follow treatment of rheumatology through the temperature given off by peripheral joints, which varies in accordance to the synovial blood flow and inflammation.

Sterns, E.E., Zee, B., "Thermography as a Predictor of Prognosis in Cancer of the Breast," Cancer (1991:67) pp. 1678-1680.
Although recognizing the significance of biomedical thermography equipment, remains skeptical about reaching close to 100 percent confidence in thermography as a prognostic technique.

Stoner, H.B., Taylor. L., Marcuson, R.W. "The Value of Skin Temperature Measurements in Forecasting the Healing of a Below-Knee Amputation for End-Stage Ischemia of the Leg in Peripheral Vascular Disease," Eur J Vasc Surg (1989:3) pp. 255-261.

Suave, C., Hand, D., Thomassin, L., Amalric, R. "The Diagnosis and Prognosis of Thermography in Breast Cancers," International Congress of Thermology (August 1992).
Found direct correlation between temperatures of cancerous breast tumors, and mortality. Recommends use of IR thermography in making prognoses for patients found to have breast cancer.

Thomassin, L., Giraud, D., Sauve, C., Amalric, R., "The Value of Thermography in Small Size Breast Cancer" International Congress of Thermology (August 1992).

Found thermography to be modestly effectively in the diagnosis of small breast cancer tumors. Recommends that thermography be an integral diagnostic technique for breast cancer diagnosis, coupled with other techniques.

Torres, J.H., Springer, T.A., Welch, A.J., Pearce, J.A., "Limitations of a Thermal Camera in Measuring Surface Temperature of Laser-irradiated Tissues," Lasers Sur Med (1990:10) pp. 510-23.

Uematsu, G. "Thermographic Imaging of Cutaneous Sensory Segment in Patienst with Peripheral Nerve Injury: SKin Temperature Stability Between Sides of the Body," J of Neurosurgery (1985;62) pp. 716-720.

Ulmer, H.U., Brinkmann, M. Frischbier, H.J. "Thermography in the Follow-up of Breast Cancer Patients After Breast Conserving Treament by Tumorectomy and Radiation Therapy," Cancer (1990; 65) pp.276-80. Concludes that thermography does serve a valuable role in follow-up procedures.

Wagter, C. De, Martens, L. "Hyperthermia State of the Art: Physical and Technological Aspects," International Congress of Thermology (August 1992).
Proposes use of biomedical thermography to ensure that the heat differential and heat dynamics in the body do not thwart attempts to heat cancerous tumors to very specific temperatures, in order to kill the tumor.

Yoo, K.M., Das, B.B., and Alfano, R.R., "Imaging of a Translucent Object Hidden in a Highly Scattering Medium from the Early Portion of the Diffuse Compnoent of a Transmitted Ultrafast Laser Pulse," Optics Letter (July 1, 1992) pp. 958-60.
Presents scientific basis for use of thermography in breast cancer diagnosis.

(v) Applications of IR Sensitive Materials in Non-Destructive Evaluation

Blazquez, C.H., "Detection of Citrus Freeze Damage with Natural Color and Color Infrared Video Systems," SPIE Thermosense XIII Conference (April 1991) pp. 394-401.
Infrared videography was used, but wavelength is in SWIR, making the application probably unavailable to MCT-based detectors.

Brecher, V.H., "Recent Advances in Inspecting Integrated Circuits for Pattern Defects," (SPIE Paper #1661-296) 1992, 16pgs.
Use of infrared detectors is discussed for inspection of IC boards; technical description of how the closed-loop inspection regime is arranged and run.

Bruno, Robert P., "Thermography in Nondestructive Industrial Testing." Photonics Spectra (July 1989), pp. 123-24.
Thermal imaging, or thermography, is now being used effectively as a tool for inspecting the integrity of composite materials and the adhesion of bonded protective overcoatings. The thermographic inspection of metals for stress-induced cracking now showing promise. Applications in metals are discussed.

Bruno, Robert P., "Tracking Gas Leaks with Active IR Scanning," Photonics Spectra, (February 1992) pp. 94-98.
Discusses how an IR laser can shine on an area and visually reveal where gas is leaking. This is because various gases have a different light absorption band than ordinary air. This is an interesting breakthrough because it shows how spectroscopy (usually without IRFPAs) begins to work more like focal plane arrays. FPAs in fact would make this process much more efficient and simpler if only the technology became

cheaper.

Cantella, M.J. et al., "Application of IR Staring Arrays to Space Surveillanc," (SPIE Paper #1540-75) 1991, 20pgs.
Best overview in the bibliography of the technologies, applications, and techniques for space-based second generation photovoltaic IRFPAs.

Cawley, P. and R.D. Adams, "Defect Types and Non-Destructive Testing Techniques for Composites and Bonded Joints," Materials Science and Technology (May 1989), pp. 413-25.
In this paper, an introduction to the aspects of composites and adhesive joints relevant to non-destructive testing is provided. The first part consists of a brief introduction to composites and adhesive joints, together with a description of the types of defects that may occur. In the second part, the main relevant non-destructive techniques used to identify these defects are described and the sensitivity of each method to the different types of defect is indicated. Thermographic inspection is described and discussed.

Cramer, K.E., P.A. Howell, W.P. Winfree, "Quantitative Thermal Depth Imaging of Subsurface Damage in Insulating Materials," SPIE Thermosense XV Conference (April 1993) Paper 1933-24.
Another application for Langley Research Center's pulse-echo thermal-wave imagnig.

Cramer, K.E., P.A. Howell, W.P. Winfree, "Wuantitative Thermal Depth Imaging of Subsurface Damage in Insulating Materials," Unpublished 10 pgs.
A thermal technique is presented for imaging subsurface admage and computing the depth of defects. This technique has been used in the detection of defects in aging aircraft skins.

Davis, Roy C., A Robotic Workcell for Linear Welding/Thermovision Scanning of Thermoplastic Bumpers (SME: 1984), 9 pgs.
This article is old but pertinent. The Ford Motor Company's Milan plastics plant utilized infrared scanning of a linear welded plastic bumper utilizing the robotic workcell concept.Buchanan, R.A., P.E. COndon, L.M. Klynn, "Recent Advances in Digital Thermography for Nondestructive Evaluation," SPIE Thermosense XII Conference (April 1990) pp. 134-142.

Ellingson, W.A., "Defect Detection in Multilayers Plasma-Sprayed ZrO2 by Time-Resolved Infrared Radiometry: A Comparison Between Analytical and Experimental Methods," SPIE Thermosense XV Conference (April 1993) Paper 1933-17.
Discusses a high-end NDE application of IRFPAs. More down-to-earth, common inspections may derive their techniques from the one explained in this article.

Favro, L.D., "Inversion of Pulse-Echo Thermal-Wave Images," SPIE Thermose XV Conference (April 1993) Paper 1933-15.
Advocates a new data processing technique for improving thermal-wave images, which is a technique being improved for the assessment of aging-aircraft and advanced composite metals.

Favro, L.D., et. al., "Infrared Thermal-Wave Studies of Coatings and Composites," SPIE Thermosense XIII Conference (April 1991) pp. 290-294.
Although focuses on high-tech coatings and composites, explains system which will likely become model for later, mass-produced machines for more down-to-earth applications.

Favro, L.D., P.K. Kuo, R.L. Thomas, "Real-Time Thermal Wave Imaging," Unpublished 27 pgs.
Extremely technical piece on this technique originally used by the researchers for detection of delaminations

and defects in aging aircraft skins.

Favro, L.D., et. al., "Real-Time Thermal Wave Tomography," in D. Bicanic (ed) Photoacoustic and Photothermal Phenomena III (Springer Verlag: 1992) pp. 519-45.
Images from thermal wave tomography have often been blurred because heat from the strobe lights diffuses out in the material. The authors contend that the diffusion can be easily removed from images if the data is correctly processed.

Favro, L.D., et. al., "Thermal Wave Detection and Analysis of Adhesion Disbonds and Corrosion in Aircraft Panels," in D.O. Thompson, D> CHimenti, Review of Progress in Quantitative Nondestructive Evaluation (Plenum Press: 1993) 5 pgs.

Feit, Edward, "Infrared Thermography for Aerospace NDT," Advanced Imaging (March 1991), 2 pgs.
The author outlines how the Physical Properties Laboratory at General Dynames's Space Systems Division (San Diego) is using thermography for nondestructive testing, rocket plume studies, to observe materials under simulated re-entry conditions, to visualize gaseous leaks, and to find defects in circuit boards. A good overview.

Finney, P., "Use Thermography to Pinpoint Faults," Test & Measurement World (November 1992) pp. 43-44.
No other test equipment can detect printed circuit board faults as well as infrared thermography. This article explains the usage, application, and different levels of integration of the testing equipment.

Gartenberg, E., A.S. Roberts, Jr., "Twenty-Five Years of Aerodynamic Research with Infrared Imaging," SPIE Thermosense XIII Conference (April 1991) pp.338-356.
Used as a reference piece; this is a pure research application with no wide-spread use.

Hadjifotiou, A., "Coherent Optical Systems: Current Status and Future Prospects." SPIE Sponsored Conference on Fiber Optics '90 (April 24-26 1990), pp. 14-24.
A case history is presented in which infrared imaging is used to locate shorts in a complex printed wiring board. Passing current through the short heats the conductor trace, and the current path is delineated on the IR image. This method is shown to be useful for a variety of current-carrying structures, both for failure analysis and reverse engineering. It can often be used with very limited knowledge of the detailed function of the device.

Hamilton, A., Childs E., and Marcia Kunz, Infrared Thermographic Evaluation of Fiber-Reinforced Composite Structures with Honeycomb and Closed-Cell Cores (SME: 1989), 26 pgs.
The planned utilization of closed-cell core in aircraft applications where honeycomb had been used previously and the fabrication of more complex shaped honeycomb parts, has necessitated the development of advanced NDE techniques for the purpose of assessing the quality of these structures. Infrared thermography has been identified as a viable candidate for evaluating bonded structures that are difficult or impossible to evaluate using conventional ultrasonics. Infrared thermographic inspection can be applied to these structures after an extensive qualification effort has been successfully concluded. The selective implementation of infrared thermography can reap both technical and economic benefits. The results of two distinct qualification projects, one involving sandwich structures having closed-cell core and the other, honeycomb core, are described.

Hamrelius, T,. "Accurate Termpature Measurement in Thermography: An Overview of Relevant Features, Parameters, and Definitions," SPIE Thermosense XIII Conference (April 1991) pp. 448-457.
This piece applied to all areas of application, not just NDE.

Howell, P.A., W.P. Winfree, B.S. Crews, "Numerical Simulations of Thermal Detection of Disbonds in Lap Joints, in Review of Progress in Quantitative NonDestructive Evaluation, Thompson, D.O., D.E. Chimenti, (eds.) Vol. 10B, 1991, pp. 1367-73.

Howell. P.A., W.P. Winfree, B. X. Crews, E. Cramer, "Parametric Studies of Thermographic Detection of Disbonds in Laminated Structures Using Computational Simulations," in Review of Progress in Quantitative NDE, Thompson, D.O., D.E. Chimenti (eds.) Vol. 9, 1990, pp. 1263-69

"IR Method Identifies Surface Contaminants," Chemical and Engineering News (Date Unknown in 1990), p.56.
A new form of microscopy developed by the Sandia National Labs, called IR microprofiling, uses a precise scanning movement of the microscopic stage to profile an entire region, pixel by pixel. (note: This sounds very much like the role IRFPAs now play, and it shows an area in which IRFPAs may make a good contribution if prices come down.)

Jones, T.S., H. Berger, and E. Weaver, "Large-Area Thermographic Inspection of CRP Composite Marine Vessel Hulls," SPIE Thermosense XV Conference (April 1993) Paper 1933-25.
Another application of IR systems designed for inspection of aging aircraft skins.

Luong, M.P., "Infrared Thermographic Characterization of Engineering Materials," Proceedings of the SPIE v. 1341 (July 11-13, 1990), pp. 327-338.
This paper illustrates the use of infrared thermography as a nondestructive and noncontact technique (a) to observe the physical processes of unstable crack propagation or flaw coalescence of engineering materials subject to various loadings, (b) to detect material defects or leakage phenomena and (c) to aid tribology experiments.

Lutovinov, V.M. et. al., "Some ways of using Thermal Imaging in Aeromechanics," Fluid Mechanics, Soviet Research (March-April 1990) pp. 82-91.
There are four main possible uses of thermal imaging systems in aeromechanics: measurment of temperature distributions on the bodies, experimental determination of points of extreme temperature on a given surface, measurement of the rate of heating of a surface, the motion of isotherms (e.g. for determing the heat flows to the surface), and monitoring changs in surface temperature in order to maintain it in a given range with the help of some other means (e.g. by cooling). Many applications in aeromechanics do not require temperature calculations, but instead qualitative analyses of the distribution of extreme heat transfer values and methods of contro9lling it. Thermal imaging systems are very effective in such cases. There is no doubt that most of the information thus derived requires computer processing.

Mackay, C.D., "Cooled CCDs in Lab Spectroscopy: The System of Choice," Photonics Spectra (February 1992) pp. 113-116
Cooled CCD systems are now the detector of choice, according to this article, in a wide range of imaging applications, and in recent years they have become the fastest-growing detector system for laboratory spectroscopy. Explains how CCDs are suited well to spectroscopy and what developments one can expect in the next few years.

Madrid, Angel, "Using IR Thermography for Detecting and Diagnosing Cracking in Concrete Dams," Conference on Infrared Technology XVI; Proceedings of the SPIE (July 11-13 1990), pp. 110-126.
Analytical and experimental research has been concluded to assess the feasibility of detecting and diagnosing deep crack in concrete dams by means of IR thermography measurements. A simplified, scale-down model of the nonoverflow section in a conventional concrete gravity dam and its reservoir has been designed with the capability of simulating both air-filled and water-filled deep cracks. A high-resolution

CMT thermal imager (BSI 7000 equipment) has been utilized for mapping the temperatures at the downstream face of the latter mode, under realistic quasi-static thermal conditions, in similar situations both with and without deep cracks present in the concrete body. The results obtained form these measurements compare reasonably well with calculations based on an ad hoc one-dimensional heat-transfer model of the simulated dam-reservoir complex.

Maldague, X., et. al., "Transient Thermogarphic NDE of Turbine Blades," SPIE Conference on Thermosense XII (1991) pp. 161-171.

McLaughlin, P.V., Jr., "Defect Detection and Quantification in Laminated Composites by EATF (Passive) Thermography," Review of Progress in Quantitative Nondestructive Evaluation (v7B, 1988), pp. 1125-1132.
The capabilities and limitations of externally applied thermal field (EATF) thermography are presented along with applications for which it seems best suited. Heating methods are reviewed for both parallel and normal EATF thermography. Liquid crystal and video radiometers are assessed for their temperature measurement sensitivities and ranges and techniques for the analysis of EATF thermographic phenomena are given. Detection and quantification of debonds and surface cracks are discussed along with ambient surface condition and support structure effects. Directors for future development of the technique are highlighted.

McLaughlin, P.V. Jr., "Using EATF Thermography for Nondestructive Evaluation," Plastics Engineering (July 1988), pp. 47-50.
The externally applied thermal field (EATF) thermographic technique for nondestructive evaluation (NDE) is capable of detecting surface and subsurface flaws, such as surface cracks and delaminations, in laminated composites during routine inspections. EATF thermography can also be used to quantify delaminations and impact damage.

Ramamurthy, A.C., et. al., "Stone Impact Damage to Automotive Paint Finishes: Post Impact Damage Analysis," International Congress and Exposition of the Engineering SOciety for Advanced Mobility Land Sea Air and Space (March 1993) 19 pgs.
Discusses several technique to assess paint chips and dents in automotive bodies after the impact of stones, such as Electrochemical Impedance Spectroscopy, Themal Wave Imaging, and Acoustic Microscopy. The authors do not unfortunately discuss the market potential (which appears very limited).

Reizman, F., "Fault Location in Printed Wiring Boards Using Thermal Imaging," SPIE Thermosense XII (April 1990) pp. 172-177.
Early article on a very popular application.

Selman, J.J., "Evaluation of a Prototype Thermal Wave Imaging System for NDE of Composite and Aluminum Aerospace Structures," SPIE Thermosense XV Conference (April 1993) Paper 1933-22.

Shephard, S.M., et. al., "Comparison of Scanning and PtSi Focal Plane Array Cameras for IR Thermal Wave Imaging," SPIE Thermosense XV (April 1993) Paper 1933-16.
Concludes that although scanning systems are more predictable and calibrated better, staring PtSi cameras should offer improved resolution, sensitivity, and faster frame rates, which should be a boon for thermal wave imaging.

Snell, J.R., " A High-Tech Tool Meets Low-Income Weatherization,' Home Energy (May/June 1989) 6 pgs.
Infrared thermography equipment has come down in price to the point where weatherization programs can fully utilize them. This article describes how weatherization programs use this equipment, and what they

specifically look for.

Snell, J.R., "A Survey of the Use of Infrared Thermography in the Department of Energy's Weatherization Assistance Program," SPIE Thermosense XI 1989 (August 1989).
The Low Income Weatherization Assistance program, administered by the Department of Energy, aims to reduce the energy consumptions of homes owned by lower income families. In the past four years, infrared thermography has become a central tool used by energy assessors to locate air leaks around windows, holes in walls, faulty heating or cooling ducts, etc.

Snell, J.R., "Moisture in Roofs: What to do About it," Roofer Magazine (October 1990) 6 pgs.
Infrared detectors can be instrumental in the location of moisture deposits in roof, which can spread and eventually require roof replacement.

Spicer, J.W., W.D. Kerns, L.C. Aamodt, J.C. Murphy, "Time-Resolved Infrared Radiometry Using Focal Plane Arrays for Characterization of Hidden Corrosion," SPIE Thermosense XV Conference (April 1993) Paper 1933-18.
More garden-variety corrosion detection techniques using IR would probably be derived from the technique explained here.

Syed, H.I., and K.E. Cramer, "Corrosion Detection in Aircraft Skin," SPIE Thermosense XV Conference (April 1993) Paper 1933-19.
Explains the major effort, being conducted at Langley Air Force Base under NASA's auspices, to use IR pulse-echo thermal-wave imagery to detect flaws in aging aircraft skin.

Tenek, L.H., E.G. Henneke, "Flaw Dynamics and Vibrothermographic-Thermoelastic NonDestructive Evaluation of Advanced Composite Materials," SPIE Thermosense XIII Conference (April 1991) pp.252-263.
Earlier article on testing metal construction materials for stress, using "stress photonics," techniques, such as IR.

Thielen, D.A., "Infrared Thermograhpic Inspection of Superelastically Formed/ Diffusion Bonded Titanium Structures," SPIE Thermosense XV Conference (April 1993) Paper 1933-21.
Discusses a specific, high-end application of IRFPAs in composite inspection.

Thomas, R.L., L.D. Fabro, P.K. Kuo, R. Bruno, "Using Thermal Wave Imaging to See Below the Surface," Photonics Spectra (January 1993) pp. 147-150.

Thun, R.L., "Thermographic Inspection of Composite Aerostructures," SPIE Thermosense XV Conference (April 1993) Paper 1933-23.
Describes use of infrared imaging techniques, contrasting it with ultrasonic techniques, the traditional method.

Titman, D.J., "Some Applications of Infra-Red Thermography to Civil Engineering Problems," British Journal of Non-Destructive Testing (December 1990), pp. 627-630.
Thermography is totally non-destructive and under suitable conditions can provide a rapid hands off approach to an investigation. However, as with other non-destructive tests, it may be necessary to correlate results with other forms of inspection, utilizing other non-destructive techniques. This paper concentrates on applications of the technique to the investigation of structural details and defects. Subject covered included conditions under which the technique may be useful, applications involving a heat source within a structure, thermal gradients, and induced heating, and practical considerations.

Traub, A.C., "Parts Inspection by Laser Beam Heat Injection," NDT International (April 1988), pp. 63-69.
When a pulse of laser radiation falls on a material surface, a certain amount of warming will occur which depends upon the surface properties of the material, particularly upon its absorptivity. The amount of warming will also depend upon what is underneath the surface and especially upon the amount of mass which is available for the thermal energy to expand into. If the warming process is monitored by an infrared detection system, one has a ready means of determining whether or not two parts are alike in their surface properties or in their international features. An automatic, non-contact system is described which uses this principle for the inspection of solder joints on printed wiring boards at rates of up to 10 joints per second. With minor changes, the inspection system an be used to repair defective joints and to manufacture new ones by the reflow of solder paste of preforms. Extensions of the inspection method are described with regard to the testing of bonds in metal sheets and to the measurement of paint thicknesses on metals.

Vogel, C., "The Art Market: When the Crowds Go Home, Museum Officials Peek Behind the Scenes, Literally," New York Times (February 5, 1993), pp. C24.
The use of infrared video cameras to closely examine great artworks on loan to museums is discussed. The Museum of Modern Art in New York City recently learned a great deal about Matisse works usnig the cameras.

Warren, L. and J.R. Paterson, "The Development of Elastomeric Insulating Materials For Use Under Extreme Service Conditions," Fifth International Conference on Dielectric Materials, Measurements and Applications (Canterbury, UK June 27-30 1988), pp. 143-146.
This technical piece discusses how to use a thermal imager to conduct predictive maintenance on insulation systems in high temperature environments. After testing insulating material in a severe heat environment, imagers and spectrometers were used to monitor the composition and gases given off from the insulation to test for toxic materials could harm users of the company's insulating equipment. The authors mention that much proprietary information has been withheld by manufacturers.

Warren, L. and J.R. Paterson, "The Use of Thermal Imaging for the Development of Materials to Withstand Extreme Service Conditions," Fifth International Conference on Dielectric Materials, Measurements, and Applications (Canterbury, UK June 27-30 1988), pp. 1290-1292.
This piece is very similar to the other from Warren and Peterson. The authors propose exposing polymeric materials to extreme testing conditions of heat, then analyzing them by thermal imaging to test for hot, weak spots which will lead to degradation and breakdown of the materials.

Watanabe, T. et. al., "Radiation Thermometry of Silicon Wafers in a Diffusion Furnace for Fabrication of LSI," IEEE Transactions on Semiconductor Manufacturing (February 1991), pp. 59-63.
Discusses a novel technique in which thermal imagers are used to measure the temperature of silicon wafers in a diffusion furnace in production. This experimental technique is very important because as annealing (cooling) time decreases in silicon wafer production (a desirable trait to increase productivity), monitoring sensitive temperature variations becomes very important.

Welch, C.S., "Material Property Measurements with Post-Processed Thermal Image Data," SPIE Conference on Thermosense XII (April 1990) pp. 124-132.
Proposes method for data processing to find defects in materials.

Yonushonis, T.M., et. al., "Infrared Thermal Wave Imaging of Thermal Barrier Coatings for Diesel Applications," American Ceramic Society Bulletin (August 1992) 9 pgs.
A rapid non-destructive evaluation technique has been developed for rapid inspection of coatings. Processing parameters can be improved without requiring expensive, time-consuming engine tests, thereby

significantly improving productivity and performance.

Zuech, N., "Improve Product Reliability with Thermal Imaging," Test & Measurement World (October 1990) pp. 73-81.
Infrared detectors can be used to assess electronics, and most significantly integrated circuit boards, at several stages of production: bare-printed circuit boards, damaged circuit cards, or prototypes.

(vi) Applications of IR Sensitive Materials in Preventive Maintenance

Ayers, W.A., "Nonintrusive Infrared Testing of High-Voltage Switchgear," Materials Evaluation (May 1991) 3 pgs.
Contends that IR thermography could be used to inspect far more electrical components in plants, and therefore be even more valuable, but quality control engineers are afraid of getting closer to high-voltage components which should be inspected. IR inspection, of course, is the most remote way to inspect those components.

Baird, G.S., and R.T. Mack, "ASNT Thermographic Certification Update," SPIE Thermosense XIV Conference (April 1992) pp.98-99.

Black, J.E., Jr., "Utility Gain Through Infrared Predictive Maintenance," SPIE13 pp. 34-40.
A case study of Toledo Edison Co.

Bryson, F.G., "Rational Approach to Nuclear Power Station IR Surveys," SPIE Thermosense XII (April 1990) pp. 64-71.

Dickey, J.W. and B.R. Schulthorpe, "Predictive Maintenance Practices at FPL," Nuclear News (December 1992), pp. 64-67.
The Florida Power & Light Co. has made significant improvements in its ability to identify existing or potential problem areas using predictive maintenance methodologies. These methods allow the utility to determine not only what work has to be scheduled, but also what work does not have to be performed, during plant outages. Thermography has been used to identify such things as high-resistance electrical connections, overloaded distribution circuits, boiler insulation degradation, blocked cooling passages, overheating bearing, shorted motor windings, etc. The article emphasizes the money savings from investing in thermography maintenance.

Edgley, Kip, "Infrared Scanning Improves Preventive Mainetnance on Equipment Used for Water and Wastewater Treatment," P/PM Technology (1991) p.21.
Infrared thermogaphy is particularly important in electrical preventive maintenance. Loose, diorty, corroded, or oxidized electrical contacts and connections produce heath proportional to the power dissipation. Thermographic scans identify and measure the termpature gain of heat related anomalies in electrical equipment. Because it surveys from a distance, it makes possible the innspection of otherqise inaccessible components.

Edgley, K. "Infrared Scanning Improves Preventive Maintenance," Water: Engineering & Management (March 1991) pp. 38-41.
Explains to utility and economic sense of periodic scheduled thermographic inspections, and applies it directly to wastewater facility machinery and electrical equipment.

Fallon, Mary D. and Andrew C. Teich., "Role of Infrared in Plant PDM." Plant Services (October 1991), 3 pgs.

Discusses how infrared thermography is emerging as one of the most diversely applicable and effective predictive maintenance diagnostic tools available today. The reason for imaging the heat distribution in moving parts is that mechanical or rotating equipment produces excessive heat when corrosion build-up occurs or when it is not properly lubricated or aligned. Abnormal heat in electrical equipment is often the result of loose connections and overloaded circuits. This is a very important article which discusses the widespread applications of thermography to maintenance.

Feit, E., "Infrared Inspection Saves Time & Money," Forest Industries (February 1986) pp. 10-11.
Describes how wood industry could benefit from thermographic inspections. Case studies. The earliest article we found on thermographic PM.

Garner, J.M., "Infrared Research Services vs. SSS: The Bottom Line," SPIE Thermosense XIV Conference (April 1992), pp. 23-29.
Case studies of how thermographic inspection as part of a preventive maintenance regime has saved companies money. Article investigates the positive savings when recommendations were implemented and the cost attributed to recommendations ignored.

Graf, R.J. and G.J. Weil, "Steel Plant Predictive Maintenance Programs Utilizing IR NDT," SPIE Thermosense XII (April 1990) pp. 47-52.
Another case study of IR used in PM.

Green, T.R., "Preventive Maintenance Program Ensures System Reliability," Transmissions & Distribution (April 1991) pp. 52-54.
Case study of Balitmore Gas & Electric, which uses thermography to inspect all its overhead power lines.

Grover, P., "Applying ANSI/IEEE/NEMA Temperature Standards to Infrared Inspections," SPIE Thermosense XIV Conference (April 1992) pp.101-107.
Discusses the temperature standards which are fundamental to thermographic inspection. Proposes an alternated method for prioritizing potential problems with overheating equipment, which is referenced to nationally-recognized electical equipment temp standards which are adjusted to account for ambient temperature and load differences.

Hurley, T.L., "Infrared Qualitative and Quantitatitive Inspections for Electric Utilities," SPIE Thermosense XII (April 1990) pp. 6-24.

Infraspection Institute Newsletter, Published quarterly by Infraspection Institute.

Johnson, P.F., "Is It Worth It? -- Statistics of Corporate-based IR Program Results," SPIE Thermosense XIII Conference (April 1991) pp. 47-50.
Using statistics, authors at American Risk Management Corp. persuade industry that substantial savings can be found to companies that implement IR regimes.

Kaplan, H. "IR Monitoring Makes Nuclear Plants Safer," Photonics Spectra (December 1990) pp.74-76.
Describes how nuclear power industry has grown, by necessity, to utilize thermographic inspection more thoroughly than any other one.

Kaplan, Herbert, "Photonics at Work," Photonics Spectra (September 1988), pp. 70-72.
Infrared nondestructive testing (IRNDT) of laminar materials is based on the facts that a good thermal bond is a good structural bond, and that voids, unbonds and foreign matter affect the flow of thermal energy

across (normal to) the laminar layer. The thermal injection approach requires the generation of a controlled flow of thermal energy across the laminar structure of the sample material under test, thermographic monitoring of one of the surfaces (or sometimes both) of the sample, and the search for anomalies in the thermal patterns so produced that will indicate a defect in accordance with established accept-reject criteria. The author reviews the mechanisms used for generation and injection of thermal energy into test samples, and the typical failure modes.

Kaplan, Herbert, "What's New in IR Thermal Imagers," Photonics Spectra (February 1991), pp. 86-88.
A short article describing several new thermal imaging models on the market, and the trends which make them more "user friendly" and therefore more likely to gain a wide audience among manufacturing engineers and non-destructive testing managers. The trends are: portability, uncooled FPA's (vastly reducing cost), and better liquid-crystal displays.

Leftwich, R., "Multi-Detector Thermal Imagers," (Magnavox Government and Industrial Electronics Company: 1989), 10 pgs.
An overview and comparison was given of the most commonly used TV- compatible systems employing parallel and serial scanners. Also described were a variety of image processing techniques for image enhancement and operator aids.

Lucier, Ronald D., "Using Infrared Thermography in Nuclear Power Generating Stations" Nuclear Plant Journal (May-June 1989), pp. 1-4.
Infrared scanning, as part of a preventive maintenance program, can isolate and or detect problems before costly failures occur. The article considers infrared as a thermal performance tool, in particular: image recording, temperature resolution, image interpretation, some infrared applications in nuclear facilities, are discussed, e.g. checking of electrical systems safety equipment, and insulation. Some new application examples are described. Computerization of infrared thermography and differential thermography are cited among new developments. Kittson, J.E., "Department of National Defence's Use of Thermography for Facilities Maintenance," SPIE
Thermosense XII Conference (April 1990) pp. 2-5

Lucier, R.D., "Essential Elements and Goals for an Infrared Predictvie Maintenance Expert System," SPIE Thermosense XV Conference (April 1993) Paper 1933-05.
Discusses how to implement a thermographic PM regime.

Lucier, R.D., "Predictive Maintenance for the 90's: An Overview," SPIE Thermosense XIV Conference (April 1992) pp. 35-42.
Predicts that machines designed for preventive maintenance will be two-dimensional staring arrays with radiometric qualities.

Lucier, R.D. and H.L. Kaplan, Infrared Thermography Guide,)Electrical Power Research Institute: Palo Alto, CA) September 1990.
A how-to guide for thermographers, listing equipment to check and procedures.

MacDavid, J.H., "Buried Steam-Line Temperature and Heat Loss Calculation," SPIE Thermosense XIII Conference (April 1991) pp. 2-10.

MacNamara, N.A. and A.E. Hammett., "Development of a Comprehensive IR Inspection Program at a Large Commercial Nuclear Utility," SPIE Thermosense XIV Conference (April 1992) pp.30-34.
This paper describes the development of an integrated infrared program within a nuclear operating company

from the early conceptual stages to the beginnings of a workable end product.

Madrid, Angel, "Using IR Thermography for Quantifying Failure Rates of Electric Power Network Components," Conference on Infrared Technology XVI; Proceedings of the SPIE (July 11-13 1990), pp. 24-45.
A technique based on IR thermography measurements is proposed to estimate realistic values of electric hardware failure rates corresponding to secondary failures; that is, those caused by past or present out-of-tolerance or abnormal operating conditions. The technique allows the establishment of useful correlations between these failure rates, and the corresponding relevant thermal patterns as mapped using IR thermography. The technique is applied to practical cases of secondary failures in typical AC and DC electric power network components having to do with failure modes due to abnormal stress, corrosion, and erosion. The applications of this technique to fault and failure diagnosis, and both reliability, availability, and maintainability analysis and probabilistic risk assessment of electric power networks is also briefly discussed.

Moy, R.Q. R. Vargas, and C. Eubanks "Predicting Electronic Component Lifetime Using Thermography," SPIE Thermosense XIII Conference (April 1991) pp.154-160.
Researchers are at IIT Research Institute and Aerospace Guidance and Metrology Center.

Nuclear Maintenance Applications Center, Infrared Thermography Guide, Final Report, NP-6973, July 1990, Research Project 2814-18.

Paxton, Clint, et. al., "Infrared-Thermographic Inspection Improves Service Reliability," Transmission & Distribution (April 1992), 4 pgs.
A non-technical article on how Pacific Gas and Electric Co. is meeting the goal of improved service reliability while cutting some of the expense associated with outages with better maintenance, construction practices, purchasing state-of-the-art equipment and providing more technical training for employees by using infrared thermography in field-inspection programs. Discusses the basics of thermography theory, inspection strategy, and hardware/personnel requirements.

Ridley, W.C., "Integrating Thermography into the Palisades Nuclear Plant's Electical Predictive Maintenance Program," SPIE Thermosense XIII Conference (April 1991) pp. 51-58.
Author, at Consumer's Power Company, contends that integration of IR into existing PM techniques at this nuclear power plant was very successful.

Sharma, Y.P., "Nondestructive Inspection of Surface Mount Compounds," Surface Mount Technology (April 1989), pp. 11-14.
High density packaging and interconnection technologies have led to the miniaturization of surface mounted components to such a degree that even routine optical inspections are not adequate to detect defects in components. It is reported that nondestructive techniques are available for inspecting individual components prior to, during, and after their assembly on the board. The nondestructive techniques such as infrared thermal imaging, ultrasonics, and X-ray radiography are useful for detecting potentially defective components from nondefective ones, although the use of ultrasonics requires immersing parts in a fluid for proper acoustic coupling.

Slizewski, L.S., "The Role of Infrared Surveys in Loss Prevention," AIPE Facilities (January/February 1992) 3pp.
Technical piece intended to give electrical plant quality control engineers a closer look at thermographic inspection. Contends that thermography has proven its worth as a loss-prevention tool. Includes survey information on how much money could be saved through routine thermographic inspection.

Snell, J.R., "Energy Management Technology Report: A Maintenance Strategy You Can't Afford to Be Without," Engineer's Digest (January 1989) 4 pgs.
IR consultant-author offers several case studies of customers who have saved several times the start-up and consultant costs after getting thermograhpic inspections of their plant's electrical equipment, mechanical equipment, roofs, etc.

Snell, J.R., "Developing Operational Protocol for Thermographic Inspection Programs," SPIE Thermosense XIV Conference (April 1992) pp. 12-22
An article intended for thermographers, discussing all the factors which contribute to effective and credible thermographic inspections of equipment.

Snell, J.R., "Infrared Thermography: Answers to Questions You've Wanted to Ask," Maintenance Technology (June 1992) 6 pgs.
Introduction to IR thermography for plant equipment maintenance engineers.

Snell, J.R., "Infrared Video Camera Improves Equipment Maintenance at Champion International," P/PM Technology (May/June 1989) pp.12-13.
Another case study which discusses the cost savings to a company which signed up with the consultant (author).

Snell, J.R., "Integration of Infrared Testing into Various Maintenance Philosophies," SPIE Thermosense XV Conference) (Paper 1933-02).
Discusses IR thermography's contributions in conjunction with oil analysis, vibration analysis, etc.

Snell, J.R., and R.W. Spring, "Surveying the Elements of Successful Infrared Predictive Maintenance Programs," SPIE Thermosense XIII Conference (August 1991).
Good background on all factors involved in good thermographic inspections, not just equipment.

Snell, J.R., "Thermographic Inspection of Plant Electrical Systems," Maintenance Technology (May 1990) 4pgs.
Intended to introduce plant maintenance engineers with how thermographic inspections are conducted, what the thermographer is loo ı g for, and what the electrical plant will get out of the inspection.

Stern, S.A, "Infrared Thermography IMaging System Multiapplications for Manufacturing," SPIE Thermosense XII (April 1990) pp. 53-63.

Teich, Andrew C., "A Cool Box Finds Hot Spots." Photonics Spectra (August 1991), p. 9.
Inframetrics, a leading industrial process IR system producer, has integrated all the necessary imaging and analysis hardware in a portable rig which can be used for failure detection. It is representative of the leading units in the field. The system can image samples from -20 to 1500 degrees celsius, with an accuracy of +- 2 degrees.

Teich, Andrew C., "Predictive Maintenance with Thermography." Promotional Piece from Inframetrics, Inc. Billerica, MA, 5 pgs.
An extremely broad overview of the utility of thermography in detecting problem areas in early stages of deterioration, thereby saving companies vast amount of money. This is just a summary piece of the other, more detailed articles written by Teich.

Tomlingson, P.D., "Predictive Maintenance: Key to an Effective, Cost-Saving maintenance Program," Complete Building Equipment Maintenance Desk Book, S.J. Fuchs (ed), pp. 39-65 (Prentice-Hall, ENglewood, NJ)

1982.

Weil, G.J., "Steel Plant Maintenance Programs Utilizing IR NDT," SPIE Thermosense XII Conference (April 1990) pp. 47-51.
Discusses how IR thermography can be used specifically in the steel industry. Dicusses the cost benefits of thermography as it applies uniquely to steel plants, and recommends specific inspection regimes.

Wurzbach, R.N., "Increasing Maintainability and Operability of Emergency Diesel Generators with Thermogaphc Inspections," SPIE Thermosense XV Conference (April 1993) Paper 1933-03)
Another specific case study.

Wurzbach, R.N., "Thermographic Monitoring of Lubricated Couplings," SPIE Thermosense XIII Conference (April 1991) pp. 41-46.
Case study of Philadelphis Electric Co.

Wurzbach, R.N. and R.G. Hammaker, "The Role of Comparative and Qualitative Thermography in Predictive Maintenance," SPIE Thermosense XIV Conference (April 1992) pp. 3-11.
Compares both techniques for preventive maintenance, concluding that although quantitative thermography is more difficult technically, it will gain more widespread appeal.

(vii) Applications of IR Sensitive Materials in Process Control

Ahlstron, J., "Review of Industrial and Research Applications of Thermography," (SPIE Paper 1320-21), 1990, 4 pgs.
An all-applications, no-technologies discussion of thermography, which gives a good overview of the applications for which IRFPA will be competing if costs can be brought down. These are certainly low-end of the market niches, but it is a good overview piece nonetheless.

Anderson, C.J., "Automated Infrared Scanning in Cray Y-MP Production," SPIE Thermosense XII (April 1990) pp. 207-217.

Back, B., "Adaptive Welding Increases Quality," Photonics Spectra (January 1991) pp. 181-185.
For high-quality welds, it is critical that joints be precisely positioned. The usual way of automating welding processes has been to install arc-welding robots, who work according to a prgram that specified weld path, torch angles, welding parameters, etc. To assure faster, more consistent and higher quality welds, , the authors developed a system which uses an infarared sensor to view the weld.

Balle, M., "Automated IR-Weld Seam Control" SPIE Thermosense XII (April 1990) pp. 332-339.

Banerjee, P, and B.A. Chin, "Gradient Technique for Dynamic Bead Width Control in Robotic Gas Tungsten Arc Welding," Conference on Recent Trends in Welding Science & Technology (June 1-5, 1992) 5 pgs.
A novel approach for the in-process detection and control of bead width is presented. An infrared sensor is used to acqure thermal distributions on the welded surface duing the gas tungsten arc welding process. In order to monitor weld bead width, these distributions were analyzed in-process.

Banerjee, P., and B.A. Chin, "Infrared-Sensor Based On-Line Weld Penetration Control," SPIE Thermosense XV Conference (April 1993) Paper 1933-12.

Banerjee, P., J. Liu, B.A. Chin, "Infrared Thermography for Non-Destructive Monitoring of Weld Penetration Variations," Proceedings of the Japan USA Symposium on Flexible Automation (American Society of Mechanical Engineers, 1992) pp. 291-295.
The thermal distributions obtained during the gas tungsten arc welding process were analyzed using mathematical techniques to determine if changes in the surface temperature distribution could be correlated with changes in weld penetration. An nfrared scanning camer was used to obtain the temperature profiles.

Banerjee, P., Nagarajan, S. and B.A. Chin, "Weld Quality Control in Gas Tungsten Arc Welding Process," Proceedings of NSF Design and Manufacturing Systems Conference (1991), pp. 143-47.
An infrared sensor was used to control the quality of welds produced during gas tungsten arc welding process. Among the weld parameters, penetration depth and position of the weld pool were investigated. Temperature distributions in the vicinity of the weld pool were measured using the infrared sensor. These measure temperature distributions were analyzed to determine penetration depth in real-time. The position of the weld pool was controlled suing the asymmetry in temperature distributions. The ability of infrared sensor to monitor more than one weld process parameter was also demonstrated. As an example, weld pool offset and width were simultaneously identified.

Banges, Edmund R. and Erland Jungert, Artificial Intelligence in the Development of Adaptive Control for Fusion Welding (SME, 1986), 18 pgs.
The ability to control fusion welding processes in an adaptive control mode and perform an inspection in real time is of interest to fabricators in the pressure vessel, aerospace, and shipbuilding industries. This paper presents a series of experiments using infrared thermography as the principal sensing mode to study artificial intelligence contained in weld puddle isotherms. The information obtained may prove valuable in the control of the welding process. Image processing computer software development was initiated in the development of algorithms that correlate geometric shape change data to changes in the critical process and procedure variables. The IR vision sensor generates a partial Raster image which is analyzed by the image processing system. Decision support for preservation of weld quality is made by an expert system.

Bangs, E., "IR Monitors Cutting-Tool Wear," Photonics Spectra (November 1991) pp. 22-23.
Millions of dollars are lost each year in the metal-removal industry in the scrapping of machined parts as a result of worn cutting tools. Research metallurgists report that the increased heat generated as a result of tool wear is readily detectable by the infrared camera. Infrared Monitoring Systems has designed a thermographic screening machine using commercialy available infrared cameras to test a tool for wear.

Bettelheim, J. and P.G. Williams, "Research and Development and Its Contribution to Improvement in Coal-Fired Plant Performance," Power Engineering Journal (September 1988), pp. 253-258.
The authors explain the ways in which their company, CEGB, is pursuing technologies, some of them infrared, to optimize coal-fired power plant performance. Among the techniques they have developed are flame monitoring which presently only uses two points on the flame (IRFPAs would vastly improve this technique) and sonic pyrometry to measure the furnace temperatures. Although not addressing IRFPAs directly, these two monitoring techniques could vastly benefit from IR arrays.

Bomse, D.S., et. al., Optically Based Methods for Process Analysis, (SPIE: March 1992) 40pgs.
The proceddings focuses on in-process analytical instrumentation used in spectroscopy, process control color measurement, and product quality measurement in industrial production environments including pharmaceutical, petrochemical, and chemical manufacturing. The papers are multidisciplinary, being contributed from scientists and engineers involved with research, plant design, process quality control, and environmental monitoring.Bickell, A., "NIR: Earning a Place in Process Control," Quality (May 1990) pp. 56-58.

Near infrared spectroscopy is being used in the process industries, such as petroleum, chemicals, polymers, textiles, pharmaceuticals, films, coatings, foods, and adhesives. Article gives several case studies and explains how other industries can stand to benefit from NIR spectroscopy.

Burkell, R., and J. Murphy, "Infrared Imaging Systems Automate Aircraft Engine Inspection at General Electric," Integrated Engineering (April 1989) pp. 28-32.
Describes how GE thermally inspects components of its aircraft engines, specifically turbine blades whic have had internal passages and surface cooling holes drilled. IR confirms that heat does circulate through those cooling passages.

Chin, B.A., Goodling, J.S. and N.H. Madsen, Infrared Thermography Shows Promise for Sensors in Robotic Welding (SME: 1983), 3 pgs.
Infrared thermography shows promise as a means of sensing errors in arc position, seam variations, and presence of contaminants in the weld path. The experiments were performed with various types of sensors (acoustic, infrared thermography, optical and on-line radiography), all categorized as direct sensors.

Chin, B.A. and N.H. Madsen, Infrared Sensors for Welding Process Control: Advanced Systems for Manufacturing (SME: 1985), 10 pgs.
The objective of the research is the development of closed-loop controlled welding using infrared sensors. The primary benefit of the research would be an increase in the number of welding situations that can be automated. This is a preliminary article to the 1991 one published by Banerjee.

Coughlan, J., "Melt-temperature Detection Problems You May Not Know You Have," Modern Plastics (April 1992) pp. 101-105.
Current systems for critical temperature measurement in plastics are outdated, relyihg on inadequate and insufficient temperature information. Precision melt-temperature control, using infrared temperature sensors, is a new technology which performs much better than all other existing techniques.

Curran, R.L. and Ihab H. Farag, "Radiation Pyrometry of Glass During The Container Forming Process," IEEE Transaction Papers (Date Unknown), pp. 1092-1097.
Radiation pyrometry is an ideal form of non-destructive testing to measure the thermal profile of glass containers during a variety of different processes. Glass production is an ideal field to employ thermal imagers because a few degree change in glass temperature can change glass viscosity by a factor of 10, significantly affecting the molding process. The authors propose that thermometry will work well in glass molding.

Curren, R.L., I.H. Farag, "Radiation Pyrometro of Glass During the Container Forming Process," IEEE Transactions (Paper #88CH2565-0, 1988) pp. 1092-1098.
Technical how-to piece on use of non-contact temperature profiling used during the forming of glass containers by a variety of idfferent processes.

D'Agostino, S., "1991 Trends: Imaging: Application Know-How Drives Success," Photonics Spectra (January 1991) pp. 131-132.
Discusses the future of machine vision. Predicts that the price/performance ration of machine vision systems will continue to improve. Whole systems could sell for <$10,000.

D'Amato, D.P., et. al., Machine Vision Applications in Charavter Recognition and INdustrial Inspection (SPIE: WA) February 1992.

There is a race to make better, smaller, faster, and less power consuming microelectronic devices, and machine vision is a technology whose time in the microelectronics manufacturing world has arrived.

Danaher, Hugh, "Thermography: Understanding the Expanded Role of Thermal Imagers in Production," Evaluation Engineering (December 1988), pp. 77-79.
Thermal imagers quantitatively and qualitatively evaluate designs, determine proper operating conditions and facilitate repair of electronics components, subassemblies and final assemblies. Thermographic and other electronic instruments rely on quantitative data to determine conformance to specification and functionality of a device-under-test. The type of data they use to draw these conclusions is irrelevant. Only the accuracy and efficiency of obtaining meaningful results matter. When considering both of these criteria, thermal imagers often are perfect adjuncts to functional and inter-circuit testers to provide the most cost-effective solution.

Deeley, E.M. and P. Kontopoulous, "Strip speed measurement using distributed infrared detectors," IEEE Proceedings, Part D (July 1991) pp. 395-399.
A non-contact method for measuring the speed of electrically conducting strip over the range of speeds found in industry is described. The method is thermal in character and relies on the ability of ht striop to store heat for short periods of time. A wavelength-sensitive reading head consisting of an array of equally spaced infrared detectors senses the heat pattern present on the moving strip. The signals from the array elements are combined and the array acts as a spatial filter. The resultant signal is then fed back to a chter, or writing head, placed upstream of the reading head, resulting in a closed loop time delay feedback systems which oscillates at a frequency proportional to the strip speed. Phase shifts within the feedback loop cause a departure from linearity in the speed/frequency relationship. This effect is minimised by a digital feedback loop. Use of high-performance detectors would enhance performance, particularly for low-emissivity material.

Fike, D.K., "Using Infrared Thermography as a Manufacturing Tool to Analyze and Repair Defects in Printed Circuit Boards," SPIE Thermosense XIII Conference (April 1991) pp. 150-153.
Author, at IBM corporation, explains their research into using IRFPA-based systems.

Fuchs, E.A., et. al., "Thermal Diagnostics for Monitoring Welding Parameters in Real Time," SPIE Thermosense XIII Conference (April 1991) pp. 136-149.

Gauvin, Jacqueline, "Technology Update," Robotics Today (January 1986), p. 12.
A NSF Grant will support a study of robot positioning accuracy that will use acoustic methods to measure position. A remote maintenance robot has been developed to perform maintenance tasks on the Sandia Pulse Nuclear Reactor III in New Mexico. A Study by Frost and Sullivan (New York) predicts the market for industrial vision systems will increase to $980 million dollars in sales by 1999 at a mean annual growth rate of 57%. An infrared charged-coupled device camera developed by RCA (Moorestown, NY) can sense slight amounts of heat, allowing the unit to "see" vehicles, observe personnel movements, track heat-emitting objects, or provide topographical data. Integrated sensor technology is being used at the University of Pennsylvania to produce microsensors small enough to allow as many as 250 sensors to fit on a single silicon chip.

Giacobbe, F.W., "Selective Hardening of High Carbon Steel Using an Argon Thermal Plasma Flame," IEEE Conference on Plasma Science (May 1989), p. 117.
Thermal sensors were used in the selective hardening of high carbon steel using an argon thermal plasma flame. While continually rotating the samples, they were rapidly heated to 870 degrees celsius, kept there fore 1 minute, and then cooled. Although the approach in the article is metallurgical, it also signals a

potential use for IR technology.Gilblom, D.L., "TDI Solves Web-Inspection Problems," Photonics Spectra (May 1991) pp. 189-192.

Govardhan, S.M. and B.A. Chin, "Adaptive Penetration Control Using Infrared Measured Temperature Gradients," SPIE Thermosense XV Conference (April 1993) Paper 1933-13.

Graeve, T., E.L. Dereniak, and J.A. Lamonica, "An Improved Infrared Technique for Sorting Pecans," Rev. Sci Instrum. (October 1991) pp. 2476-2479.
Presents the rsults of a study of pecan spectral reflectances. Describes an experiment for measuring the contrast between several components of raw pecan product to be sorted. It is believed that this technique has the potential to dramatically improve the efficiency of current sorting machinery, and to reduce the cost of processing pecans for the consumer market.

Gring, W., "It's Either Hot. or it's Not: Infrared Technology Speeds up Power Inspections at US West COs in Arizona and New Mexico," Telephony (July 27, 1992) pp. 22-24.
Case study of immense financial benefits to companies which began using sophisticated IR cameras to scan power lines. Goes through the mechanics of inspections.

Guerrieri, M., Infrared Temperature Sensing (SME: 1987), 8 pgs.
To improve the manufacturing process in both productivity and quality, precise data must be gathered on the variables that affect production. Temperature plays a critical role at vital points in most manufacturing processes. Processing temperatures are a measure of resultant quality in metals, plastics, chemical and food processing, as well as paper making, printing, and numerous other processes. Infrared noncontact temperature sensors provide a method of gathering significant information on temperature and, when coupled with data processing electronics, can be a vital element in an automated process or manufacturing line. This paper covers recent advances in infrared thermometers and applications in which they have made major contributions in quality and/or productivity.

Guerrieri, Matt, State of the Art in Infrared Temperature Sensors (SME: 1986), 8 pgs.
Noncontact infrared thermometers are aiding engineers to achieve enhanced productivity and improved quality control in manufacturing processes. In virtually any process in which temperature is a significant factor, IR thermometers can provide precise heat measurement, resulting in greater yield and consistency of product. Improvements in IR sensor components, accompanied by significant price declines for the instruments, have made possible price and performance that matches almost every heat sensing requirement.

Haugh, M.J., D.P. Stone, M. Thangavelus, "Paint Skip Detector," SPIE Thermosense XII (April 1990) pp.190-199.

Holmsten, D. and R. Houis, "High-Resolution Thermal Scanning for Hot-Strip Mills," SPIE Thermosense XII (April 1990) pp. 322-331.

Hospod, T., "MV Soft- and Hardware Integration -- A Practical Approach," Photonics Spectra (February 1991) pp. 177-183.
An introduction to machine vision: discusses both machine guidance and automated inspection, common requirements, processing-hardw~re selection, and camera selection. A good overview article, which does not specifically address infr detectors.

Hyvarinen, Timo, et. al., "Infrared Analyzers for Process Measurements." Unpublished Paper (1992) 6 pgs.
Optical analysis techniques, infracrd spectroscopy in the front end, are rapidly achieving new applications in process control. This progress is accelerated by the development of more rugged instrument

constructions. This paper discusses two analyzer techniques especially developed for use in demanding environments: the integrated multichannel detector technique, and a miniaturized Fourier transform infrared spectrometer. The future holds more detector array style sensors rather than the singular photovoltaic sensors presently in use. This will make it possible to monitor the human body, the food we eat, and the environment we live in (ie. the authors simplified the possible applications)

Jenks, Nigel, "Transverse Temperature Measurement to Improve Hot Strip Quality," Steel Times (May 1989), pp. 242-44.
Accurate temperature measurement has a role to play in all modern hot strip mills in helping to achieve consistency of material properties. Infra-red scanning cameras enable hot band temperature profiles to be measured across the width and along the length of the hot band. Information on the complete temperature profile, instead of just the center line temperature as recorded by a pyrometer, enables accurate control measures to be implemented to maintain uniform properties.

Kaplan, Herbert, "Applications Unlimited: Innovations Spur Productivity," Photonics Spectra (September 1991), pp. 79-89.
Kaplan discusses how photonic systems are assuring quality in non-destructive testing in real time, often in automated assembly-lines. He emphasizes the linear CCD (Charge-Coupled Displays) camera, which will employ IRFPAs as soon as the technology becomes affordable. Although not a head-on articles for IRFPAs, it introduces photonics in industrial sensors well.

Kaplan, H., "Innovations Spur Productivity," Photonics Spectra (September 1991) pp. 79-89.
Outlnes four new automated industrial applications for photonic technologies which are representative of the areas in which machine inspection technologies are penetrating the market. One application discussed, in which solders on a PC board are monitored, uses infarred detectors.

Kaplan, H., "Laser-Beam Diagnostics with Pyroelectric Cameras," Photonics Spectra (December 1992) pp. 64-65.
Pyroelectric cameras can uniquely image over a broad spectrum, from ultraviolets to far-infarred. In the 1-25 micron region, the cameras could perform beam detection, beam alignment, and beam-dispersion analysis, since most lasers operate at those wavelengths.

LeBeau, C.J., "Machine Vision Drives Quality to New Highs," Photonics Spectra (September 1991) pp. 122-126.
Describes how Motorola is integrating machine vision, some infrared, into its semiconductor manufacturing processes from the early states of wafer fabrication to the ifnal stages of outgong package inspection.

Lin, T.T., J.S. Goodling, and K. Groom, Adaptive Welding Using Infrared Sensing Techniques: Manufacturing Processes, Machines, and Systems (SME: 1986), 8 pgs.
This appears to be an intermediate article between the preliminary sensors-in-the-welding-process study by Madsen in 1985, and the final results published by Banerjee in 1991. The research investigates the feasibility of using infrared sensors to monitor the welding process. An infrared camera was trained on the molten metal pool during the welding operation. Several types of process perturbations which result in weld defects were then intentionally induced and the resulting thermal images monitored. Gas tungsten arc using AC and DC currents and gas metal arc welding processes were investigated using steel, aluminum, and stainless steel plate materials. The thermal images obtained in the three materials and different welding processes revealed nearly identical patterns for the same induced process perturbation. Based upon these results, infrared thermography is a method which may be applicable to automation of the welding process.

Linnander, B., "James River Uses Infrared Scanner to Investigate Off-Spec Production," Pulp & Paper (November

1992) pp. 131-132.
Case study of a paper mill which uses sophisticated infrared cameras to troubleshoot when paper quality falters. Discusses the benefits of permanent, linear arrays which image rapidly and are placed in several locations along the paper production web.

Matthews, Thomas R., Application of Sensors in an Untended Forging Cell: A Case History (SME: 1986), 9 pgs.
Sensors are important to the successful operation of any untended manufacturing process. This paper examines how sensors are integrated in the design of a turbine blade preform forging manufacturing cell. A wide range of sensors, including vision gaging, gas analyzers, infrared temperature measurements, other temperature transducers, pressure transducers and others are required to achieve untended operation of the cell. Also discusses are problems, solutions, and future requirements.

McWalter, K., "Machine Vision on Today's High-Tech Factory Floor," Photonics Spectra (September 1991) pp. 97-100.
Discusses the advent of widespread machine vision, the mechanics of actually integrating cameras into assembly processes, the integration process, the benefits once a system is installed, and new industries in which inspection equipment is becoming available. Article is not strictly IR. A good overview of direction of machine vision market and machinery.

"Microelectronics Spurs Measurement Market," Photonics Spectra (January 1992) p. 118.
As a result of higher integrated circuit densities and pressure for low-cost, high-throughput quality control, the demand in the microelectronics industry for electro-optic test, measurement and inspection (TMI) equipment will continue to grow. This market, $582.4 million in 1989, is forecast to reach $1.4 billion by 1996, according to Market Intelligence Research Corp. (MIRC).

Nagarajan, Sundaram, et. al., "Control of the Welding Process Using Infrared Sensors," IEEE Transactions on Robotics and Automation (February 1992), pp. 86-93.
Preliminary results from the use of sensors in a welding system suggest that simultaneous penetration depth, bead width, and torch position control are possible using a single IR camera. The camera, produced by Inframetrics, was in the 8-12 micron range, and gave a matrix of 250 x 192 discrete temperature measurements. The experiment showed that IR sensors can indeed be successfully used to control the welding process. This is a good piece on IR research in metallurgy welding.

Nagarajan, S., W.H. Chen, B.A. Chin, "Infrared Sensing for Adaptive Arc Welding," Welding Research Supplement (November 1989) pp. 462-466.
Adaptive welding enables dynamic altering of the welding parameters to compensate for changing environment. Sensors providing process status information in real time are integral to an adaptive system. In this investigation, IR thermography was used as a sensor to control the position of the arc and the penetration depth of the weld. Preliminary work on IR thermography showed that variation in these parameters produces a change in the surface temperature distributions of the plates being welded. Subsequently, to achieve computer control of these variables, image analysis techniques were developed to quantify the changes in the temperature distribution.

Nagarajan, S., H.C. Wikle III, B.A. Chin, "On-Line Weld Position Control for Fusion Reactor Welding," Journal of Nuclear Materials (Paper 0022-3115, 1992) pp. 1060-1064.
Infrared sensing techniquse were investigated to assist remote welding systems to identify and correct weld-joint offsets in real time. During the welding process, the temperature distribution along a line of normal to the joint and ahead of the arc was measured, using an IR detector.

O'Connor, L., "Smart Sensors Ride the Rails," Mechanical Engineering (December 1991) pp. 54-55.
Costly and dangerous freight car derailments that occur when roller bearings heat up rapidly havbe prompted the development of new sensor based systems to avert the danger. Infrared temperature sensors are one solution.

"Optical Spectrometry," Chemical and Engineering News (March 18, 1991), pp. 46-55.
An overview of the optical spectrometers shown at their annual instrumentation trade show. The trends were sharper detection levels, portability, and an accent on designing for specific applications. This will be a good market manufacturer survey if we identify spectrometry as an important future area of IRFPA use.

Orlove, G.L., "Development of a Radiometric Model for the Detection of Plastic Coating Omissions on Aluminum Substrate," SPIE12 pp. 184-189.

O'Shaughnessey, S., "Machine Vision Catches Problems Early On," Photonics Spectra (December 1990) pp. 80-81.
Discusses several industries which are using state-of-the-art machine vision which uses a complete control strategy to implement a statistical process control system.

Paxton, C., "Infrared Thermogarphic Inspection Improves Service Reliability," Transmission & Distribution (April 1992) pp. 32-35.
Another electrical utility describes the economic benefits of thermographically inspecting its power lines.

Rabie, Abdelrahman, The Use of Sensors in Part Handling (SME: 1983), 12 pgs.
Although old, this articles discusses an important IR technology. Two laboratory techniques for part handling implement two different types of noncontact proximity light sensors. One technique used photo-resistive cells for part orientation while the other used IR sensors for part detection. Both the hardware and the software are fully explained as are the major limitations of each technique.

Raghavan, S., H.C. Wilkle, B.A. Chin, "Adaptive Control of Submerged Arc Welding Using Infrared Sensing," SPIE Thermosense XV Conference (April 1993) Paper 1933-11.

Rogers, J.K., "Gaging Systems Lead March to Quality," Modern Plastics (November 1992) pp. 54-56.
Dicusses, among other technologies infrared gages, which are used in industry whe on-line compositional analysis is necessray, such as in determining the amount of barrier material in a multilayer extrusion, or measuring the amount of polymer on a foil or paper substrate in a coating operation.

Rose, Jennifer, "Solder Joint Inspection Systems Aid Process Control Efforts," Connection Technology (February 1989), pp. 25-27.
Sophisticated computerized technologies for analyzing the quality of the solder joint is critical in the process control of soldering in electronics manufacturing. A vision system may be inadequate since many joints are hidden from view. Several non-destructive inspection systems are either under development or currently available. The most viable technologies for obtaining the image (data) involved either infrared detection, a combination of laser/infrared, ultrasonics, or x-rays.

Schreiber, Rita R., "Sensors," Robotics Today (May 1983), pp. 16-17.
Describes Ford Motor Company's plans to use the cyto-computer vision system from Synthetic Vision Systems. Inc. to verify precision circuitry. The model 815 passive infrared sensing module is described as the first practical system designed to precisely detect an object by sensing the thermal contract between the moving object and its background.

Seitzer, T., "Industrial Vision tackels Web Inspection," Advanced Imaging (February 1993) pp. 32-34.
Overview of web inspection markets opening up recently to machine vision. Discusses applications form steel to newsprint, continuous pavement surfaces to food harvesting. Discusses technologies which make inspection possible, some infrared.

Setzer, J.B., M. Thangavelu, "Infrared Sensor for Automated Inspection of Hot Metal Surface," SPIE Thermosense XII (April 1990) pp. 200-206.
Authors describe how a linear infrared sensor could be used for automated inspection of hot metal sheets. The sensor locates voids, inclusions, and surface defects characterized by a variation from background radiant flux. The sensor can be coupled with a commercially avilable processing system, developed for visible wavelength line scan cameras, to automatically track, classify, and report product flaws in real time.

Shelley, S., "Real-Time Emissions Monitors Now Detect Smaller Quantities of More Compounds at Breakneck Speed," Chemical Engineering (November 1991) pp. 30-39.
Discusses the growing area of continuous emissions monitoring, which would use an "open path" or "fenceline" monitoring systems based on infrared optics. The system would pick up emissions in plants such as pul-and-paper mills, petroleum refineries and waste incinerators, and monitor the level of government regulated gases entering the air.

Smith, C., "Noncontact High-Temp Measurement," Photonics Spectra (July 1992) pp. 22-24.
Special filtering at narrow spectral ranges makes it possible to measure high surface temperatures through glass ports, flames, and products of combustion using non-contact IR thermoemeters. This article outlines well the areas of application more likely to favor point infrared radiometers rather than linear or scanning systems.

Stern, H., "Machine Vision Turns From Autos to Electronics: Standards Hold the Key to Success," Photonics Spectra (December 1991) pp. 101-104.
Machine vision, its hope in automobile production diminished, has found relief in electronics inspection. The author discusses what is available, what needs to be done to integrate an inspection system into existing processes, and the mechanics of conducting automatic inspections.

Stinson, S.C., "Advances Made in APplying IR Sensors to Process Control," Chemical and Engineering News (January 9, 1989) pp. 30-31.
Discusses two developments in infrared spectroscopy which have deepended interest in applying IR sensors to chemical and plant and oil reginery process control. One monitors multicomponent gas flows. The other determines gasoline octane numbers from IR spectra.

Stout, A., "IR Aids Development of High-Power Chips," Photonics Spectra (November 1992) pp. 24-26.
Infrared technology is being used to test cooling integrated circuit boards for high-power computer chips that are still on the drawing board. Since a deviation of 5 degrees on any component can affect operating speed, performance, and overall integrity, infrared detectors can profile chips and confirm that temperatures remain within those ranges.

Teich, Andrew C., "Predictive Maintenance with Thermography in Paper Mills," PaperAge (Forthcoming, 1992), 5 pgs.
A very good introductory, plain speaking article which describes how thermography is rapidly emerging as one of the most valuable resources available for predictive plant maintenance, detecting hidden problems in factories and allowing for corrective action before costly system failures occur. Applications in present use include surveying roofs for leaks, and checking rotating mechanical equipment such as electric motors,

bearings, and conveyors for signs of heat. Electrical distribution and motor control centers can be monitored for loose connections and phase imbalances. Circuit overload conditions can be detected long before burn marks for discoloration occur on the wire insulation. Other applications include refractory lining breakdown analysis, roof moisture detection, building envelope studies, steam trap conditions, heat exchanger evaluations and even the location of spontaneous combustion of stored paper products in ware houses and paper making supplies in outside yards.

Tervo, M., Kiukaaniemi, E., and T. Kauppinen, "Applications of Aerial Thermography in Peat Production in Finland," SPIE Thermosense XV Conference (April 1993), Paper 1933-14.

"Thermography Monitors Weld Quality," Quality (January 1992) pp. 37.
Discusses new servo-style automated system to perform resistance welding and percussive arc welding.

Tournerie, B., Reungoat, B. and J. Frene, "Temperature Measurements by Infrared Thermography in the Interface of a Radial Face Seal," Journal of Tribology, Transactions of the ASME (July 3 1991), pp. 571-76.
Mechanical seal functioning can be greatly affected by thermal effects and particularly by the coupling of seal face geometry and heat dissipation in the interface. It is necessary to develop new investigation means in order to study accurately such very delicate phenomena. This paper deals with the feasibility of temperature measurements by means of infrared thermography technique. The capabilities of the infrared camera which has been used are examined.

Travis, M., "Color Vision Helps Manufacturing and Quality of Food Products," Photonics Spectra (September 1992) pp. 139-143.
Although IR is not discussed, author outlines all areas of food inspection, from picking to automated inspection, which could use machine vision. Describes systems design, system integration, and other parameters in putting together an automated vision system which works for food inspection.

Valenti, M., "Infrared Sensors: Hands-Off Temperature Measurement," Mechanical Engineerg (October 1991) pp. 40-45.
Survey article which discusses how noncontact heat-measurement instruments, known as radiation thermometers, have evolved into compact sophisticated devices that accurately measure temperature in a wide variety of industrial applications, from steel and glass production to the manufacture of semiconductor chips.

Vanzetti, Riccardo, "Combining Soldering with Inspection," IEEE Control Systems Magazine (v.5, 1988), pp. 29-32.
A procedure is described in which an infrared detector is used to control the quality of solder joints being formed on printed circuit boards and a laser is used to inspect the quality of each joint at the same time. This approach eliminates after-the-fact inspection while making available real-time data for process control of the soldering operation. Although the joints are formed one at a time, with somewhat longer manufacturing time as compared to alternative processes, the extra time is partly compensated for by elimination of a separate inspection. Moreover, when joints of different sizes occur on the same circuit board, each one receives a tailored amount of reflow energy, thus avoiding underheating or overheating, which can occur when the entire board is soldered at once.

Vanzetti, Riccardo, Intelligent Laser Does Soldering, Inspection and Process Control (SME, 1988), 20 pgs.
A method is described in which an infrared detector controls quality of solder joints being formed by laser beam heating on printed circuit boards while, at the same time, automatically inspecting the quality of just

made joint. It eliminates the after-the-fact inspection process while simultaneously making available real time data for process control of the soldering operation. A similar method for inspecting solder joints on previously built PCBS is addressed.

Vanzetti, Riccardo and Dr. Alan C. Traub, Laser Soldering and Inspection for SMD's and FPT (SME, 1989), 11 pgs.
A means of manufacturing solder joints by laser-beam reflow in combination with infrared thermal sensing controls the heating process for each joint. The method tailors the heating dosage to the heating requirements for each joint, thus accommodating variations in thermal mass or in the amount of heat sinking by adjoining parts. In this method, the surface temperature of each solder mass is brought quickly to its melting temperature, the laser power is then reduced and controlled, via feedback, in order to give the rest of the solder mass time to reflow. The thermal signature of each reflowed target, as seen by the infrared detector, indicates whether the joint is normal or whether it may have been defective due to poor preparation beforehand.

Wallin, B., "Real-Time Temperature Measurement on PCBs, Hybrids, and Microchips," SPIE Thermosense XIII Conference (April 1991) pp. 180-187.
Author at AGEMA Infrared explains how their systems offer the potential to perform thermographic inspections for this applicaton.

Warren, C., "Infrared Thermometers: Out of the Lab and into the Factory," Machine Design (November 22, 1990) pp. 85-88.
Discusses the variety of industrial jobs in which infrared thermometers (both simple and linear) are used. Describes their advantages over contact thermometers, and basic principles behind their functioning and integration into industrial processes.

Willis, H.A., "Review of Industrial and Process Applications of Infrared Spectroscopy," (SPIE paper 1320-01) 1990.
Work mainly relates to applications under research in the United Kingdom.

Welty, G., "When Bearings Fail...," Railway Age (December 1991) pp. 40-58.
When journal roller bearings in railway cars fail, the $200 components could cause millions of dollars of damage. The need for improved, early-warning, hot-bearing detectors is clear. Acoustic detectors are one approach, IR detectors are another.

Wilson, J.S., "Thermal Analysis of the Bottle Forming Process," SPIE Thermosense XIII Conference (April 1991) pp. 219-229.
Explains efforts at Coors to integrate IR scanners to monitor bottle production in the Vertiflow cooling system, to increase yield. Thermal imaging is used to analyze the cooling effect due to different variable changes. The goal is to achieve uniformity in the iron temperature and glass flow which improves the quality of the bottle and also allows for a reduction in the total amount of glass required for each bottle.

Wright, J., "Infrared Measures Solder," Quality (June 1990) pp. 52-53.
Describes how simple IR thermometers can be used potentially to meet Nave Weapons specification WS-6536E (June 10, 1985) that requires all soldering irons used on products manufactured under a Naval Air contract be checked weekly to ensure that tip temperatures meet specification requirements.

(viii) Applications of IR Sensitive Materials in Remote Sensing

"Airborne IR Sensors Search Out Waste Sites," Photonics Spectra (July 1991), pp. 39-42.
Discusses how an IRFPA based sensor is being used to scan the formerly East German countryside for forgotten toxic-waste sights. As toxic waste decomposes, it releases heat, which is shown by the sensors flown by a plane at 1000 meters altitude. A large problem was distinguishing between background noise and genuinely hotter areas. Another problem was that weather conditions, the terrain of the survey area and discovering what's naturally hot can complicate, and in some cases, increase the costs of a survey. The licensing company is booked with customers.

Allen, A.R., S.A. Semanovich, "Thermal Analysis of Masonry Block Buildings During Construction," SPIE Thermosense XIII Conference (April 1991) pp. 99-103.

Asker, J., "Commercial Remote Sensing Faces Challenges on Three Fronts," Aviation Week & Space Technology (July 13, 1992) pp. 53-59.
Facing the possibility of new competitors later in the decade, the two leaders in the world satellite remote sensing market, Eosat and Spot, are planning for new technologies, grappling with US legislative uncertainly, and simultaneously nurturing established market relations while seeking new customers. IR technology is not addressed directly. Instead, the focus is on the future of the commercial satellite market.

Asker, J., "Remote Sensing Sales Grow with Expanded Data Needs," Aviation Week & Space Technology (July 13, 1992) pp. 46-51.
A survey of the most significant developments in space and informaton technology, along with the market trends, which will shape the space remote sensing business in the coming decade. This is a good article on the large potential for commercial satellites, and describes how new technologies will increase the versatility of the satellites, and create demand.

Carts, Y., "Automted Spectroscopy System Measures Smog," Laser Focus World (June 1993) pp. 23-24.
Spectrometers have been developed at the Lund Institute of Technology (Sweden) to measure a variety of atmospheric pollutants, including ozone, ammonia, nitrogen, and sulfur oxides, and aromatic hydrocarbons.

Colantanio, A., "Metal Cladding Envelope Problems, Retrofit Solutions, and Quality Control Investigations," SPIE14 pp.64-73.
Explains the use of IR thermography to find air leakage in complex, retrofitted, rebuilt etc. buildings.

Everitt, J.H., "Introduction to Videography: Historical Overview, Relation to Remote Sensing, Advantages, Disadvantages," First Workshop on Videography (19-20 May 1988) 4 pgs.
The researcher, at the US Department of Agriculture, offers an introduction to videography technology, focusing exclusively on it as a research tool.

"Fighting Forest Fires With Remote Sensing," Photonics Spectra (August 1991), p. 66.
A joint venture of scientists at Terra-Mar Resource Information Services and NASA's Ames Research Center plans to develop in three years a commercially viable real-time remote sensing system for monitoring such disasters as fires, oil spills, and floods. If the system works, it should take less than 30 minutes to provide fire fighters with images showing a fire's intensity and location. Current systems, relying on film, can take 6 to 12 hours.

Fouche, P.S., "Assessment of Crop Stress COnditions by Using Low Altitude Aerial Color Infrared Photography and Computer Processing," Proceddings of the 13th Biennial Workshop on Color Aerial Photography and Videography in the Plant Sciences (6-9 May 1992) pp. 19-23.
Infrared imagery was found useful in the detection of stress condition in various crops caused by moisture

deficiency, nutrient deficiency, and plant diseases.

Gordon, D.K., P.W. Mueller, M. Heric, "An Analysis of TIMS Imagery for the Identification of Manmade Objects," Photogrammetric Engineering & Remote Sensing (December 1991) pp. 1599-1604.
Concluded that a multispectral thermal infrared capability may have considerable value in reconnaissanc esensor packages such as Aided Target Recognition because objects such as metal- and stone-covered roofs were easily detected using the airborne Thermal Infrared Multispectral Scanner (TIMS).

Green, R., "Remote Sensing Soars to New Heights," Photonics Spectra (August 1991) p.81.
Leading the way to remote sensing with greater spatial, spectral and radiometric sensitivity is the Airborne Visible/ Infrared Imaging Spectrometer by the Jet Propulsion Laboratoty. Using silicon and Indium antimonide line-array detectors, the instrument is bringing new capabilities to scientists studying ecology, geology, oceanography, inland water supply, snow hydrology and the atmosphere.

Hock, J.C., "Monitoring Environmental Resouces Through NOAA's Polar Orbiting Satellites," Thermology (1: 1986) pp. 154-160.
Good overview of the environmental monitoring missions served by infrared detectors. The MWIR and LWIR channels are mostly used for cloud and surface temperature determination, and rainfall estimates.

Jiang, H., Y. Qian and K.T. Rhee, "High-Speed Dual-Spectra Infrared Imaging," Optical Engineering (June 1993) pp. 1281-1289.
A nre method of achieving controlled high-speed infrared imaging is presented, which has made it possible to overcome some of the limitations in current imaging technology, particularly in disposal of high-rate data flow synchronized with the event or object being detected. This technique is employed to simultaneously capture two geometrically identical images in respective spectral bands for quantitative spectrometric data reduction.

Jones, T,. "Lack of Photos Hurt Yellowstone Fight," Los Angeles Times (October 21, 1988) pp. 116.
The battles against a Yellowstone national park blaze was hampered by lack of infrared aerial photos, which were slow in being supplied due to communication problems.

Kaasinen, H.I., "Infrared Thermogrphy for Assessing the Quality of Waterproofing of Bridges Under Construction," SPIE Thermosense XV Conference (April 1993) Paper 1933-07.
This application appears to be very similiar to roof moisture surveys, only more sophisticated and demanding of the detectors.

Kaplan, H., "Using Laser Backscatter to Find Gas Leaks," Photonics Spectra (June 1991) pp. 98-100.
Researchers at the Livermore National Laboratory developed a gas-leak detection system based on "laser backscatter/absorption gas imaging (BAGI)" for the Naval Sea Systems Command which has commercial application. It can detect gas leaks which cost companies money, and, if the gases are toxic, could detect the release of hazardous gases before anyone is harmed. The technology is being marketed by Laser Imaging Systems of Punta Gorda, FL. The systems uses a LWIR system. Article explores various applications for the BAGI system.

Kaupinnen, R., et. al., "Renovation Concepts for Private Houses: The Use of Thermography as A Supporting Method," SPI14 pp.54-63.
Explains various ways Finland's Department of Energy is using, and has proposed the use of, infrared imagers in weatherproofing, and checking the air-tightness of homes.

Ketler, D.J., "Insights into Interpretability Differences Between Color Infrared Photography and Color Infrared Video Data," Proceedings of the Thirteenth Biennial Workshop on Color Aerial Photography and Videography in the Plant Sciences (6-9 May 1992) pp. 110-117.
Typical of the many articles on detection of plant stress using near infrared video or photography. Has good review of uses and history of color infrared photography and videography.

Knehans, A., and J. Ledford, "Impact of Aerial Infrared Roof Moisture Scans on the U.S. Army's Roofer Program," SPIE Thermosense XV Conference (April 1993) Paper 1933-10.

Koskelainen, L., "Predictive Maintenance of District Heating Networks by Infrared Measurement," SPI14 pp.89-96.
Although there were several articles over the years on this subject, the application seemed to only interest the scandinavian countries, so the application was left out of our final report.

Lareau, A.G., "Flight Performance of an Airborne Minefield Detection and Reconnaissance System," Photogrammetric Engineering & Remote Sensing (February 1991) pp. 173-178.
Reports on how the Airborne Minefield Detection and Reconnaissance System, developed by the US Army, could succeed in detecting mines using IR technology. The system uses a passive IR linescan sensor in the LWIR. The paper reports on the performance of the system.

Lightfoot, D., and V. Lightfoot, "Revealing the Ancient World Through High Technology," Technology Review (May/June 1989) pp. 54-61.
Discusses how color infrared photography and videography offer a new frontier for archeologists studying and searching for ancient cultures. Features such as dwellings, agricultural fields, and footpaths have been located easily using IR imagery. Airplane archeology using IR imagery should continue, the authors predict, to be invaluable to archeologists.

Linkous, A., B. McKnight, "Using Thermography to Detect and Measure Wall Thinning," SPIE Thermosense XV (April 1993) Paper 1933-04).
A new buildings & structures application.

Lyberg, M.D. and S. Ljungberg, "Thermography and Complementary Methods; A Tool for Cost-Effective Measures in Retrofitting Buildings," SPIE Thermosense XIII Conference (April 1991) pp. 104-116.

Marsh, S.E., J.L. Walsh, C.T. Lee, L.A. Graham., "Multemporal Analysis of Hazardous Waste Sites Through the Use of a New Bi-Spectral Video Remote Sensing System and Standard Color-IR Photography," Photogrammetric Engineering & Remote Sensing (September 1991) pp. 1221-1226.
Reports on a study which combined standard aerial color infarred photography, a new bi-spectral video acquisition systems, and GIS software to evaluate conditions at a waset site near Phoenix, Arizonia. Found that a video system offers several potential advantages over conventional photography for an operational monitoring program, including the immediate availability of multispectral data.

Mausel, P.W., "Airborne Videography: Current Status and Future Perspectives," Photogrammetric Engineering & Remote Sensing (August 1992) pp. 1189-1195.
Video imagery has only been used in remote sensing for about ten years, but new technologies, such as CCDs, offer higher resolution than had been previously available. The low resolution of videographic equipment had limited the technology's potential. Although all varieties of wavelengths are discussed, a video system used in the mid-wave IR could distinguish among plant species, determine succulent and non-succulent plant species, identify crop irrifation management potential, differentiate between variale soil surface conditions, and detect wild fires. Best survey article on the direction of photogrammetry.

McMullan, P.C., "Masonry Building Envelope Analysis," SPIE Thermosense XV Conference (April 1993) Paper 1933-06.

McMullan, P.C., "Field Documentation and Client Presentation of Infrared Inspections on New Masonry Structures," SPIE Thermosense XIII Conference (April 1991) pp. 66-74.

McMullan, P.C., "Case Study of Commercial Building Envelope Air Leakage Detection Using INfrared Imaging," SPI14 pp. 74-83.

Mecham, M., "Europeans Prepare to Build on Early ERS Satellite Success," Aviation Week & Space Technology (July 13, 1989) pp. 68-69.
The European Space Agency plans to build a second European Remote Sensing Satellite. The technology to be used (including IR) are explained, and the political and funding scenario for such a satellite are discussed.

Morgan, W.T., "Thermographic Inspections of Air Distribution Systems," SPI14 pp. 85-8.

Narayanan, R.M., S.E. Green, D.R. Alexander, "Soil Classifications Using Mid-Infrared Off-Normal Active Differential Reflectance Characteristics," Photogrammetric Engineering & Remote Sensing (February 1992) pp. 193-199.
Using laser fluroescence, found that differnet soil samples have unique reflectance signatures in the 9-11 micron region. Recommends that wavelength's use for understanding coil composition.

Nordstrom, R.J., "The CO2 Laser In Remote Sensing," Photonics Spectra (February 1992) pp.89-94
Discusses the range of uses for the CO2 laser, which is the illuminator of choice for infrared applications because it operates optimally within the 8-12 micron range. The 8-12 micron range is called the "fingerprint region" of the spectrum because so many molecules have distinct vibration bands there. This single distinction is enough to make the CO2 an instrument of choice despite its relatively poor atmospheric transmittance.

Nordwall, B.D., "Airborne Surveillance Will Give Forest Service Real-Time Fire Maps," Aviation Week & Space Technology (May 29, 1989) pp. 105-107.
Reports that the US Forest Service plans to use two aircraft equipped with dual-band IR sensors and a Navstar Global Positions System to locate fires and immediately send information to firefighters on the ground. Explains the equipment installed in two aircraft, and the techniques which have been designed for collecting and quickly relaying information to the ground.

Olsen, J.D., "Airborne Multispectral Imaging Monitor Environment," Photonics Spectra (August 1992) p.71
The information in the imagery significantly affected site investigations by identifying representative locations for observation and testing, detecting anomalous conditions for special investigation and refocusing investigations to an area that was initially considered fof-site. The use of remote sensing as an analytical tool resulted in reduced site-investigation time and costs, improved company and regulatory communication, and reduced time for site closure. The source of the chemical contamination at a pesticide plant was revealed on images in the near-infrared and thermal-infrared bands by vegetation stress.

"Panel Picks Priorities for Astronomy Research," Chemical and Engineering News (March 25, 1991), pp. 6.
A report coming from the National Research Council, entitled "The Decade of Discovery in Astronomy and Astrophysics," stresses that two technologies are liable to have the greatest impact: infrared technology and adaptive optics (that is, "giving Earth-based telescopes optics that respond quickly to eliminate atmospheric

distorting effects.

Parsons, M.L., et. al., "Fire Detection Systems for Aircraft Cargo Bays," (SPIE Paper 1308-29) 1990, 13pgs.
Discussion of an application using linear IRFPAs designed at Pacific Scientific Co.

Pierce, L.L., S.W. Running, G. Riggs, "Remote Detection of Canopy Water Stress in Coniferous Forests Using the NS001 Thematic Mapper Simulator and the Thermal Infrared Multispectral Scanner," Photogrammetric Engineerng and Remote Sensing (May 1990) pp.579-586.
Concluded that neither system could effectively detect moderate levels of canopy water stress, although extreme stress was easily detected.

Proctor, P., "Japan Plans New Generation of Remote Sensing Satellites," Aviation Week & Space Technology (July 13, 1992) pp. 66-67.

Schott, L.R., "Image Processing of Thermal Infrared Images," Photogrammetry Engineering and Remote Sensing (September 1989) pp. 1311-1321.
Technical piece which discusses how to implement absolute temperature calibration algorithms, methods for registering and combining multiple thermal infrared imags, and methods for combining thermal infrared reflected visible and near-infrared data.

Shropshire, G., and J. DeShazer, "Optical Sensors Aid Agriculture," Laser Focus World (May 1993) pp. 79-84.
Discusses development of sensors to reduce the use of chemcials and conserve natural resources in agriculture. Optical-based sensors used in agriculture represent one area in which strides are being made to analyze and improve our environment, in soil analysis, ammonia sensing, detecting plant stress and finding weeds.

Sopko, V., "Discussion of the Standard Practice for the Location of Wet Insulation in Roofing Systems Using Infrared Imaging (ASTM C1153-90)," SPIE Thermosense XIII Conference (April 1991) pp. 83-89.

Sundberg, J., "Use of Thermogaphy to Register Air Temperature in Cross Sections of Rooms and to Visualize the Air Flow From Air Supply Diffusers," SPIE Thermosense XV Conference (April 1993) Paper 1933-08.

Stout, A., "IR Images and Environmental Sleuths," Photonics Spectra (December 1991), p.117-120
Discusses Nancy Del Grande, at the Lawrence Livermore Laboratory, who is putting an AGEMA infrared systems Thermovision 880 infrared burst scanner to work to search for buried and covered, as well as exposed, objects that heat and cool at rates different from those of the surrounding soil. Uses include: mine detection, aquifers, nuclear testing size verification, building structures, buried archeological sites excavation.

Tobiasson, W., and A. Greatorex, "Use of an INfrared Scanner and a Nuclear Meter to Find Wet Insulation in a Ballasted Roof," SPIE Thermosense XV Conference (April 1993) Paper 1933-09.

Tomlingson, P.D., "Predictive Maintenance : Key to an Effective, Cost-Saving Maintenance Program," Complete Building Equipment Maintenance Desk Book, S.J. Fuchs (ed.) (Prentice Hall: Englewood, N.J.) 1982 pp. 39-65.

Tulloch, M., "IR IMaging Studies Solar Atmosphere," Photonics Spectra (September 1991) pp. 18.
A researcher at the Smithsonian Astrophysics Observatory recorded a solar eclipse in near-IR wavelengths to detime if the sun is encircled by rings of interplanetary dust or rocks, which would be left from the early stage of development of the solar system. The camera used was based on a 128x128 InSb focal plane array.

Tulloch, M., "Auroral Imaging to Aid Ionosphere Monitoring," Photonics Spectra (March 1992) p.18.
An integrated system of sensors- IR, UV, and visible, has been proposed for global space weather systems to detect occurances in the ionosphee and forecasts its fluctuations. This would help the oepration of communications, navigation, and radar systems tathd epend on conditions in the Earth's upper atmosphere.

Tulloch, M., "Photonic Technology Assists Oakland Firestorm Efforts," Photonics Spectra (December 1991) pp. 18-20.
During an Oakland fire on October 20, research aircraft from NASA AMes Research Center tracked the firestorm with infrared scanners and camers to provide maps of the fire region. These aerial images gave fire fighters the first high-resolution overview of the firelines, hot spots and smoldering areas about to reignite.

Vleek, J., "Nature of Video Images," First Workshops on Videography (19-20 May 1988) 5 pgs.
Focuses primarily on remote sensing aerial video, including IR, for forestly and land use applications.

Waggoner, J., "Optical Filters a Critical Part of Environmental Monitors," Photonics Spectra (July 1991) p. 18.
When an oil monitor is designed using an IR source, a 3.4 micron band pass filter and a detector, it is possible to easily measure concentrations as low as 1 ppm for oil. For a given absorbance signal, this simple debice is three times more sensitive than the FTIR spectrometer and ten times more sensitive than grating IR spectrometers.

Weil, G.J., "Detecting the Defects," Civil Engineering (September 1989) pp. 74-77.
Infrared thermography exposes minor structural problems before they become major catastrophes in areas such as highway pavement, sewers, bridgers, water lines. The result: lower repair costs.

Weil, G.J., "Nondestructive Remote Sensing of Buried Tanks," Unpublished
Details how infrared thermography was used during an environmental assessment of a 50 acre industrial plant site to locate buried industrial waste materials, such as underground storage tanks, and miscellaneous waste items as small as a 55 gallon drum.

Weil, G.J., "Nondestructive Remote Sensing of Hazardous Waste Sites," SPIE Thermosense XV Conference (April 1993) Paper 1933-31.
Describes EnTech Inc.'s combination Ground Penetrating Radar- IR Thermograpy technology, in use for detection of hazardous waste leaks & buried drums. Discusses the growing demand for such land surveys, and offers three case studies: a West Coast Air Force Base, a US Government testing laboratory, and a rehabilitated gasoline station.

Weil, G.J. and R.J. Graf, "Infrared Thermography-Based Pipeline Leak Detection Systems," SPIE Thermosense XIII Conference (April 1991) pp. 18-33.
Describe EnTech's technique, using GPR and IR. The technique has been used to test pipelines in chemical plants, water supply systems, steam lines, natural gas pipelines, and sewer systems. The paper details the development of a computerized system using GPR and IR, with several case studies.

Weil, G.J., "Non-Destructive Testing of Bridge, Highway, and Airport Pavements," Unpublished, 13 pgs.
Describes how GPR and IR techniques can, in conjunction, be used to inspect concrete structures rapidly and economically. Discusses in detail the requirements for an automated inspection systems, and explains with several case studies how the joint IR/GPR technique can fulfill the inspection needs.

Wiegand, C.L., D.E. Escobar, J.H. Everitt., "Comparison of Vegetation Indices from Aerial Video and Held-held

Radiometer Observations for Wheat and Corn," Proceedings of the Thirteenth Biennial Workshop on Color Aerial Photography and Videography in the Plant Sciences (6-9 May 1992) pp. 99-105.
Founds that the automatic gain control in video cameras can complicate multitemporal analyses of crop health, since the overflight video imagery was much more variable day-to-day than on-ground radiometric readings. Study recommends some ways it has or recommends dealing with this auto gain control variation.

Wilson, B.A. (ed), "Sensor Systems for Space Astrophysics in the 21st Century," Workshop Proceedings from NASA conference NASA-CR-189449 (August 1, 1991) 80pgs.
This report was prepared by one of the three Integrated Technology Planning workshops initiated in 1989 by the Astrophysics Division of the Office of Space Science and APplication within NASA. Its objectives were to develop an understanding of future missions requirements for electromagnetic radiation sensor systems, and to recommend a comprehensive development program to achieve the required capabilities. There is discussion of the passive IR sensors required for space in the years ahead.

(ix) Applications of IR Sensitive Materials in Surveillance

Aikens, D.M., "Airborne Infrared and Visible Sensors Used for Law Enforcement and Drug Interdiction," SPIE Conference on Surveillance Technologies (April 1991) pp. 435-44.
Discusses some of the applications of visible and IR sensors in law enforcement and the issues peculiar to their use in that community. Sensor technology which are both currently available and forthcoming are described.

Berardomos. L.A., "No Place to Hide: The Ability to FIght at Night May have Been the Deciding Factor in the GUlf War and in Panama, but the Equipment That Makes it Possible is Still Getting Better," Machine Design (October 24, 1991) pp. 57-61.

Blackwell, J.D., "High Performance InSb 256x256 Infrared Camera," SPIE Conference on Surveillance (Apri 1991) pp. 324-334.
More a discussion of the camer's potential than a direct relation to the needs of surveillance applications.

Bruder, J.A., et. al., "Detection of Contraband Brought into the United States by Aircraft and other Transportation Methods: A Changing Problem," SPIE Conference on Surveillance (April 1991) pp. 316-323.
Executives at US Customs Service discuss the latest in counter-detection methods used by smugglers, and other innovative ways to avoid detection of their contraband. Intended to facilitate thinking on technologies to counter such attempts at avoidance.

Byrd, V., "Helping Police See in the Dark," New York Times (September 27, 1992) pp. K9.
Discusses NYC police use of night vision goggles to approach locales where they don't want to use a flightlight.

Cantell, M.J., " Infrared CCD Sensor for Surveillance," SPIE Conference on Surveillance Technologies and Imaging Components (April 1993) 12 pgs.

"Coast Guard Uses Hu-25 FLIR, Radar to Detect Smugglers," Aviation Week & Space Technology (January 30, 1989) pp. 42-43.
Westinghouse F-16 radar and FLIR systems have provided Coast Guard Hy-25 Falcons with the dya-night capability they need to be a more effective combat air patrol for aerial drug interdiction. Whereas radar picks up the faraway signals of suspicious planes, infrared detectors allow pursuers to sneak up without giving away their location.

Creel, R., "Airborne Law Enforcement Association: 1992 National Database Summary," Airborne Law Enforcement Association (August 1, 1992) 6 pgs.
Survey of which photonic equipment was used by the ALEA's airborne members, which were most helpful, how much money in contraband was confiscated using that equipment, how many criminals arrested with the help of that equipment, etc.

Cullen, R.M., "Low-Cost Space Platforms for Detection and Tracking Technologies," SPIE Conference on Surveillance Technologies (April 1991) pp. 295-305.
Outlines possibilities of satellites, currently and soon to be deployed, in surveillance.

Del Grande, N.K., et. al., "Buried Object Remote Detection For Law Enforcement," SPIE Conference on Surveillance Technologies (April 1991) pp. 335-51.
Another application for the dual-use infared detector designed by researchers at the Lawrence Livermore National Labs. Their technology could be easily modified for drug interdiction and pollution control, for finding jungle canopies and covered containers used for contraband, and to depict buried waste containers, sludge migration pathways from faulty contrainers, and the juxtaposition of groundwater channels, if present, nearly. The dual bandIR technology could detect underground epicenters of smuggling and pollution.

Dial, O.E., "CCD Performance Model," SPIE Conference on Surveillance Technologies (April 1991) pp. 2-11.
Relates CCD technology to applications in surveillance.

Elerding, G.T., J.G. Thurnen, L.M. Woody, "Wedge Imaging Spectrometer: Application to Drug and Pollution Law Enforcement," SPIE Conference on Surveillance Technologies (April 1991) pp. 13 pgs.
Designers at Hughes Aircraft have invented the wedge imaging spectrometer which is compact and rugged, and suitable for use in drug interdiction and polluttion monitoring activities by detecting small quantities of gases remotely. Uses a focal plane array.

"EMS Pilots Disagree on Value of Night-Vision Goggles," Helicopter News (October 30, 1992) pp. 1,4.
Reports on the reactions of aeromedical pilots meeting at annual Air Medical Transport Conference in Salt Lake City, Utah, to night vision goggles. Older pilots who used earlier NVGs disliked the technology, and constituted the majority of attendees.

Frank, J., "Out of the Darkness," Security Management (August 1991) pp. 45-47.
Discusses how focal plane array-based surveillance cameras could revolutionize nighttime security.

"Gotcha, for Now," The Economist (March 11, 1989) pp. 32.
Since police can no longer count on radar to detect speeders, since almost 15 percent of drivers use radar detectors, their newest weapon is a speed detector that uses infrared lasers, which of course, cnannot be sensed by radar detectors. The system, however, does not use focal plane arrays. The article is included because several people had suspected that IR could be used to detect speeding vehicles.

Henderson, B.W., "Radar/Digital Adapting P-3 AEW Radar for Small Drug Interdiction Aircraft," Aviation Week & Space Technology (Feburary 24, 1992) pp. 128-29.
Radar/Digital Systems is developing a system that will allow drug enforcement officlas on small aircraft to combine radar and FLIRS on a single display. The system would make it easier for drug agents to track smugglers and force them to land.

Holton, W.C., "Tales From the Dark Side: Shedding New Light on Crime: Photonics Joint the Law Enforcement Arsenal," Photonics Spectra (December 1992) pp. 52-61.

Extensive coverage of photonics technologies applied to law enforcement and surveillance, especially focal plane array based cameras for drug interdiction and police use.

"IR, Optical Sensors Search Out Drug Labs" OE Reports (July 1992) 4.
This is an interview with Michael Calvert (a special agent with the California Department of Justice supervising a clandestine drug laboratory investigation team) and Nancy Del Grande (principal investigator for the FAA- sponsored Dual-Band IR Imaging for Aging Aircraft Inspection Project).

Johnson, C., "Police Tools of the 90's Are Highly Advanced, but Privacy Laws Lag," Wall Street Journal (November 12, 1990) pp. A1, 10.
Discusses upcoming police use of Unmanned Aerial Vehicles for surveillance, which have on-bard high resolution cameras, infrared detectors, and chemical sensors.

Kulp, T.J., et. al., "Application of Backscatter Absorption Gas Imaging to the Detection of Chemicals Related to Drug Production," SPIE Conference on Surveillance (April 1991) pp. 352-363.
A gas detection system originally designed by the Lawrence Livermore National Labs, and transfered to Laser Imaging Systems, could be used in the surveillance of suspected drug production sites.

Laband, S., "IR Imaging For Autonomous Pole-Mounted Surveillance," Photonics Spectra (January 1993) pp. 146.
Discusses Amber's new Radiance 1 surveillance camera which is lightweight, rugged, easy to install, etc., compared with older IR systems.

Lytle, David, "Night-Vision Devices Head for Civilian Market," Photonics Spectra (May 1991), pp. 68.
A brief article which explains that the Army's decision to declassify its uncooled thermal imaging sensor technology will encourage a slew of commercial spinoffs of its night vision: for police and fire department use, and for vision enhancers for nighttime drivers.

"Marines Respond to EMS Debate; Defend Night Vision Goggles," Helicopter News (March 19, 1993) pp. 8.
Two officers in the US Marine Helicopter Squadron One argue that the new night vision goggles can offer great potential in EMS missions. The FAA, however, remained steadfast in opposing NVGs, considering them unsafe for civilian operations.

Mataloni, R.J., "Application of Lighter-than-Air Platforms to Law Enforcement," SPIE Conference on Surveillance Technologies (April 1991) pp. 306-315.
Discusses possibilities for floating balloons and other platforms in aerial surveillance, including the use of IR detectors.

May, C., "New Devices May Stop More Bombs at the Gate," New York Times (December 25, 1988) pp. 11.
Pan Am World Airways flight that crashed in Scotland gave impetus to installation of new devices to stop bombs at airports, including TNA explosive detectors and infrared sensors.

McCauley, H., Auborn, J., "Image Enhancement of Infrared Uncooled Focal Plane Array Imagery," SPIE Conference on Surveillance Technologies (April 1991) pp. 416-422.
Proposes several low-cost algorithms to enhance uncooled FPA imagery.

Office of National Drug Control Policy, Counter-Drug Technology Assessment Center, Executive Office of the President, "Broad Agency Announcement BAA 92-15" 1992, 5 pgs.
Agency announcement for proposals from industry for technologies in four counter-drug areas: non-intrusive inspection, wide area surveillance, targeting of drug organizations, and demand reduction.

Robinson, C.A., "Arcane Science Sparkes in Drug Enforcement War: October Confab Showcases Array of Science to Stanch Contraband Flow," Signal (August 1992) pp. 21-27.
Preview of various innovative technolgies to be shown in October 1992 international meeting on contraband and cargo inspection. No discussion of IR technologies; they would not be helpful in this area.

Williams, R.H., "The US Customs Service Spearheads the Drug War," Signal (December 1990) pp. 52-54.
Overview of technologies used by US Coast Guard for drug interdiction. Includes list of equipment used, such as infrared cameras.

Yanagimoto, S. and Seiji Yamamoto, "Thermal Imagers for Security Systems," Mitsubishi Electronic Advances (June 1991) p.2-4.
Security systems are becoming common in an ever widening variety of fields, the environments in which they are set are becoming more diverse, and these conditions are feeding a growing demand for video-surveillance systems that can exhibit more powerful monitoring functions under lightless conditions. This article describes the basic functions of the IR-5120C, and describes how it can be used in the security field.

(x) Applications of IR Sensitive Materials in Transportation

Appleby, R., et. al., "High Performance Passive Millimeter-Wave Imaging," Optical Engineering (June 1993) pp. 1370-1373.
Discusses the current status of passive MMW radiometry as a thermal imaging technique, which is a technology competing with IR cameras for airplane enhanced vision systems. The major problems are poor spatial resolution and slow response time. Techniques for overcoming these difficulties are identified, including the use of aperture synthesis, multichannel receivers, correlation, and inverse transform techniques. A comparison is made with infrared imaging.

"Army Promotes Defense Technologies for US Automakers," Aerospace Daily (March 9, 1993) pp. 382.
The Army showed off a number of defense technologies, including virtual prototyping, infrared focal plane arrays, and obstacle avoidance, that it believes could meet the needs of the domestic auto industry. They presented at the Automotive Technology Exposition at the University of Michigan, by the invitation of the sponsor, the US Council for Automotive Research.

Commander, U.S. Army CECOM, "Request for Procurement for Driver's Vision Enhancer (Solicitation Number DAAB0793RK007)," 2 March 1993.

Dornheim, M.A., "MMW Radar Shows Commercial Utility," Aviation Week & Space Technology (November 2, 1992) pp. 55-59.
The joint FAA/Defense Department/industry synthetic vision systems technology program for EVS is leaning towards radar rather than IR technology because it produces better images.

Figueroa, L., et. al., "Photonics Technology for Aerospace Applications," Photonics Spectra (July 1991) pp. 117-124.
Introduces several sophisticated control and communications systems for future aircraft and space systems. Includes fly-by-wire flight control systems, fiberoptic position sensor technology, multiplexing technology, and fiber optic data buses.

Holusha, J., "Infrared Rays May Improve Night Driving," New York Times (October 28, 1987) pp. D8.
General Motors Corp. and US automotive industry predict use of infrared lights to greatly improve night vision by year 1990!

Hughes, D., "Affordable Systems to Drive Civil, Military Electronics," Aviation Week & Space Technology (September 7, 1992) pp. 87-90.
Illustrates how formerly military-only firms are moving into the commercial sector with the enhanced vision system. Contrasts milimeter-wave technology with infrared; discusses firms in alliances to meet anticipated EVS demand.

Judycki, D., Euler, G., "The Intelligent Vehicle-Highway Systems Program in the United States," U.S. Department of Transportation, Federal Highway Administration (Unpublished) 15 pgs.
A complete overview of the IVHS program, discussing all programs, funding sources and scenarios, the role of private industry, and plans for the future.

Nordwall, B.D, "HUD With IR System Extends Pilot Vision," Aviation Week & Space Technology (February 22, 1993) pp. 62-63.
Reports on research at the Maryland Advanced Development Laboratory on enhanced vision systems combining heads-up displays with IR imagers.

Scott, William B., "Hughes Testing Radar, IR Sensors to Aid Reduced-Visibility Landings," Aviation Week & Space Technology (May 6, 1991), pp.49-50.
Hughes' new Commercial Division is seeking to further develop an IR sensor prototype which will permit commercial aircraft to land autonomously in adverse weather conditions, when pilot vision is limited. This reflects Hughes' desire to move towards a 60/40 mixture of military/commercial business by the mid-90s. The division is a bellweather for Hughes because the commercial avionics equipment is a departure from the usual military market.

Shoemaker, C., "DoD Unmanned Ground Vehicle Program," IVHS America Third Annual Meeting (April 14-17, 1993) 12 pgs.

Shulman, M., "AVCS From the Automobile Companies' Perspective," IVHS America Third Annual Meeting (April 14-17 1993) 15 pgs.
Overview of automobile companies' desires and technological challenges regarding the advanced vehicular collision avoidance system, which is part of the IVHS plan. Mentions briefly IR technologies for aided vision.

Tulloch, M., "Intelligent Vehicle Highway System," Photonics Spectra (February 1992) p.18
Discusses Siemen Automotive's new IVHS technology, which will integrate IRFPAs for various systems for guidance, lane reading, collision avoidance, etc.

"Using Cameras to See a Foggy Road," New York Times (August 8, 1990) D7.
Engineers at BMW are working on a system using video and infrared cameras to improve automobile drivers' perception of the road under conditions of poor visibility.

Welch, S.S., Sensors and Sensor Systems for Guidance and Navigation, (SPIE: WA) April 1992.
The recent growth of the number of applications for sensors in guidance and navigation has spawned a rapid development of technology. This proceedings presents the latest developments in sensor technology and applkcations. Papers discuss design, integration, characyterization, materials, and sources for sensors operating in the IR, millimeter, radar and acoustic regimes. Several papers report innovative technology, emphasizing new materials and novel approaches to sensing, miniaturization, new sources, and signall processing.

Yazigi, M.P., "Promethean Plans for the Next Generation of Cars," New York Times (September 13, 1992) pp. E14.

A European project called Prometheus, which stands for Program for European Traffic of Highest Efficiency and Unprecedented Safety, is said to be perhaps the largest effort currently undertaken to equip automobiles with such devices as radar, lasers, and infrared cameras that are intended to enhance traffic safety. Some of the technology being put to use in the Prometheus project is discussed.

Appendix D
Private Organizations Carrying out Research on Applications of Infrared Materials Database

Organization:	Acme-Ceveland Corporation
Component:	Namco Controls Division
Address:	7567 Tyler Blvd. Mentor, OH 44060
Contact:	Jon Slaybaugh
Position:	General Manager
Notes:	Product oriented R&D of electronic measurement and control devices including photoelectric sensors, laser guidance, identification and tracking devices.

Organization:	Adcole Corporation
Component:	
Address:	669 forest St. Marlborough, MA 01752
Contact:	AD Cole
Position:	President
Notes:	Research on sun sensing systems, scientific instruments for rockets and satellites, linear and radial electro-optical measuring techniques, computer controlled cylindrical coordinate gauging equipment.

Organization:	Advanced Design Corporation
Component:	
Address:	8560 Cinderbed Rd Newington, VA 22122
Contact:	Michael Coleman
Position:	Direng
Notes:	Product oriented electro-optics; night vision devices both image intensification and thermal imaging.

Organization:	Advanced Kinetics
Component:	
Address:	Unit 108, 18281 Gothard St. Huntington Beach, CA 92648
Contact:	Ronald Huynh
Position:	Pres
Notes:	Research in laser physics and applications, including IR sources (black bodies).

Organization:	Advanced Technology Materials
Component:	
Address:	520-B Danbury Road New Milford, CT 06776
Contact:	Glenn Tom
Position:	VPres Research
Notes:	Recently awarded an SDIO contract to develop a new electronic thin-film material to improve IR detector technology. The company will focus on using barium strontium titanate to develop new sensors capable of operating at room temperature.

Organization:	Advanced Technology Materials
Component:	Semiconductor Products Department
Address:	7 Commerce Drive Danbury, CT 06810
Contact:	C.P. Beetz, Jr.
Position:	Mr.
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Buffer Layers for Deposition of Supercondcuting YBaCuO Thin Film on Polycrystalline Diamond"

Organization:	AEG
Component:	
Address:	D-7100 Heilbronn GERMANY
Contact:	H. Maier
Position:	
Notes:	Co-authored for 1991 MCT Workshop "Influence of Resonant Defect States on Subband Structures in HgCdTe"

Organization:	AEG
Component:	
Address:	D-7100 Heilbronn GERMANY
Contact:	H. Maier
Position:	
Notes:	Co-authored for 1991 MCT Workshop "Influence of Resonant Defect States on Subband Structures in HgCdTe"

Organization:	Aerodyne Research, Inc,
Component:	
Address:	45 Manning Rd. Billerica, MA 01821-3976
Contact:	Roger Putnam
Position:	Director of Marketing
Notes:	Basic and applied product-oriented research in electro-optical and photo-optical systems, combustions, atmospheric, and environmental science; molecular physics; laser development; spectroscopy; product surface chemistry; optical signal processing; optical computing.

Organization:	Aerojet Corp.
Component:	Electronic Systems Division
Address:	Azuza, CA
Contact:	H. Vydyanath
Position:	Mr.
Notes:	Co-authored for 1992 MCT Workshop "Photo-Induced Excess Low Frequency Noise in HgCdTe Photodiodes"

Organization:	Affiliated Manufacturers, Inc. (AMI)
Component:	
Address:	PO Box 5049 North Branch, NJ 08876
Contact:	B Austin
Position:	CEO
Notes:	Process and manufacturing considerations of the microelectronics manufacturing industry; innovative manufacturing processes; thick film hybrid circuits.

Organization:	Agema Infrared Systems
Component:	
Address:	550 County Avenue. Secaucus, N.J. 07094
Contact:	Philip Smith
Position:	President
Notes:	Manufactures infrared thermal imaging systems for condition monitoring, process monitoring and control, military/ defense research, surveillance and the nondestructive meeasurement and analysis of materials and components.

Organization:	Agema IR Systems
Component:	
Address:	550 County Avenue Secaucus, NJ 07094
Contact:	Jay Levy
Position:	Communications Director
Notes:	

Organization:	AGR International, Inc.
Component:	
Address:	PO Box 149 Butler, PA 16003-0149
Contact:	John Wasylyk
Position:	Director of Research
Notes:	Development of optical inspection techniques for process control in glass container manufacturing.

Organization:	AIL Systems, Inc.
Component:	
Address:	Commack Road Deer Park, NY 11729
Contact:	Harvey N. Kreisberg
Position:	Director Corporate Development
Notes:	Manufactures Infrared systems & equipment, alongside RF & Microwave and other passive and active systems

Organization:	Air Products and Chemicals, Inc.
Component:	Gas Group
Address:	7201 Hamilton Blvd Allentown, PA 18195-1501
Contact:	Brian Rushton
Position:	VP R&D
Notes:	Applications R&D for infrared spectroscopy.

Organization:	Alabama University in Huntsville
Component:	
Address:	Huntsville, AL
Contact:	
Position:	
Notes:	Authored "Focal Plane Array Testing Support" in January 1992, 55 pages. No author given. Founded in 1985, the center has programs in nonlinear optics, crystal growth, high Tc superconducting infrared detectors, and optical design. Adjacent to the NASA Marshall Flight Center, US Army Missile Command, and US Army Strategic Defense Command.

Organization:	Alcan Aluminum Limited
Component:	ManLabs
Address:	21 Erie St. Cambridge, MA 02139
Contact:	David Morton
Position:	CEO
Notes:	Basic applied and product oriented research in metals, alloys, ceramics, and electro-optical materials.

Organization:	Alcatel Bell-SDT S.A.
Component:	
Address:	101, rue Chapelle Beaussart 6032 Mont-Sur-Marchienne BELGIUM
Contact:	J.P. Rasquin
Position:	Directeur Departement de Defense
Notes:	Infrared Systems and Equipment

Organization:	Allen Infrared Associates
Component:	
Address:	RR #1, Box 239K Coward, SC 29530
Contact:	Lee Allen
Position:	Mr.
Notes:	active in infrared predictive maintenance

Organization:	Alliant Techsystems
Component:	
Address:	5901 Lincoln Drive Edina, MN 55436
Contact:	Cathy Rude
Position:	Marketing Communications
Notes:	Thermal Imaging, Night vision, detectors and sensors

Organization:	AlliedSignal Aerospace
Component:	
Address:	2525 W. 190th Street Torrance, CA 90504
Contact:	John V. Alexander
Position:	Public Relations
Notes:	Thermal IMaging, detectors and sensors,

Organization:	Alpha Omega Instruments Corp
Component:	
Address:	253 Mansfield Drive, P.O. Box DE Norton, MA 02766
Contact:	RIchard Buonauito
Position:	Mr.
Notes:	Has developed an approach to manufacturing a low cost, two-dimensional array uing lead selenide or other resistive type detectors, with a targeted manufacturing cost of under $500 in quantitities

Organization:	Alturdyne
Component:	
Address:	8050 Armour San Diego, CA 92111
Contact:	Frank Verbeke
Position:	President
Notes:	Infrared systems and equipment

Organization:	Amber Engineering
Component:	
Address:	5756 Stonewood Drive Goleta, CA 93117
Contact:	Stan Laband
Position:	Marketing Director
Notes:	Participant in DARPA's IRFPA team and producer of InSb used in medium-wave infrared systems.

Organization:	American Electronic Laboratories, Inc.
Component:	
Address:	305 Richardson Rd., PO Box 552 Landsdale, PA 19446
Contact:	Dr Leon Reibman
Position:	CEO
Notes:	Diversivied R&D and manufacturing organization specializing in state-of-the-art equipment for military and industrial applications, electronic warfare and electronic warfare support measure systems, radar and fire control, antennas, supplies, technical service, system engineering services and manufacturing services.

Organization:	American Interplex Corporation Laboratories
Component:	
Address:	8600 Kanis Rd. Little Rock, AR 72204
Contact:	Asa Morton
Position:	Pres
Notes:	R&D on thermal properties of various metals and metal coatings; research in infrared spectroscopy and monitoring using infrared technologies.

Organization:	American Magnetics Inc
Component:	
Address:	PO Box 2509 Oak Ridge, TN 37831-2509
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	American Risk Management Corp.
Component:	
Address:	4807 Rockside Road, Ste 500 Cleveland, OH 44131
Contact:	Ronald Lucier
Position:	Mr.
Notes:	infrared non-destructive evaluation

Organization:	American Telephone and Telegraph
Component:	AT&T Bell Labs
Address:	600 Mountain Ave. Murray Hill, NJ 07974
Contact:	Robert Allen
Position:	CEO
Notes:	Wide range of research in electronics, focusing on emerging technologies including opto-electronics.

Organization:	Amherst Systems, Inc.
Component:	
Address:	30 Wilson Road Buffalo, NY 14221
Contact:	Robert L. Cockrell
Position:	Director, Business Development
Notes:	Passive and Active electro-optical systems, infrared systems & equipment

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Organization:	AMOCO Corporation
Component:	Solarex Corp
Address:	1335 Piccard Dr. Rockville, MD 20850
Contact:	John Wohlgemuth
Position:	Head of R & D
Notes:	Applied R&D including photovoltaic devices and power systems.

Organization:	Amorphous Materials Inc.
Component:	
Address:	3130 Benton Street Garland, TX 75042
Contact:	A. Ray Hilton
Position:	President
Notes:	Infrared materials production of CdTe, GaAs, and silicon.

Organization:	AMP Incorporated
Component:	AMP Technology, Electro-optics Division
Address:	PO Box 3608 Harrisburg, PA 17105-3608
Contact:	J Hassan
Position:	Vice President for Technology
Notes:	Applied and product-oriented research and development on fiber optic, electro-optic, passive, and interconnection devices.

Organization:	Amteck
Component:	
Address:	Paoli, CA
Contact:	
Position:	
Notes:	Development of CdTe arrays for solar applications.

Organization:	Anacon Corp.
Component:	
Address:	117 S St. Hopkinton, MA 01748
Contact:	Theodore Prophet
Position:	Gmgr
Notes:	Applied research on refractometers; chlorine monitors; stack gas monitors; ultra-violet and infrared analyzer.

Organization:	Andersen Group
Component:	
Address:	1280 Blue Hills Ave. Bloomfield, CT 06002
Contact:	Francis Baker
Position:	CEO
Notes:	Research and development in photonics, telecommunications and high tech industries.

Organization:	Andersen Instruments, Inc.
Component:	Nutech Corporation
Address:	2806 Cheek Rd Durham, NC 27704
Contact:	Reggie Stroupe
Position:	Pres
Notes:	Applied and product-oriented research in the areas of air pollution sampling, filter systems, electronic sensors and controls, temperature control, chromatography, and laboratory research instruments, medical electronics and mass spectrometry.

Organization:	Andorian Cyrogenics Inc
Component:	
Address:	26 Farwell Street Newtonville, MA 02160
Contact:	
Position:	
Notes:	cyrogenics equipment

Organization:	Angstrom Technologies, Inc.
Component:	
Address:	PO Box 607 Florence, KY 41042
Contact:	Keith Seybald
Position:	Melec
Notes:	Basic and applied electro-optical vision for robotics and automated guided vehicles; applied and product-oriented research in packaging and material handling vision systems.

Organization:	Applied Electron Corp.
Component:	
Address:	2360 Owen Street Santa Clara, CA 95054
Contact:	Francis Ziemba
Position:	VP
Notes:	Product-oriented research in the field of radiation detection, both nuclear and optical, including alpha, gamma, x-ray and radon detection, also near IR to visible optical radiation detection.

Organization:	Applied Materials, Inc.
Component:	
Address:	3050 Bowers Ave. Santa Clara, CA 95054
Contact:	James Morgan
Position:	President
Notes:	Research on chemical vapor deposition and plasma etching processes materials and equipment, with particular emphasis on semiconductor materials, metals and dielectrics for the electronics industry, ion implantation of dopauts into silicon and process control equipment.

Organization:	Applied Solar Energy corporation
Component:	
Address:	15251 E Don Julian Rd. City of Industry, CA 91749
Contact:	Gerard McLarhon
Position:	CEO
Notes:	Product oriented R&D of solar laser detector products.

Organization:	Arco Solar Inc
Component:	
Address:	4650 Adohr Ln., PO Box 6032 Camarillo, CA 93010
Contact:	Charles Gay
Position:	Pres
Notes:	Advanced and applied research and development of photovotaic devices and systems. Production continues of square foot panels with Commer Indium Diselenide (CIS) coated with Cadmium Sulfide. CIS is increasingly viewed as the most promising material for solar power.

Organization:	Aritech
Component:	Aritech Corporation
Address:	1510 Tate Blvd., SE Hickory, NC 28603
Contact:	David Miller
Position:	Gmgr
Notes:	Sensor detector and alarm system equipment.

Organization:	Arizona State University
Component:	
Address:	
Contact:	M.C. Shaw
Position:	
Notes:	Co-authored 1983 "Application of Infrared Radiation Measurements in Grinding Studies"

Organization:	Arvin Industries, Inc
Component:	Franklin Research Center
Address:	2600 Monroe Blvd. Norristown, PA 19403
Contact:	Charles Stokes
Position:	Dir
Notes:	Applied research, design, and development in electronic and electrical engineering, including electro-optics.

Organization:	Astronautics Corporation of America
Component:	
Address:	4115 N. Teutonia Milwaukee, WI 53209
Contact:	P.D. Zingen
Position:	Marketing Coordinator
Notes:	Night vision, robotics, security systems, ASW equipment, infrared systems & equipment

Organization:	AT&T Bell Laboratories
Component:	
Address:	Murray Hill, NJ 07974
Contact:	B.F. Levine
Position:	Mr.
Notes:	

Organization:	ATD, Inc.
Component:	Advanced Technology Division
Address:	PO Box 566 Woodinville, WA 90872
Contact:	Kenneth Kaylor
Position:	COO
Notes:	Applied R&D of video instrument systems including high-speed, IR microscopic and related research.

Organization:	Atlantic Research Canada, Inc.
Component:	
Address:	1900 City Park Drive, Suite 400 Gloucester, Ontario CANADA K1J 1A3
Contact:	Tony Canning
Position:	Mr.
Notes:	Thermal Imaging

Organization:	Atomergic Chemetals Corporation
Component:	
Address:	222 Sherwood Avenue Farmingdale, NY 11735
Contact:	M. Hollander
Position:	National Sales Manager
Notes:	Material processing of CdTe, GaAs, Germanium, Silicon, ZnS, and ZnSe.

Organization:	Auburn University
Component:	
Address:	
Contact:	P. Banerjee
Position:	
Notes:	Co-authored 1991 "Weld Quailty Control in Gas Tungsten Arc Welding Process"

Organization:	Auburn University
Component:	Materials Engineering Dept
Address:	201 Ross Hall Auburn, AL 36849-5351
Contact:	Brian Chin
Position:	
Notes:	active in infrared process control

Organization:	Aurora Technoligies Corp.
Component:	
Address:	San Diego, CA 92121-2410
Contact:	F.P. Doty
Position:	Mr.
Notes:	Co-authored for 1991 MCT Workshop "Properties of CdZnTe Crystals Grown by a High Pressure Bridgman Method"

Organization:	Automatic Switch Co
Component:	
Address:	50-60 Hanover Road Florham Park, NJ 07932
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	AUTOMETRIC, INC.
Component:	
Address:	5301 SHAWNEE ROAD ALEXANDRIA, VA 22312
Contact:	DAVID K. GORDON
Position:	MR.
Notes:	ACTIVE IN INFRARED REMOTE SENSING

Organization:	Avimo USA, Inc.
Component:	
Address:	716 S Milwaukee Ave. Wheeling, IL 91702
Contact:	Brad Doetzel
Position:	CEO
Notes:	Product oriented research in night vision optics and custom optical components, used mainly by the military.

Organization:	Baird Infrared Technology, Inc.
Component:	
Address:	110 South Poplar Street #310 Wilmington, DE 19801-5046
Contact:	George S. Baird
Position:	Mr.
Notes:	active in infrared predictive maintenance

Organization:	Baker Hughes, Inc.
Component:	TN Technology, Inc.
Address:	PO Box 800, Round Rock TX 78680-0800
Contact:	Dr John Nelson
Position:	VP
Notes:	Applied R&D of radiation detectors and sources, acoustical transducers, and measurements and data processing methodolgy directed toward the development of instrumentation for the measurement of industrial process parameters.

Organization:	Ball Electro-Optics and Cryogenics Div.
Component:	
Address:	P.O. Box 1062 Boulder, CO 80306
Contact:	Terry Fleener
Position:	Manager, Business Development
Notes:	Thermal Imaging, Active and Passive EO systems

Organization:	BASF Corporation
Component:	Coatings Technical Center
Address:	26701 Telegraph Southfield, MI 48034
Contact:	A.C. Ramamurphy
Position:	
Notes:	infrared non-destructive evaluation

Organization:	Batelle Memorial Institute
Component:	Electronic Systems
Address:	505 King Ave. Columbus, OH 43201
Contact:	James Sorenson
Position:	General Manager
Notes:	Advanced development and integration of complex electronic and optical systems; development of large laser materials for interaction studies; automated inspection systems and optical systems for tracking reentry vehicles.

Organization:	Bath Electrical Systems
Component:	
Address:	5009 N Hwy 288 B, PO Box 198 Clute, TX 77531
Contact:	Thomas Soderman
Position:	Pres
Notes:	Design and development of systems for infrared scanning for energy losses problems.

Organization:	Battelle Memorial Institute
Component:	
Address:	505 King Avenue Columbus, OH 43201-2693
Contact:	Milton Seiler
Position:	Mr.
Notes:	infrared non-destructive evaluation

Organization:	BDM Federal, Inc.
Component:	
Address:	1501 BDM Way McLean, VA 22102-3204
Contact:	Duncan Campbell
Position:	Corp. V.P.
Notes:	Thermal Imaging, imaging software

Organization:	BEI Electronics Company, Inc.
Component:	BEI Defense Systems Company, Inc.
Address:	11312 S Pipeline Rd., PO Box 155429 Fort Worth, TX 76155
Contact:	Michael Florimbi
Position:	CEO
Notes:	Product-oriented research, development, testing and evaluation on photoelectric shaft position encoders.

Organization:	Belov Technology Co. Inc.
Component:	
Address:	345 Sandford Street New Brunswick, NJ 07891
Contact:	Valery Belov
Position:	President
Notes:	Manufactures MCT, DTGS, TGS pyroelectric detectors and detector electronic systems, and multi-element arrays. MCT room temperatuer detectors. Related components.

Organization:	Bertram Laboratories, Inc.
Component:	
Address:	72 Readington Road Somerville, NJ 08876
Contact:	Leslie G. Polgar
Position:	Vice President
Notes:	

Organization:	Bethlehem Steel Corporation
Component:	Homer Research Laboratories
Address:	Bethlehem, PA 18016
Contact:	Dr. Malcom Roberts
Position:	Dirres
Notes:	Investigation on new methods of measurement and instrumentation used in the control of steel processes and product quality.

Organization:	BHP Research
Component:	Melbourne Laboratories
Address:	P.O. Box 264 Clayton, 3168, AUSTRALIA
Contact:	H. Buskes
Position:	Mr.
Notes:	Co-authored for 1992 MCT Workshop "In-Sity Ellipsometric Measurements of the MBE Growht of CdTe/HgTe and CdTe/ZnTe Superlattices"

Organization:	Bio-Rad Laboratories
Component:	Sadtler Research Laboratories
Address:	3316 Spring Garden St. Philidelphia, PA 19104
Contact:	Richard Shaps
Position:	Dvmgr
Notes:	Raman and infrared spectroscopy.

Organization:	BMA Inc
Component:	
Address:	PO Box 562 31 Willows Road Ayer, MA 01432
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	Bobbit Laboratories
Component:	Viggo-Spectramed
Address:	1900 Williams Dr. Oxnard, CA 93030
Contact:	Michael Magers
Position:	Dirtc
Notes:	Instrumentation and precise measurement using advanced systems, including infrared sensors.

Organization:	Boston Electronics Corp.
Component:	
Address:	72 Kent Street Brookline, MA 02146
Contact:	
Position:	
Notes:	Manufacture and use of germanium and silicon.

Organization:	Brimrose Corporation of America
Component:	
Address:	5020 Campbell Blvd Baltimore, MD 21236
Contact:	John Kasprazak
Position:	Marketing Director
Notes:	

Organization:	Brooklyn College
Component:	Semiconductor Institute
Address:	Brooklyn, NY
Contact:	Fred H. Pollak
Position:	Dr.
Notes:	Former director of the SPIE

Organization:	Brown Group, Inc.
Component:	Research and Development Laboratory
Address:	8400 Maryland Ave. Saint Louis, MO 63166
Contact:	Lloyd Brunkhorst
Position:	VPeng
Notes:	Basic research for new manufacturing processes.

Organization:	Brown University
Component:	
Address:	Providence, RI
Contact:	Donald E. McClure
Position:	
Notes:	AUthored "Image Acquisition and Processing Equpipment for Machine Vision" September 1990

Organization:	Brunson Instrument Co, Inc
Component:	
Address:	800 E 23rd PO Box 7951 Kansas City, MO 64129
Contact:	Gary Powell
Position:	Dreng
Notes:	Research, design, and development in the optical mechanical and electro-optical field, circular and linear developing.

Organization:	Brunswick Technical Group
Component:	
Address:	1 Brunswick Plaza Skokie, IL 60077
Contact:	Diane R. Sheerar
Position:	Manager Marketing Services
Notes:	Infrared Systems and Equipment

Organization:	BSA Technology, Inc.
Component:	
Address:	3812 Sepulvida Blvd, Ste 500 Torrance, CA 90505
Contact:	
Position:	
Notes:	

Organization:	Buck Werke GMBH & Co.
Component:	
Address:	Hans-Buck-Strasse 1 D-7844 Neuenburg, GERMANY 07631
Contact:	Walter Hanser
Position:	Marketing Director
Notes:	Services, Infrared Systems and Equipment

Organization:	Burleigh Instruments, Inc
Component:	
Address:	Burleigh Park Fishers, NY 14453-9999
Contact:	
Position:	
Notes:	

Organization:	Burleigh Instruments, Inc.
Component:	
Address:	Burleigh Park Fishers, NY 14453
Contact:	Ronald Autos
Position:	drR&D
Notes:	Product oriented research in lasers, optical equipment, and micropositioning equipment.

Organization:	California Institute of Technology
Component:	
Address:	CA
Contact:	R.W. Capps
Position:	
Notes:	Co-authored for 1990 IEEE Meeting on Advanced IR Detectors "Space Science APplications of Infrared Detector Technology: A Review"

Organization:	California Institute of Technology
Component:	Jet Propulsion Laboratory
Address:	Pasadena, CA 91109
Contact:	Anthony C. Ibbott
Position:	Mr.
Notes:	active in infrared remote sensing

Organization:	California Institute of Technology
Component:	Jet Propulsion Laboratory
Address:	4800 Oak Grove Drive Pasadena, CA 91009-8099
Contact:	Marija S. Scholl
Position:	
Notes:	Editor of upcoming January 1994 edition of the SPIE's Optical Engineering journal, focusing on infrared technology.

Organization:	Cambridge University
Component:	Cavendish Lab
Address:	Cambridge, UNITED KINGDOM
Contact:	T.D. Golding
Position:	
Notes:	Co-authored October 1988 "MBE of HgCdTe"

Organization:	Carl Zeiss
Component:	
Address:	Sondertechnik Postfach 1380 7082 Oberkochen, GERMANY
Contact:	Peter Albers
Position:	Sales Manager
Notes:	Thermal Imaging, Detectors and Sensors, Night Vision

Organization:	Carnegie-Mellon University
Component:	Robotics Institute
Address:	Pittsburgh, PA
Contact:	C. Caillas
Position:	
Notes:	Authored an APril 1990 study, 100 pages, on "Thermal Imaging for Robotic Applications in Outdoor Scenes"

Organization:	CEI Technologies, PTE Ltd.
Component:	
Address:	249 Jalan Boon Lay Singapore 2261
Contact:	Toh Kim-Huat
Position:	V.P./ General Manager
Notes:	Thermal imaging, night vision

Organization:	Cerac Inc.
Component:	
Address:	Milwaukee, WI
Contact:	
Position:	
Notes:	Manufacturer of infrared materials.

Organization:	Channel Technologies
Component:	Electro-optical Industries, Inc.
Address:	859 Ward Dr. Santa Barbara, CA 93111
Contact:	Arthur Cussen
Position:	Pres
Notes:	Research on infrared and visible blackbody radiant energy standards, radiometry, electro-optical instrumentation, microwave standards, low-level instrumentation, industrial temperature measurement, and radiation thermometry.

Organization:	Chemring, Ltd.
Component:	
Address:	Alchem Works Fratton Trading Estate Portsmouth, Hampshire, ENGLAND PO4 8SX
Contact:	David Radford
Position:	Marketing Director
Notes:	Infrared Systems & Equipment, passive EO systems

Organization:	CIC International, Ltd.
Component:	
Address:	38-01 23rd Avenue Astoria, NY 11105
Contact:	James Chladek
Position:	Vice President
Notes:	Detectors and Sensors, infrared systems and equipment, night vision equipment

Organization:	Cincinatti Electronics
Component:	
Address:	7500 Innovation Way Mason, OH 45040-9699
Contact:	Tom Venable
Position:	Marketing Manager for IR Detectors
Notes:	Manufactures and designs IR detectors including single-element, linear and two dimensional arrays, discrete channel amplified, multiplexed, in Ge, MCT, InSb and InAs, 1-12 um.

Organization:	Claflin College
Component:	Department of Mathematics and Physics
Address:	Orangeburg, South Carolina 29115
Contact:	Sylvester N. Ekpenuma
Position:	
Notes:	Co-authored for 1991 MCT Workshop "Critical Stress of HgCdTe Solid Solutions" and "Microhardness of Hg-Containing II-Vi Alloys"

Organization:	Clarkson University
Component:	
Address:	Potsdam, NY 13699
Contact:	Frederick M. Carlson
Position:	Mr.
Notes:	Attended 1992 MCT conference

Organization:	Cleveland Crystals, Inc.
Component:	
Address:	19306 Redwood Avenue, P.O Box 17157 Cleveland, OH 44117
Contact:	Peter Direnzo
Position:	Gnl Mgr
Notes:	Manufacturer and research into CdTe, ZnS, and ZnSe infrared materials.

Organization:	CMTEK Pty, Ltd
Component:	
Address:	P.O. Box 1500 Salisbury 5108, South Australia
Contact:	M.A. Folkard
Position:	Mr.
Notes:	Co-authored for 1992 MCT Workshop "In-Situ Ellipsometric Measurements of the MBE Growth of CdTe/HgTe and CdTe/ZnTe Superlattices"

Organization:	CNRS
Component:	Laboratiore de Physique des SOlides de Bellevue
Address:	F-92195 Meudon-Cedex, FRANCE
Contact:	Y. Marfaing
Position:	
Notes:	Authored for 1991 MCT Workshop "Point Defects and Defect-Purity Interaction of CdHgTe and Other II-Vi Semiconductors: Facts and Conjectures."

Organization:	Cochise Instruments Inc
Component:	
Address:	6304 De Mello Street Hereford, AZ 85615
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	Codenoll Technology Corporation
Component:	
Address:	Yonkers, NY
Contact:	
Position:	
Notes:	Development of InP sensors for use in optical transmitters and receivers in cooperation with NYNEX.

Organization:	College of William and Mary
Component:	Dept of Physics
Address:	Williamsburg, VA 23185
Contact:	Christopher S. Welch
Position:	Mr.
Notes:	infrared non-destructive evaluation

Organization:	Colorado Research Lab
Component:	
Address:	Walsenburg, CO
Contact:	Maruice J. Brau
Position:	
Notes:	Authored January 1991 report "Ultra-high-purity Starting Materials for Infrared Detector Crystal Growth" and January 1991 "Traveling Heater Method Growth of Bulk Compound Semiconductor Alloy Crystals"

Organization.	Columbia University
Component:	
Address:	New York, NY
Contact:	E.R. Fossum
Position:	
Notes:	Co-authored for 1990 SPIE workshop on IR Detectors "GaAs CCD Readout for Engineered Bandgap Detectors"

Organization:	Commerical Crystal Laboratories, Inc.
Component:	
Address:	4406 Arnold Avenue Naples, FL 33942
Contact:	
Position:	
Notes:	Manufacturer of CdTe, GaAs, silicon, ZnS, and ZnSe.

Organization:	Commonwealth Scientific Corp
Component:	
Address:	500 Pendleton Street Alexandria, VA 22314
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	Compaq Computer
Component:	
Address:	
Contact:	Greg Haug
Position:	Mr.
Notes:	

Organization:	Computing Devices Co.
Component:	
Address:	Castleham Road St. Leonards on Sea East Sussex, UK TN389NJ
Contact:	Mike Turley
Position:	Marketing Director
Notes:	Infrared systems and Equipment

Organization:	Concept Engineering
Component:	
Address:	43 Ragged Rock Rd. Old Saybrook, CT 06475
Contact:	Ludwig Holtermann
Position:	owner
Notes:	IR-technology sensor and detector development.

Organization:	Continental Optical Corp.
Component:	
Address:	15 Power Drive Hauppauge, NY 11788
Contact:	Manfred W. Grindel
Position:	President
Notes:	Manufacturer of silicon, ZnS, and ZnSe infrared materials.

Organization:	Contraves USA
Component:	Boston Electro Optic Division
Address:	170 Locke Dr. Marlborough, MA 01752
Contact:	Max Riedl
Position:	CEO
Notes:	Applied researach on electrical-optical systems, instruments and components utilizing infrared, visible and ultraviolet spectrums, including infrared detectors, optical elements, and optical interference and coatings filters, radiation sources, radiometers, combustion analyzers, navigation instruments for satellites and spacecraft and sensors for meteorological satellites; chemical and drug detection, instrumentation, target and scene simulation, models, gas detection, measurement insstrumentation.

Organization:	Cornell University
Component:	School of Electrical Engineering and the National Nanofabrication Facility
Address:	Ithaca, NY 14853
Contact:	Y. Shacham-Diamand
Position:	
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "P-Channel MIS Double-Metal Process InSb Monolithic Unit Cell for Infrared Imaging"

Organization:	Cox & Company, Inc.
Component:	
Address:	200 Varick St. New York, NY 10014
Contact:	Warren Achenbaum
Position:	Pres
Notes:	Electronic and mechanical engineering, aerodynamics, thermal engineering.

Organization:	Crane Co
Component:	Hydro-Aire Division
Address:	3000 Winona Ave. Burbank, CA 91504
Contact:	JD Tarbet
Position:	VPeng
Notes:	Infrared tracking for wind shear detection and high response control synthesis for extra fast control systems.

Organization:	Craver & Craver Inc
Component:	
Address:	761 W Kirkham Ave. Saint Louis, MO 63122
Contact:	Dr Clara Craver
Position:	COO
Notes:	Computer-assisted database searches in infrared spectroscopy; reference spectra for IR.

Organization:	Cray Research
Component:	
Address:	925 First Avenue Chippewa Falls, WI 54729-1402
Contact:	Christine Anderson
Position:	Ms.
Notes:	active in infrared process control

Organization:	Crystal Specialties International
Component:	
Address:	2853 Janitall Road Colorado Springs, CO 80906
Contact:	Kelly Burke
Position:	Operations Manager
Notes:	Production of GaAs and germanium for infrared applications.

Organization:	Crystal Systems Inc.
Component:	
Address:	Shetland Industrial Park 27 Congress St. Salem, MA 01970
Contact:	Frederick Schmid
Position:	CEO
Notes:	Growth of semiconductors using such materials as GaAs and CdTe, and use of silicon in infrared applications

Organization:	CVS Systems & Services, Inc,
Component:	CVD Systems & Services
Address:	Penn Centre Plaza Quakertown, PA 18951
Contact:	Warner Whitmer
Position:	Pres
Notes:	Production of solar cells and sensor prototyping.

Organization:	Daedalus Enterprises, Inc.
Component:	
Address:	300 Parkland Plaza, PO Box 1869 Ann Arbor, MI 48106
Contact:	Charles G Stanich
Position:	Vice President
Notes:	Infrared and multispectral analysis.

Organization:	DALSA Inc, CCD Image Sensors
Component:	
Address:	605 McMurray Road Waterloo, Ontario CANADA N2V 2E9
Contact:	
Position:	
Notes:	

Organization:	Datametrics Corp.
Component:	
Address:	8986 Comanche Avenue Chatsworth, CA 91311
Contact:	Betty Blodgett
Position:	Marketing
Notes:	Thermal Imaging

Organization:	Datron Systems, Inc.
Component:	
Address:	200 W Los Angeles Ave. Simi Valley, CA 93065-1650
Contact:	Dave Derby
Position:	Pres
Notes:	Production and research in infrared optical and laser sensors.

Organization:	David Sarnoff Research Center
Component:	
Address:	CN5300 Washington Road Princeton, NJ 08543-5300
Contact:	John R. Tower
Position:	Mangager, Visible and IR Imaging Business
Notes:	

Organization:	Davin Optical, Ltd.
Component:	
Address:	9A Chester Road Borchamwood, Herts, UK WD6 1LD
Contact:	David Holland
Position:	Managing Director
Notes:	Night Vision, EO Systems, Infrared Systems and Equipment, Thermal Imaging

Organization:	DBA Systems, Inc.
Component:	
Address:	P. O. Box 550 Melbourne, FL 32902
Contact:	Darrell Curtis
Position:	Director Business Development
Notes:	Thermal Imaging, infrared systems and equipment

Organization:	Decilog, Inc.
Component:	
Address:	555 Broad Hollow Rd Melville, NY 11747-5093
Contact:	John Marchesano
Position:	President
Notes:	Technical support to government and industry in infrared systems and components.

Organization:	Decision Images, Inc
Component:	
Address:	196 Tamarack Circle Skillman, NJ 08558
Contact:	
Position:	
Notes:	remote sensing systems, thermal infrared, multispectral

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Organization:	Delco Electronics
Component:	
Address:	700 East Firman Avenue Kokomo, IN 46901
Contact:	Bill Bauson
Position:	Mr.
Notes:	active in infrared non-destructive evaluation

Organization:	Delta International, Inc.
Component:	
Address:	2111 Wilson Boulevard, Suite 700 Arlington, VA 22201
Contact:	Earl Thompson
Position:	President
Notes:	Thermal imagnig, detectors and sensors

Organization:	Diagnostic Retrieval Systems, Inc.
Component:	Photronics Corporation
Address:	270 Motor Pkwy. Hauppauge, NY 11788
Contact:	Richard Ross
Position:	CEO
Notes:	Develop and manufacture optical laser ultraviolet detection components, missile optical component and specialized coating.

Organization:	Difracto Ltd.
Component:	
Address:	2835 Kew Dr. Windsor, ON N8T 3B7
Contact:	Omer Hageniers
Position:	Pres
Notes:	Research in vision sensors and gas lasers for measuring purposes.

Organization:	Digital Equipment Corp
Component:	
Address:	Mail Stop MLO5-4/E22 Maynard, MA 01754
Contact:	Edward Cox
Position:	Mr.
Notes:	infrared non-destructive evaluation

Organization:	Diversified Optical Products
Component:	
Address:	282 Main St. Salem, NH 03079
Contact:	Lawrence Kessler
Position:	Pres
Notes:	Automated IR and visible automated MTF testing.

Organization:	Dover Corporation
Component:	Universal Instrument Corp.
Address:	PO Box 825 Binghamton, NY 13902
Contact:	John Pomeroy
Position:	Pres
Notes:	Automation of electronics industry production.

Organization:	Dresden University of Technology
Component:	Institut fur Festkorperelektronik
Address:	Dresden, FEDERAL REPUBLIC OF GERMAN
Contact:	H. Budzier
Position:	
Notes:	Co-authored for 1992 SPIE IRFPA meeting "Pyroelectric IR Single-Element Detectors and Arrays Based on LiNbO3 and LiTaO3" Co-authored for 1991 SPIE meeting on Growth of IR Materials "Pyroelectric Linear Array IR Detectors with CCD Multiplexer"

Organization:	DRS Photronics Corp
Component:	
Address:	270 Motor Parkway Hauppauge, NY 11788
Contact:	Patricia Williamson
Position:	Assistant VP Corp. Comm.
Notes:	Electro optical systems, night vision, infrared systems and equipment

Organization:	DTX Corporation
Component:	Dynatherm Corporation
Address:	One Beaver Ct. Cockeysville, MD 21030
Contact:	Edward Scicchitano
Position:	CEO
Notes:	Thermal systems research oriented toward industrial process temperature control.

Organization:	Dukane Corporation
Component:	Microbiotics Division
Address:	2900 Dukane Dr. Saint Charles, IL 60174
Contact:	JM Stone
Position:	Pres
Notes:	Precision automated alignment and laser welding systems used to manufacture optoelectronic devices.

Organization:	Dynamics Research Corporation
Component:	
Address:	60 Concord St. Wilmington, MA 01887
Contact:	Albert Rand
Position:	Pres
Notes:	Design and fabrication of optical digital shaft angle encoders for aerospace and industrial applications.

Organization:	Dynatech Corporation
Component:	Sensors, Inc.
Address:	6812 S State Rd Saline MI 48176
Contact:	Tom Fournier
Position:	President
Notes:	Commercial uses for infrared technology.

Organization:	E-Systems, Inc.
Component:	HRB Systems, Inc
Address:	300 Science Park Rd. State College, PA 16804
Contact:	Michael Keebaugh
Position:	Pres
Notes:	Integration of sensors into systems capable of military surveillance missions.

Organization:	E2 Technology corp.
Component:	
Address:	4475 Dupont Ct., No 9 Ventura, CA 93003
Contact:	Earnest Emery
Position:	CEO
Notes:	Product oriented research in infrared blackbodies

Organization:	Eagle-Picher Industries, Inc.
Component:	
Address:	P.O.Box 737 Quapaw, OK 74363
Contact:	Brian McLain
Position:	Sales Manager
Notes:	High Purity infrared materials

Organization:	Eastman Chemical Co
Component:	Eastman Laboratory Chemicals
Address:	1001 Lee Road Rochester, NY 14652-3512
Contact:	
Position:	
Notes:	

Organization:	Eastman Kodak Co.
Component:	Government Systems Div.
Address:	1447 St. Paul Street Rochester, NY 14653
Contact:	Rollo Black
Position:	Business Development
Notes:	IR Detectors work, mostly PtSi.

Organization:	Eastman Kodak Company
Component:	Kodak Apparatus Division
Address:	901 Elmgrove Rd. Rochester, NY 14653
Contact:	Lawrence Matteson
Position:	Manager
Notes:	Applied research in physics and engineering to establish experimental and analystical foundations for new and improved processes in electro, photo-optical, and mechanical products. Additional research with PtSi under a contract from the Air Force Aeronautical Systems Division for use in adverse weather landing systems.

Organization:	EDO Corporation
Component:	Barnes Engineering Company
Address:	88 Long Hill Cross Rd. Shelton, CT 06484
Contact:	Frank Fariello
Position:	Pres
Notes:	Product oriented research in infrared sensors.

Organization:	EEV Ltd.
Component:	
Address:	Waterhouse Lane Chelmsford, Essex ENGLAND CM1 2QU
Contact:	David Taylor
Position:	Sales Manager
Notes:	Active and passive co systems, infrared systems and equipment, night vision.

Organization:	EG & Mound Applied Technology
Component:	
Address:	Box 3000 Manisburg, OH 45342
Contact:	Jonathan H. Mohler
Position:	Mr.
Notes:	active in infrared remote sensing

Organization:	EG&G Princeton Applied Research
Component:	
Address:	375 Phillips Boulevard Trenton, NJ 08618
Contact:	S.E. Mohr
Position:	Mr.
Notes:	Co-authored for 1992 SPIE Workshop on IRFPAs "Popcorn Noise in Linear InGaAs Detector Arrays"

Organization:	EG&G Reticon Corp.
Component:	
Address:	345 Potrero Avenue Sunnyvale, CA 94086-4197
Contact:	John Skurla
Position:	Sales Manager
Notes:	

Organization:	EG&G, Inc.
Component:	EG&G Judson
Address:	221 Commerce Dr. Montgomeryville, PA 18936
Contact:	Andrew Allen
Position:	VP Sales
Notes:	Application of infrared materials including germanium and mercury cadmium telluride.

Organization:	Elbit Systems, Inc.
Component:	
Address:	16 Esquire Road North Billerica, MA 01862
Contact:	Joseph A. Parini
Position:	President
Notes:	EO systems, infrared systems and equipment, night vision

Organization:	Electric Power Research Institute
Component:	
Address:	3 Industrial Highway Eddystone, PA 19022
Contact:	Robert G. Hammaker
Position:	Mr.
Notes:	active in infrared predictive maintenance

Organization:	Electro Optical Industries, Inc
Component:	
Address:	859 Ward Drive Santa Barbara, CA 93111
Contact:	
Position:	
Notes:	

Organization:	Electronic Devices, Inc.
Component:	
Address:	Urbana, IL
Contact:	
Position:	
Notes:	Participated in DARPA's initial Electronic Services HgCdTe program.

Organization:	Electronic Space Products International (ESPI)
Component:	
Address:	5310 Derry Avenue Agoura Hills, CA 91301
Contact:	
Position:	
Notes:	Manufacture and application of CdTe, GaAs, germanium, ZnS, and ZnSe infrared systems.

Organization:	Electrophysics
Component:	
Address:	373 Route 46 West, Building E Fairfield, NJ 07004
Contact:	Frank J. Vallese
Position:	General Manager
Notes:	Night Vision, thermal imaging

Organization:	Elettronica S.p.A.
Component:	
Address:	via Tiburtina KM 13.7 1-00131 Rome, ITALY
Contact:	Camillo Pariset
Position:	P.R. Manager
Notes:	Infrared systems and equipment

Organization:	Elop-Electro Optics Industries
Component:	
Address:	P.O. Box 1165 Rehovot, Israel 76110
Contact:	Tuvia Charmey
Position:	Advertising Manager
Notes:	Infrared systems and equipment, thermal imaging, detectors and sensors, night vision

Organization:	Emcore Corp.
Component:	
Address:	35 Elizabeth Avenue Somerset, NJ 08873
Contact:	William J. Burns
Position:	President
Notes:	Material production of GaAs, CdTe, silicon, ZnS, and ZnSe for infrared applications.

Organization:	Emerson Electric Co
Component:	Rosemount Inc.
Address:	12001 technology Dr. Eden Prairie, MN 55344
Contact:	Robert Cox
Position:	President
Notes:	Applied research on sensors and instruments for measurements of temperature, flow level, pressure, and other industrial applications.

Organization:	Entec
Component:	
Address:	Suite 100, 2817 Garden Hwy Sacramento, CA 95833
Contact:	Robert Ngyen
Position:	COO
Notes:	Basic research in photovoltaics.

Organization:	EnTech Engineering, Inc.
Component:	
Address:	111 Marine Lane St. Louis, MO 63146
Contact:	Leann M. Forister
Position:	Ms.
Notes:	active in infrared remote sensing

Organization:	Enterprise for Semiconductor Devices
Component:	
Address:	ROMANIA
Contact:	M.N. Udrea-Spenca
Position:	
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Accurate Method for Neutraon Fluence Control Used in Improving Neutron-Transmutation-Doped Silicon Detectors"

Organization:	Environmental Technology Group, Inc.
Component:	
Address:	1400 Taylor Ave., PO Box 9840 Baltimore, MD 21284-9840
Contact:	John Spelman
Position:	Pres
Notes:	Applied research in detectors for explosives, hazardous drugs and chemical warfare agents.

Organization:	Environmetrics, Inc.
Component:	
Address:	2345 Millpark Dr. Maryland Heights, MO, 63043
Contact:	Dr Eugene Scheide
Position:	Pres
Notes:	Development of "smart sensors," interest in using IR, esp. sensitive MCT variety

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Organization:	EOIS
Component:	
Address:	Suite 501, 710 Wilshire Blvd. Santa Monica, CA 90401
Contact:	John Fitts
Position:	Pres
Notes:	Smart sensor technology development.

Organization:	EPI Crystal Supplies Pty, Ltd.
Component:	
Address:	Monbulk, Victoria, 3793 Australia
Contact:	G.N. Pain
Position:	Mr.
Notes:	Authored for 1991 MCT Workshop "Effects of mixed-valence Mercury and Indium on the Electrical Properties of HgCdTe"

Organization:	EPIR, Ltd.
Component:	
Address:	Oak Brook, IL 60521
Contact:	P.S. Wijewarnasuriha
Position:	Mr.
Notes:	Co-authored for 1992 MCT Workshop "Influence of CdZnTe (211)B Substrate on Electrical Properties of HgCdTe Grown by MBE"

Organization:	Epitaxx, Inc.
Component:	
Address:	3490 Route 1, Princeton, NJ 08540
Contact:	Ken Fujiwara
Position:	President
Notes:	Long-wavelength high speed sources and detectors for fiberoptic communcations (InGaAs photodiodes, 1300 & 1500 nm edge LED and laser diode), large area InGaAs detectors for test and measurement rangefinding. Develops 512 element InGaAs arrays of cutoff wavelengths of 2.6um.

Organization:	ERIM - Environmental Research Inst of Michigan
Component:	
Address:	PO Box 8618 Ann Arbor, MI 48107-8618
Contact:	
Position:	
Notes:	remote sensing systems, thermal infrared, multispectral

Organization:	ESA-ESTEC
Component:	
Address:	Keplerlaan 1, NL-2200 AZ Noordwijk, THE NETHERLANDS
Contact:	Marino Babbricotte
Position:	Mr.
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Comparative Study of SWIR and MWIR Schottky-Barrier Imagers."

Organization:	Euromissile Dynamics Group
Component:	Eltro
Address:	Germany
Contact:	
Position:	
Notes:	Produces HgCdTe-based infrared guidcance systems for military applications.

Organization:	Evans & Sutherland
Component:	
Address:	600 Komas Drive Salt Lake City, UT 84108
Contact:	Jeff Edwards
Position:	Communications Manager
Notes:	Night Vision, thermal imaging

Organization:	Evey Engineering Co Inc
Component:	
Address:	154 Center Street Groveland, MA 01834-1016
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	Exotech, Inc
Component:	
Address:	8502 Dakota Dr. Gaithersburg, MD 20877
Contact:	Robert Lyle
Position:	Pres
Notes:	Electo-optical and electronic instrumentation.

Organization:	Exotic Materials, Inc,
Component:	
Address:	2930 Bristol St. Costa Mesa, CA 92626
Contact:	Roderick R. Randolph
Position:	Sales Manager
Notes:	Applied, product-oriented research as related to electro-optical materials, vacuum deposited coatings and devices for government, industrial and military systems applications.

Organization:	Fermionics
Component:	
Address:	4555 Runway St. Simi Valley, CA 93063
Contact:	Peter Wang
Position:	CEO
Notes:	Produces wholesale CdTe and participant in CECOMs night vision advanced research.

Organization:	FIBERTEK, Inc.
Component:	
Address:	Herndon, VA 22070
Contact:	Horacio R. Verdun
Position:	Mr.
Notes:	Co-authored for 1992 MCT Workshop "Tunnelling Current Probe for Contactless Electrical Performance Measurements of Infrared Focal Plane Detector Arrays"

Organization:	FJW Optical Systems, Inc
Component:	
Address:	629 S Vermont St. Palatine, IL 60067
Contact:	Edward Wood
Position:	President
Notes:	Electro-optical systems and infrared viewing devices for production.

Organization:	FLIR Systems, Inc.
Component:	
Address:	16505 SW 72nd Avenue Portland, OR 97224
Contact:	Frans Eberth
Position:	Mr.
Notes:	infrared non-destructive evaluation

Organization:	Ford Motor Co.
Component:	Scientific Research Laboratory
Address:	P.O. Box 2053 Dearborn, MI 48121
Contact:	R.P. Cooper
Position:	Mr.
Notes:	infrared non-destructive evaluation

Organization:	Fraser-Volpe Corporation
Component:	
Address:	Warminster Industrial Park, 1025 Thomas Dr. Warminster PA 18974
Contact:	David Fraser
Position:	Pres
Notes:	Electro-optics and electronic systems; design and development of systems for inspection of fluid-filled vials and other glass containers to detect chips, cracks and foreign particles, stabilization systems for optical viewing devices, television and motion picture cameras, laser stabilization.

Organization:	Fraunhofer-Institut fur Angewadnte Festkorperphysik
Component:	
Address:	Tullastr. 72 D-7800 Freiburg, Germany
Contact:	D.D. Edwall
Position:	
Notes:	AUthor of "Characterization of MCT Heterostructures by Thermoelectric Measurements"

Organization:	FSI International
Component:	
Address:	322 Lake Hazeltine Dr. Chaska, MN 55318
Contact:	Joel Elftmann
Position:	Pres
Notes:	Research for semiconductor production equipment.

Organization:	FTS Sys Inc
Component:	
Address:	PO Box 158 Stone Ridge, NY 12484
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	Fujitsu Laboratories, Ltd.
Component:	Atsugi Infrared Devices Laboratory
Address:	10-1 Morinosato-Wakamiya Atsugi 243-01 JAPAN
Contact:	K. Awamoto
Position:	Mr.
Notes:	Co-authored for 1992 SPIE Workshop on IRFPAs "Resolution Improvement for HgCdTe IRCCD"

Organization:	Future Technology Services
Component:	
Address:	700 Indian Trail Road Atlanta, GA 30247
Contact:	
Position:	
Notes:	Prepared a study on the potential IR thermography market in 1988.

Organization:	Galileo Electro-Optics Corp.
Component:	
Address:	Galileo Park, PO Box 550 Sturbridge, MA 01566
Contact:	William Hanley
Position:	CEO
Notes:	Develops fiber-optic and electro-optic components which transmit, intensify or sense light images.

Organization:	Galtech Semiconductor Materials Corp.
Component:	
Address:	265 North State Street Mt. Pleasant, UT 84647
Contact:	Melvin J. Carr
Position:	President
Notes:	Manufacture of CdTe infrared materials, germanium, wafers and ingots, monocrystalline and polycrystallins. Polishing and slicing series for CdTe and CdZnTe.

Organization:	GE Aerospace
Component:	Electronics Lab
Address:	Syracuse, NY
Contact:	Bob Yanka
Position:	
Notes:	Scientist working on MBE, past work on advanced iRFPA concepts for WRight Patterson AFB April 1987-DeCember 1990

Organization:	GEC Ferranti
Component:	
Address:	Ferry Road Edinburgh, Scotland EH5 2XS
Contact:	John Ford
Position:	Public Relations Manager
Notes:	night vision, detectors and sensors, active and passive e/o systems

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Organization:	GEC Ferranti Defence Systems, Ltd.
Component:	
Address:	Navigation and Electro Optics Division Silverknowes, Ferry Road Edinburgh, UK EH4 4AD
Contact:	F.J. Graham
Position:	Marketing Support Exec
Notes:	Infrared systems and equipment, night vision e/o systems

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Organization:	GEC Hirst Research Centre
Component:	
Address:	Wembley, UNITED KINGDOM
Contact:	L.M. Smith
Position:	Mr.
Notes:	Co-authored May 1990 report "Integrated Technology in MCT/GaAs and MCT/Si for Medium and Long Wavelength Infrared"

Organization:	GEC Marconi Dynamics, Ltd.
Component:	
Address:	The Grove Warren Lane Stanmore, Middlesex, UK HA7 4LY
Contact:	R. Coltart
Position:	Press Officer
Notes:	infrared systems and equipment, MMW radar, etc.

Organization:	GEC Sensors
Component:	Hirst Infrared Division
Address:	East Lane, Wembley, Middlesex, HA9 7PP, UK
Contact:	
Position:	
Notes:	Production of a wide variety of HgCdTe-based systems, including sensors for the Tornado, Harrier, and Lynx. Most HgCdTe material is purchased from Philips. The company also has invested heavily in internal research on InSb and dual-wave band sensor technology.

Organization:	General Dynamics
Component:	Space Systems Division
Address:	2945 Arcola Avenue Sand Diego, CA 92117
Contact:	Douglas Burleigh
Position:	Mr.
Notes:	active in infrared remote sensing, predictive maintenance, non-destructive evaluation

Organization:	General Dynamics Corporation
Component:	Electronics Division
Address:	5011 Kearny Villa Rd. San Diego, CA 92123-1447
Contact:	Terry Straetten
Position:	Vice President
Notes:	Product oriented research in automatic test equipment and electronics, communications, electronic warfare, signal processing, and displays and imagery, lasers.

Organization:	General Electric Company
Component:	Aerospace Electronics Systems Department
Address:	French Rd. Utica, NY 13503
Contact:	Alexander Horvath
Position:	General Manager
Notes:	Research into pattern recognition.

Organization:	General Microwave Corp.
Component:	
Address:	5500 New Horizon Blvd Amityville, NY, 11701
Contact:	Sherman Rinkel
Position:	Pres
Notes:	Applied sensor technology for industrial and automative applications.

Organization:	General Motors Corporation
Component:	Hughes Aircraft Co., Research Laboratories
Address:	3011 Malibu Canyon Rd Malibu, CA 90265
Contact:	Arthur Chester
Position:	VP
Notes:	Production of GaAs and InP integrated circuits; infrared sensors, especially monolithic focal plane arrays.

Organization:	General Motors, Corporation
Component:	Santa Barbara Research Center
Address:	75 Coromar Dr. Goleta, CA 93117
Contact:	Fletcher Phillips
Position:	President
Notes:	Manufacture of infrared photodetectors and associated components, packages and infrared focal plane arrays; electro-optical instrumentation for space; particularly multispectral earth observation sensors and weather sensors; specialized military equipment such as vehicle fire sensors and missle proximity fuses.

Organization:	Geonex Verde Technologies
Component:	
Address:	734 E. Lake Avenue Watsonville, CA 95076
Contact:	Paul Reising
Position:	Mr.
Notes:	active in infrared remote sensing

Organization:	Georgia Institute of Technology
Component:	
Address:	
Contact:	C.J. Summers
Position:	
Notes:	On Program Committee of 1991 & 1992 MCT Workshop For 1991 Workshop, "Selected-area Epitaxy on CdTe," and "Gas Source IOdine Doping and Characterization of MBE Grown CdTe"

Organization:	Georgia Tech Research Institute
Component:	Physical Sciences Laboratory
Address:	Room 128 Baker Bldg Atlanta, GA 30332
Contact:	R.G. Benz
Position:	
Notes:	Authored "CdTe and HgTe Growth Kinetics During Gas SOurce Molecular Beam Epitaxy" for 1992 MCT Workshop For 1991, "Selected-area Epitaxy of CdTe"

Organization:	GFI Advanced Technologies, Inc.
Component:	
Address:	112-41 69th Avenue Forest Hills, NY 113754
Contact:	Karl Lifschitz
Position:	Chief Executive
Notes:	Manufacture of GaAs, germanium, ZnS, and ZnSe for infrared applications.

Organization:	Glenro, Inc.
Component:	
Address:	29 McBride Ave. Paterson, NJ 07501
Contact:	Hervert Van Denend
Position:	Pres
Notes:	Research into infrared system production.

Organization:	Graduate Center for the City Univ of NY
Component:	Dept of Electrical Engineering and Physics
Address:	Institute for Ultrafast Spectroscopy & Lasers, Photonics Appl Lab New York, NY 10031
Contact:	K.M. Yoo
Position:	Dr.
Notes:	active in infrared biomedical thermography

Organization:	Groton Technology, Inc.
Component:	
Address:	45 Winthrop St. Concord, MA 01742
Contact:	George Barringer
Position:	Pres
Notes:	Applied and product-oriented research in optical inferometry and solid state optical detectors. Application of infrared technologies to scientific spectroscopy.

Organization:	Grumman Aircraft Systems
Component:	
Address:	MS B46-35 Bethpage, NY 11714
Contact:	Michel Engelhardt
Position:	
Notes:	active in infrared process control

Organization:	Grumman Corporate Research Center
Component:	
Address:	Bethpage, NY 11714-3580
Contact:	M.B. Lee
Position:	Mr.
Notes:	Co-authored for 1992 MCT workshop "White Beam X-ray Synchroton Topography Analysis of CdTe (111)B Substrates and Epilayers"

Organization:	Hardin Optical Company
Component:	
Address:	P.O. Box 219 1320 Oregon Avenue Bandon, OR 97411
Contact:	Larry Hardin
Position:	President
Notes:	Manufacture of GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications.

Organization:	Harris Corporation
Component:	Government Communications Systems Division
Address:	256 SE Palm Bay Rd., PO Box 9100 Melbourne, FL 32902
Contact:	alan Henry
Position:	Gmgr
Notes:	Satellite and terrestrial communications, electro-optics, imagery and voice privacy systems.

Organization:	Harris RF Communications
Component:	
Address:	1680 University Avenue Rochester, NY 14610
Contact:	John Cicotta
Position:	Marketing Communications Manager
Notes:	Thermal imaging, digital imaging systems, imaging software

Organization:	Harvard University
Component:	Division of Applied Sciences
Address:	Cambridge, MA 92138
Contact:	H. Ehrenreich
Position:	
Notes:	Co-Authored "Augur Lifetimes in Ideal InGaSb/InAs Superlattices" for 1992 MCT Workshop.

Organization:	Helix Technology Corp
Component:	CTI Cyrogenics Div
Address:	Nine Hampshire Street Mansfield, MA 02048
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	HGH Ingenerie Systemes
Component:	
Address:	au Parc d'Activities du Moulin de Massy 3, rue du Saule Trapu Massy, 91300 FRANCE
Contact:	Michel Balle
Position:	
Notes:	active in infrared process control

Organization:	Honeyhill Technical Corporation
Component:	
Address:	193 East Avenue Norwalk, CT 06855
Contact:	Herbert Kaplan
Position:	President
Notes:	Contributing editor to Photonics Spectra, consultant in IR business. Someone good for exposure of IDT study

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Organization:	Honeywell Corp.
Component:	Sensor and System Development Center
Address:	Bloomington, MN 55420
Contact:	B.R. Johnson
Position:	Mr.
Notes:	Co-authored for 1992 SPIE Workshop on IRFPAs "YBa2Cu3O7 Superconducting Microbolometer Linear Arrays" supported by DARPA with Office of Naval Research as contracting agency.

Organization:	Honeywell, Inc.
Component:	Solid State Sensors Group
Address:	830 E. Arapaho Road Richardson, TX 75081
Contact:	J. Buie
Position:	Marketing Manager
Notes:	Manufactures IR optoelectronic components and assemblies, fiberoptic components, and modules.

Organization:	Huazhong University of Science and Technology
Component:	
Address:	Wuhan, Hubei 430074 REPUBLIC OF CHINA
Contact:	Wang Lingjie
Position:	
Notes:	Authored for 1992 SPIE IRFPA meeting "Optimum Design Model for the Injection of IRCCD"

Organization:	Hughes Aircraft Co.
Component:	Electron Dynamics Division
Address:	3100 W. Lomita Torrance, CA 90509-2999
Contact:	J.A. Christensen
Position:	Marketing Director
Notes:	

Organization:	Hughes Aircraft Company
Component:	
Address:	328 Ellen Street Midland, Ontari, L4R 2H2, CANADA
Contact:	J. Mactaggart
Position:	VP Marketing
Notes:	

Organization:	ICI America
Component:	
Address:	Wilmington, DE
Contact:	
Position:	
Notes:	A varity of work with InP, primarily for solar applications.

Organization:	II-VI Inc.
Component:	
Address:	375 Saxonburg Blvd Saxonburg, PA 16056
Contact:	Carl Johnson
Position:	President and CEO
Notes:	Manufacture of CdTe, GaAs, germanium, silicon, ZnS, ZnSe for infrared applications.

Organization:	Imago Machine Vision Inc.
Component:	
Address:	1354 Wellington Street Ottaws, Ontario, CANADA K1Y 3C3
Contact:	Roy Ball
Position:	President
Notes:	Security systems and equipment, robotics, c/o systems, infrared sysetms and equipment

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Organization:	Imagraph Corp.
Component:	
Address:	11 Elizabeth Drive Chelmsford, MA 01824
Contact:	Joseph Plonski
Position:	V.P. Sales and Marketing
Notes:	thermal imaging

Organization:	IMEC
Component:	
Address:	Jaoekdreef 75 B-3001 Leuven, BELGIUM
Contact:	Jan Vermeiren
Position:	Ms.
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Comparative study of SWIR and MWIR Schottky-Barrier Imagers"

Organization:	Imo
Component:	Varian Industries
Address:	Palo Alto, CA
Contact:	Alan Bennett
Position:	V Pres R&D
Notes:	Producer of a wide variety of military thermal systems. Development of InP- and HgCdTe-based infrared sensors, as well as the use of GaAs materials.

Organization:	Indiana State University
Component:	Department of Geography and Geology
Address:	Terre Haute, IN 47809
Contact:	David J. Kettler
Position:	Mr.
Notes:	active in infrared remote sensing

Organization:	Inframetrics
Component:	
Address:	16 Esquire Road North Billerica, MA 01862
Contact:	Charles Alicandro
Position:	Commercial Sales
Notes:	

Organization:	Infrared Engineering Services
Component:	
Address:	110 Shadow Oaks Drive Easley, SC 29642
Contact:	William T. Morgan
Position:	Mr.
Notes:	infrared non-destructive evaluation

Organization:	Infrared Industries
Component:	
Address:	12151 Research Pkwy, Orlando, FL 32826
Contact:	Ed Patton
Position:	COO
Notes:	Lead sulphide, lead selenide, indium antimonide and silicon infrared detectors and thin film optical filters for government and industrial applications; hybrid preamplifier microcircuits.

Organization:	*Infrared Monitoring Systems*
Component:	
Address:	10 West 35th Street Chicago, IL 60616
Contact:	Ed Bangs
Position:	
Notes:	active in infrared process control

Organization:	Infrared Optical Products, Inc.
Component:	
Address:	P.O. Box 3033 South Farmingdale, NY 11735
Contact:	Barry Bassin
Position:	President
Notes:	Manufacture of CdTe, GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications.

Organization:	Infrared Research, Inc.
Component:	
Address:	100 Park City Road Roosville, GA 30741
Contact:	James Garner
Position:	Mr.
Notes:	active in infrared predictive maintenance

Organization:	Infrared Scanning, Inc.
Component:	
Address:	3955 Pleasantdale Rd. Atlanta, GA 30340
Contact:	Robert Lacer
Position:	Pres
Notes:	Infrared inspection techniques and applications.

Organization:	Infraspection Institute
Component:	
Address:	1971 Shelburne Road, Suite C Shelburne, VT 05482
Contact:	Paul Grover
Position:	Mr.
Notes:	active in infrared predictive maintenance

Organization:	Innovation Industries, Inc.
Component:	
Address:	Hwy 64E PO Box K Russellville, AR 72801
Contact:	Tom Benson
Position:	CEO
Notes:	Opto-electronics product oriented for patent and manufacture.

Organization:	Institute for Atomic Physics
Component:	
Address:	ROMANIA
Contact:	D.N. Lazarovici
Position:	
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Accurate Method for Neutron Fluence Control Used in Improving Neutron-Transmutation-Doped Silicon Detectors"

Organization:	Intergraph Corp.
Component:	
Address:	2051 Mercator Drive Reston, VA 22091
Contact:	John Dahmes
Position:	Executive Manager, Marketing
Notes:	Thermal Imaging, imaging software

Organization:	International Advanced Materials Inc.
Component:	
Address:	2 North Circle Avenue Spring Valley, NY 10977
Contact:	JoElaine Cary
Position:	CEO
Notes:	Manufacture of CdTe, GaAs, germanium, silicon, ZnS, and ZnSe materials for infrared systems.

Organization:	International Crystal Laboratories
Component:	
Address:	11 Eric St. Garfield, NJ 07026
Contact:	Theresa Herpst
Position:	Pres
Notes:	Applied research for growing crystals for infrared transmission.

Organization:	International Imaging Systems
Component:	
Address:	1500 Buckeye Drive Milpitas, CA 95035
Contact:	
Position:	
Notes:	remote sensing systems, thermal infrared, multispectral

Organization:	International Machine & Tool Corp.
Component:	Instrument & Development Laboratory
Address:	115 Maple St. Warwick, RI 02888
Contact:	WJ Elsdoefer
Position:	Pres
Notes:	Electronic and optical measurement development.

Organization:	International Optical Telecommuncations
Component:	
Address:	18 E Blithedale Ave. Mill Valley, CA 94941-1916
Contact:	Dr. Herbert Elion
Position:	CEO
Notes:	Hardware and software market research including lab facilities, design improvement and patenting technology assistance.

Organization:	International Research and Evaluation
Component:	
Address:	21098 IRE Control Ctr. Eagan, MN 55121
Contact:	Randall Voight
Position:	CEO
Notes:	Product-oriented with emphasis on photovotaic cells.

Organization:	International Sensor Systems, Inc.
Component:	
Address:	Industrial Park, PO Box 345 Aurora, NE 68818
Contact:	Clifford Williams
Position:	Pres
Notes:	Research in hybrid thick film technology and optical relays.

Organization:	International Solar Electric Technologies
Component:	
Address:	Englewood, CA
Contact:	
Position:	
Notes:	Development research on a variety of infrared materials, including CIS, for solar applications.

Organization:	Interscan Corporation
Component:	
Address:	21700 Nordhoff St. PO Box 2496 Chatworth, CA 91313-2496
Contact:	Dr Manny Shaw
Position:	Pres
Notes:	Gas analyzer and sensor developments.

Organization:	IR Scientific Inc
Component:	
Address:	PO Box 110 Carlisle, MA 01741
Contact:	R Sommer
Position:	Pres
Notes:	Product-oriented near infrared research and development manufacturing and infrared consulting services.

Organization:	Iri Vision
Component:	
Address:	Suite D, 6231 Yarrow Dr. Carlsbad, CA 92009
Contact:	Lawrence Goshorn
Position:	CEO
Notes:	Product-oriented research of light-based vision systems.

Organization:	Irtronics Instruments, Inc.
Component:	
Address:	132 Forest Blvd. Ardsley, NY 10502
Contact:	John Jenkofsky
Position:	Gmgr
Notes:	Standard and custom infrared radiation pyrometers for measuring temperature in industrial research applications.

Organization:	Irvine Sensors Corp.
Component:	
Address:	3001 Redhill Ave Bldg 3 Costa Mesa, CA 92626
Contact:	James Alexiou
Position:	Pres
Notes:	Applied research in military detection system (infrared sensing).

Organization:	Iscan, Inc.
Component:	
Address:	125 Cambridgepark Drive Cambridge, MA 02140
Contact:	Rikki Razdan
Position:	Marketing Manager
Notes:	Infrared systems and equipment, c/o systems

Organization:	ISI Group
Component:	
Address:	211 Conchas SE Albuquerque, NM 87123
Contact:	James Fritz
Position:	Mr.
Notes:	active in infrared process control

Organization:	ISPRA - Israel Product Research Co. Ltd.
Component:	
Address:	Galgal Haplada Street, Industrial Zone Herzelia, Israel 052-555464
Contact:	
Position:	
Notes:	Manufacture of germanium, silicon, ZnS, and ZnSe for infrared applications.

Organization:	Israel Aircraft Industries, Ltd.
Component:	
Address:	Ben-Gurion International Airport Israel 70100
Contact:	F.P. Hermann
Position:	Corp. Foreign Press and Adv. Mgr.
Notes:	passive and active e/o components, detectors and sensors, infrared systems and equipment

Organization:	ITD - Space Remote Sensing Center
Component:	
Address:	Building 1103 Suite #118 Stennis Space Center, Mississippi 39529
Contact:	George A. May
Position:	Mr.
Notes:	active in infrared remote sensing

Organization:	ITI Electro-Optics Corp.
Component:	
Address:	11500 W Olympic Blvd Los Angeles, CA 90064
Contact:	Richard Caserio
Position:	Sales Manager
Notes:	Manufacture of CdTe, GaAs, germanium, ZnS, and ZnSe for infrared technologies.

Organization:	ITT Defense and Electronics
Component:	
Address:	1000 Wilson Boulevard, Suite 3000 Arlington, VA 22209
Contact:	Brandon Belote
Position:	Director Marketing Communications
Notes:	Night vision, active and passive e/o systems, infrared systems and components

Organization:	JA Noll Co.,
Component:	
Address:	PO Box 312 Monroeville, PA 15146
Contact:	JA Noll
Position:	CEO
Notes:	Research in optical metrology.

Organization:	Jamieson Science and Engineering
Component:	
Address:	
Contact:	James Jamieson
Position:	President
Notes:	Advocate of MCT being able to overcome cost barriers to break into commercial market. Long history of involvement in IR since advent.

Organization:	Janos Technology, Inc.
Component:	
Address:	HCR #33, Box 25 Townshead, VT 05353-7702
Contact:	Bruce Gardner
Position:	Pres
Notes:	Manufacturer of CdTe, GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications.

Organization:	Jodon Engineering
Component:	
Address:	62 Enterprise Dr. Ann Arbor, MI 48103
Contact:	John Gillespi
Position:	Pres
Notes:	Optical engineering for machine vision.

Organization:	John Snell & Associates
Component:	
Address:	17 First Avenue Montpelier, VT 05602
Contact:	Robert W. Spring
Position:	Mr.
Notes:	active in infrared predictive maintenance

Organization:	Johns Hopkins University
Component:	Center for NDE ad Applied Physics Laboratory
Address:	Laurel, MD 20723
Contact:	James C. Murphy
Position:	Mr.
Notes:	infrared non-destructive evaluation

Organization:	JTT International Inc.
Component:	
Address:	3045 Technology Pkwy Orlando, FL 32826
Contact:	Dr. M.Y. Hwang
Position:	Ch. Sci
Notes:	Manufacturer of germanium, silicon, ZnS, and ZnSe infrared systems.

Organization:	Kappler Crystal Optics Inc.
Component:	
Address:	1244 Highland Street Holliston, MA 01746
Contact:	Ronald Kappler
Position:	Pres.
Notes:	Manufacturer of ZnS and ZnSe for infrared applications.

Organization:	Kemet Electronics Corporation
Component:	
Address:	2605 Laurens Hwy., PO Box 5928, Greenville, SC 29606
Contact:	DE Maguire
Position:	Pres
Notes:	Applied research and development on passive electronic components.

Organization:	Kidron Microelectronics Research Center
Component:	Department of Electrical Engineering
Address:	Technion-Israel Institute of Technology Haifa 32000, ISRAEL
Contact:	A. Bezinger
Position:	
Notes:	"UV Photon Assisted Control of Interface Charge Between CdTe Substrates and Metal Organic Chemical Vapor Deposition CdTe Epilayers" for 1992 MCT Workshop.

Organization:	King's College
Component:	Thermal Biology Research Unit
Address:	Campden Hill Road, Kensington London, W8 7AH, UNITED KINGDOM
Contact:	Ray P. Clark
Position:	Dr.
Notes:	active in infrared biomedical thermography

Organization:	King's College London, University of London
Component:	Thermal Biology Research Unit
Address:	Campden Hill Road Kensington, Longon W8 7AH UNITED KINGDOM
Contact:	Ray P. Clark
Position:	Dr.
Notes:	President of European Academy of Thermology. Interviewed 1-16

Organization:	Kistler-Morse Corporation
Component:	
Address:	10201 Willows Rd., NE, PO Box 3009, Redmond, WA 98073
Contact:	Charlie Morse
Position:	Pres
Notes:	R&D of seminconductor displacement sensors.

Organization:	Kollmorgen Corp.
Component:	
Address:	347 King Street Northampton, MA 01060
Contact:	Doug James
Position:	Systems Engineer
Notes:	Detectors and sensors, infrared systems and equipment, night vision

Organization:	Kollmorgen Corporation
Component:	Photo Research
Address:	9330 DeSoto Dr. Chatsworth, CA 91311
Contact:	James Fogle
Position:	VP
Notes:	Optical and electromechanical light measuring devices.

Organization:	Kollsman Division of Sequa Corp.
Component:	
Address:	220 Daniel Webster Highway Merrimack, NH 03054
Contact:	Jeannette Neff
Position:	Mgr. Marketing Communications
Notes:	E/O Systems, infrared systems and equipment, night vision

Organization:	Korea University
Component:	
Address:	Chong Am Dong Sung-Buk-Ku Seoul, KOREA 11136-701
Contact:	Sun Ung Kim
Position:	
Notes:	Attended 1992 MCT Workshop

Organization:	KRS Electronics Corporation
Component:	
Address:	Suite 16, 11649 Chairman Dr. Dallas TX, 75243
Contact:	Steve Zimmerman
Position:	Pres
Notes:	Optical electronic sensing of liquids gases and temperatures.

Organization:	Kussmaul Electronics Company, Inc.
Component:	
Address:	170 Cherry Ave. West Sayville, NY 11796
Contact:	Ernest Kussmaul
Position:	Pres
Notes:	R&D of photoelectronic controls.

Organization:	Lab de Physique des Solides/ INSA
Component:	
Address:	
Contact:	R. Granger
Position:	Mr.
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Infrared Reflectivity: A tool for bond Investigation in II-VI Ternaries"

Organization:	LaBarge Inc.
Component:	LaBarge Electronics
Address:	*11616 E 51st St.* Tulsa, OK 74146
Contact:	Bob Stauder
Position:	VP
Notes:	Intrusion detection systems and components, telemetry systems and components and other eletromechanical systems and components for airborne and space applications; atmospheric, weather and data measuring systems and components.

Organization:	Laboratory for Infrared Physics
Component:	Academia Sinica
Address:	420 Zhong Shan Bei Yi Road Shanghai, 200083, CHINA
Contact:	Qian Dingrong
Position:	
Notes:	Authored for 1992 SPIE meeting on IRFPAs "Element of a new Infrared Detector Plasma Edge Detector"

Organization:	Laser Diode Inc.
Component:	
Address:	205 Forrest Street Metuchen, NJ 08840-1292
Contact:	Bob Gill
Position:	President
Notes:	Manufacturer of GaAs and germanium materials for infrared applications.

Organization:	Laser Fare, Inc.
Component:	
Address:	One Industrial Dr S Esmond, RI 02917
Contact:	Terry Feeley
Position:	Pres
Notes:	Applied laser technology to industrial materials processing; research in aerospace, medical and electronic applications.

Organization:	Laser Focus World
Component:	
Address:	One Technology Park Drive P.O. Box 989 Westford, MA 01886
Contact:	David Kales
Position:	Senior Editor, Markets
Notes:	Wrote November 1992 article "Detector Makers Seek Dual-Use Technology for Survival." F :ends with David Leech.

Organization:	Laser SOS Limited
Component:	
Address:	4B Bartholomew's Walk Cambridgeshire Bus. Pk., ANgel Drove Ely, Camb. CB74EAG
Contact:	A.W. Koszykowski
Position:	Pres.
Notes:	Manufacture of CdTe, GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications.

Organization:	Lasermike, Inc.
Component:	
Address:	6060 Executive Blvd Dayton, OH 45424
Contact:	Steve Cox
Position:	Pres
Notes:	Development of intelligence sensors.

Organization:	Lattice Materials Corp.
Component:	
Address:	516 E. Tamrack Bozeman, MT 59715
Contact:	John Tengelsen
Position:	Pres.
Notes:	Manufacturer of silicon for infrared applications.

Organization:	Lawrence Livermore National Laboratories
Component:	
Address:	Livermore, CA 94551
Contact:	Nancy C. DelGrande
Position:	Ms.
Notes:	active in infrared remote sensing

Organization:	LETI (CEA - Technologies Avancees)
Component:	DOPT - CEN/G - 85 X
Address:	F38041 Grenoble Cedex FRANCE
Contact:	G. Destefanis
Position:	Mr.
Notes:	Co-authored for 1992 MCT Workshop "Large Improvement in HgCdTe Photovoltaic Detector Performances at LETI"

Organization:	Life Support, Inc.
Component:	
Address:	2926 State St. Erie, PA 16509
Contact:	Dr Eskil Karlson
Position:	Dir
Notes:	Optical system design including IR detection and systems.

Organization:	Liquid Carbonic
Component:	
Address:	135 LaSalle Chicago, IL 60603
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	Litton Corporation
Component:	
Address:	1725 Jefferson Davis Highway Suite 601, Crystal Square Two Arlington, VA 22203
Contact:	John Georg
Position:	Public Relations Manager
Notes:	e/o systems, night vision, infrared systems and equipment, detectors & sensors

Organization:	Litton Electron Devices
Component:	
Address:	1215 S. 52nd Street Tempe, AZ 85281
Contact:	Paul Everett
Position:	Manager, Business Development
Notes:	

Organization:	Litton Electron Devices Product Group
Component:	
Address:	1215 South 52nd Street Tempe, AZ 85281
Contact:	
Position:	
Notes:	

Organization:	Litton Industries, Inc.
Component:	Applied Technology Division
Address:	4747 Hellyer Ave., PO Box 7012 San Jose, CA 95150-7012
Contact:	Clayton Williams
Position:	Pres
Notes:	Electro-optic and acouto-optic systems.

Organization:	Lockheed Corporation
Component:	Lockheed Palo Alto Research Laboratories
Address:	3251 Hanover St., Orgn 90-01 Palo Alto, CA 94304
Contact:	JB Reagan
Position:	General Manager
Notes:	Research and development of electro-optic systems, including HgCdTe under DARPA's Electronic Sciences program.

Organization:	Lockheed Missiles & Space Co., Inc.
Component:	
Address:	1111 Lockheed Way Sunnyvale, CA 94088
Contact:	Larry M. Klynn
Position:	Mr.
Notes:	infrared non-destructive evaluation

Organization:	Lockheed Sanders, Inc.
Component:	
Address:	NHQ-1-735 68 Spit Brook Road Nashua, NH 03061
Contact:	Marvin L. Braman
Position:	Director of Public Relations
Notes:	Infrared systems and equipment, passive and active c/o devices

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Organization:	Loral Corporation
Component:	Loral Fairchild Systems
Address:	300 Robbins Ln. Syosset, NY 11791
Contact:	James Dunn
Position:	Pres
Notes:	Development of electro-optical imaging systems.

Organization:	Loral Corporation
Component:	Loral Infrared & Imaging Systems, Inc.
Address:	2 Forbes Rd. Lexington, MA 02173
Contact:	R.A. Bell
Position:	Director of Marketing
Notes:	

Organization:	Loral Electro-Optical Systems
Component:	
Address:	300 North Halstead Street Pasadena, CA 91107
Contact:	Jim Carey
Position:	Marketing Director
Notes:	Infrared systems and equipment, c/o systems

Organization:	Lousiana Tech University
Component:	
Address:	
Contact:	David H. Cowling
Position:	
Notes:	Co-authored 1990 "A Simplified Vision System WIth Robotic Assembly and Manufacturing Applications"

Organization:	LTV Aerospace and Defense Company
Component:	
Address:	Mail Stop PT-88 Dallas, TX 75265
Contact:	Y.L. Tyan
Position:	Mr.
Notes:	Co-authored for 1991 MCT Workshop "Analysis of Excess Carrier LIfetime in p-Type HgCdTe Using a Three-Level Shockley-Read Model"

Organization:	Luoyang Optic-Electronic Institute
Component:	
Address:	P.O. Box 030-12, 471009, Luoyang, Henan, P.R. CHINA
Contact:	Yongping Ni
Position:	
Notes:	Authored for 1992 SPIE meeting on IRFPAs "Auto-Gain-Control Characteristics of InSb P+/N Diode with High Sheet Resistance"

Organization:	MacDonald, Dettwiler & Associates, Ltd
Component:	
Address:	13800 Commerce Parkway Richmond, BC, V6V 2J3 CANADA
Contact:	
Position:	
Notes:	remote sensing systems, thermal infrared

Organization:	MacVicar Associates
Component:	
Address:	1171 Buckingham Drive Los Altos, VA 94024
Contact:	Duncan MacVicar
Position:	Consultant, President
Notes:	Consultant on electro-optics

Organization:	Magna Industries, Inc
Component:	
Address:	2201 W 110th St., PO Box 734 Cleveland, OH 44107
Contact:	Larry Whited
Position:	Pres
Notes:	Research in infrared products.

Organization:	Magnavox Corporation
Component:	
Address:	1313 Production Road Fort Wayne, IN 46808
Contact:	
Position:	
Notes:	Participant in Army's night vision investigation program to develop advanced thermal night vision systems.

Organization:	Magnavox Electronic Systems Company
Component:	Elecrto-Optical Systems
Address:	46 Industrial Avenue Mahwah, NJ 07430-2206
Contact:	Dan Laerfeld
Position:	Marketing Manager
Notes:	

Organization:	Marconi Radar and Control Systems, Ltd.
Component:	
Address:	P.O. Box 133 Chobham Road, Frimley Camberley, Surrey, UK GU16 5PE
Contact:	Mark Broughton
Position:	Head of public Relations
Notes:	Thermal Imaging, detectors and sensors, night vision

Organization:	Marine-Air Systems
Component:	
Address:	24 Bridge Street P.O. Box 30-248 Lower Hutt, NEW ZEALAND
Contact:	David Clist
Position:	Business Development Manager
Notes:	c/o systems, detectors & sensors, infrared systems & equipment, thermal imaging

Organization:	Marlow Industries, Inc.
Component:	
Address:	10451 Vista Park Road Dallas, TX 75238-1645
Contact:	Bill Kolander
Position:	Product Marketing Manager
Notes:	infrared systems & equipment, night vision, detectors and sensors, c/o systems

Organization:	Martin Marietta
Component:	
Address:	103 Chesapeake Park Plaza Mail point 110 Baltimore, MD 21220
Contact:	William Greenlaw
Position:	Mr.
Notes:	

Organization:	Matrix Scientific Systems
Component:	
Address:	
Contact:	Ken Matz
Position:	Mr.
Notes:	

Organization:	Maury Microwave Corp
Component:	
Address:	2900 Inland Empire Blv Ontario, CA 91764
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	McCallum & Associates, Inc.
Component:	
Address:	330 Pearl Street, Suite 3A New York, NY 10038
Contact:	Alex McCallam
Position:	President
Notes:	Represents MediScience, Inc, which funded Alfano's work at CCNY on breast cancer detection. Interests in additional funding. Sees use in cancer pre-diagnosis and cardiology during operations.

Organization:	McDonnel Douglas Tech Inc.
Component:	
Address:	11955 Bajada Road San Diego, CA 92128-2023
Contact:	Bob Madding
Position:	Mr.
Notes:	active in infrared remote sensing

Organization:	McDonnell Douglas Aerospace
Component:	
Address:	1801 E. St. Andrew Place Santa Ana, CA 92705
Contact:	Nick Willick
Position:	Senior Manager
Notes:	Night Vision, thermal imaging, e/o systems

Organization:	McDonnell Douglas Corporation
Component:	MD Research Laboratories
Address:	PO Box 516 Saint Louis, MO 63166
Contact:	John Dimmock
Position:	Gmgr
Notes:	Infrared detectors and fluid dynamics.

Organization:	McGill University
Component:	
Address:	
Contact:	L. Kops
Position:	
Notes:	Co-authored 1983 "Application of Infrared Radiation Measurements in Grinding Studies"

Organization:	MCP Wafer Technology
Component:	
Address:	Unit 34, Maryland Road, Tongwell, Milton Keynes, Bucks, MK158HJ UNITED KINGDOM
Contact:	K.C. Lamb
Position:	Marketing Manager
Notes:	Production of CdTe and GaAs for infrared applications.

Organization:	MDA Scientific, Inc.
Component:	
Address:	Suite 185, 3000 Northwoods Pkwy Norcross, GA 30071
Contact:	Orman Simpson
Position:	Pres
Notes:	Optical remote sensing techniques.

Organization:	Melles Griot
Component:	
Address:	1770 Kettering St. Irvine, CA 92714
Contact:	Jan Melles
Position:	CEO
Notes:	Research into optical sciences and optical thin films.

Organization:	Merlin Engineering
Component:	
Address:	1888 Embarcadero Road Palo Alto, CA 94303
Contact:	Dan Dusel
Position:	Vice President
Notes:	thremal imaging, infrared systems & equipment

Organization:	MET, Inc.
Component:	
Address:	Dallas, TX
Contact:	
Position:	
Notes:	A joint effort between Hughes and Texas Instruments to develop large scanning arrays for use on the RAH-66 helicopter.

Organization:	Metaleurop
Component:	
Address:	Langelsheim, Germany
Contact:	
Position:	
Notes:	Manufacture of germanium for infrared applications.

Organization:	Microwave Technology Incorporated
Component:	
Address:	4268 Solar Way Fremont, CA 94538
Contact:	Bill Wilson
Position:	Pres
Notes:	Research on GaAs and silicon for infrared applications.

Organization:	Mikron Instruments
Component:	
Address:	445 W. Main Street Wyckoff, NJ 07481
Contact:	K. Irani
Position:	
Notes:	infrared non-destructive evaluation

Organization:	Minco Prods Inc
Component:	
Address:	7300 Commerce Lane Minneapolis, MN 55432
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	Minnesota University
Component:	Department of Electrical Engineering
Address:	Minneapolis, MN
Contact:	P.H. Handel
Position:	
Notes:	Co-authored August 1991 "Quantum Noise in Solid-State Devices in Particular HgCdTe Diodes"

Organization:	Mission Research Corporation
Component:	
Address:	Newington, VA 22122
Contact:	James P. Karins
Position:	Mr.
Notes:	Authored for 1992 SPIE workshop on IRFPAs "Models of Nonlinearities in Focal Plane Arrays"

Organization:	MIT
Component:	
Address:	Cambridge, MA 02139
Contact:	R.L. Aggarwal
Position:	
Notes:	On Program Committee of 1991 & 1992 MCT Workshop

Organization:	Mitsubishi Electric Corporation
Component:	LSI Laboratory
Address:	4-1, Mizujara Itami, Hyogo, 664 JAPAN
Contact:	Hirofumi Yagi
Position:	Mr.
Notes:	Co-authored for 1992 SPIE Workshop on IRFPAs "Improved 512X512 IRCSD with Large FIll Factor and High Saturation Level"

Organization:	Mitsubishi Electronics America, Inc.
Component:	
Address:	5665 Plaza Drive Cyprec, CA 90630
Contact:	
Position:	
Notes:	

Organization:	MMR Technology Inc
Component:	
Address:	1400 North Shoreline Blvd, Ste A-5 Mountain View, CA 94043-1312
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	Mobil Oil Corp.
Component:	Mobil Solar Energy Corp.
Address:	4 Suburban Park Dr. Billerica, MA 01821
Contact:	BM Gillespi
Position:	Pres
Notes:	Solar cell and photovotaic power components and systems development.

Organization:	Monitek Technologies, Inc.
Component:	
Address:	1495 Zephyr Ave. Hayward, CA 94544
Contact:	Kenneth Anderson
Position:	Pres
Notes:	Optical and electronic measurement systems to detect particulate matter, oils and color in fluids.

Organization:	Morton International
Component:	CVD Incorporated
Address:	185 New Boston St. Woburn, MA 01801
Contact:	Robert Donadio
Position:	Pres
Notes:	Material sciences, novel optical concepts and laser applications.

Organization:	MOSET Corporation
Component:	
Address:	El Toro, CA 92630
Contact:	Ken Zanio
Position:	Mr.
Notes:	Authored for 1992 SPIE Workshop on MCT "HgCdTe on Si for Monolithic Focal Plane Arrays" supported by NRL contract from Dean Scribner

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Organization:	Motorola Corporation
Component:	
Address:	1303 East Algonquin Road Schaumberg, IL 60196
Contact:	Ravi Bhatla
Position:	
Notes:	infrared non-destructive evaluation

Organization:	MR Semicon, Inc.
Component:	
Address:	276 Route 59 Tall Pines Industrial Park Monsey, NY 10952-3407
Contact:	Roger Waldock
Position:	Pres.
Notes:	Manufacture of CdTe and GaAs for infrared applications.

Organization:	MS2i
Component:	
Address:	38 Bd Paul Cezanne BP 235 78052 St Quentin en Yvelines FRANCE
Contact:	
Position:	
Notes:	remote sensing systems, multispectral

Organization:	Muffoletto Optical Company, Inc
Component:	
Address:	6100 Everall Ave. Baltimore, MD 21206
Contact:	Rose Jones
Position:	Pres
Notes:	Design and development of optical systems for underwater, laboratory and space applications.

Organization:	Nalorac Cyrogenics Corp
Component:	
Address:	837 Arnold Drive, Ste 600 Martinez, CA 94553
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	NASA
Component:	Langley Research Center
Address:	MS 231 Hampton, VA 23665
Contact:	Elliot Cramer
Position:	Mr.
Notes:	infrared non-destructive evaluation

Organization:	NASA, Langley Research Center
Component:	Analytical Services and Manufacturing, Inc.
Address:	c/o MS 231 Hampton, VA 23665
Contact:	Patricia A. Howell
Position:	Ms.
Notes:	infrared non-destructive evaluation

Organization:	National Institute of Standards and Technology
Component:	Semiconductor Electronics Division
Address:	Gaithursburg, MD 20899
Contact:	J.R. Lowney
Position:	
Notes:	Co-Authored "Heavily Accumulated Surfaces of MCT Detectors: Theory and Experiment" for 1992 MCT Workshop. For 1991 Workshop, "Investigation of Mercury Interstititals in MCT Alloys Using Resonant Impact-Ionization Spectroscopy"

Organization:	National Taiwan University
Component:	Department of Electrial Engineering
Address:	Taipei, Taiwan, REPUBLIC OF CHINA
Contact:	Shi-Chen Chao
Position:	
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Electrolyte Eletroreflectance Specrtoscopics for the Ion-Implanted HgCdTe with Thermal Annealing"

Organization:	NEC Corporation
Component:	
Address:	4-1-1 Miyazaki Miyamae, Kawasaki, 216 JAPAN
Contact:	T. Sasaki
Position:	Mr.
Notes:	Co-authored for 1991 MCT Workshop "Study of CdTe Epitaxial Growthn on (211)B GaAs by MBE"

Organization:	NEC Corporation
Component:	Microelectronics Research Laboratories
Address:	1120, Shimokuzawa, Kanagawa 229, JAPAN
Contact:	A. Tanabe
Position:	Mr.
Notes:	Co-authored for 1992 SPIE workshop on IRFPAs "Optimum Barrier Height in Schottky-Barrier Infrared CCD Image Sensor"

Organization:	NESLAB Instruments Inc
Component:	
Address:	PO Box 1178 Portsmouth, NH 03802-1178
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	New Jersey Institute of Technology
Component:	
Address:	Newark, NJ 07102
Contact:	N.M. Ravindra
Position:	
Notes:	Authored for 1992 SPIE meeting on IRFPAs "HgCdTe Photovoltaic Detectors and Some Related Aspects"

Organization:	Newport Corporation
Component:	
Address:	18235 Mount Baldy Circle Fountain Valley, CA 92708
Contact:	Dr Tom Galantowicz
Position:	CEO
Notes:	Electro-optic and electro-mechanical components and systems for laser optical applications.

Organization:	Newport Industrial Glass Inc.
Component:	
Address:	2044-C Placentia Avenue Costa Mesa, CA 92627
Contact:	Ray Larsen
Position:	Director
Notes:	Manufacturer of CdTe, GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications.

Organization:	Nichols Research Corp.
Component:	
Address:	4040 South Memorial Parkway Huntsville, AL 35802
Contact:	Patsy Hattox
Position:	Vice President
Notes:	Infrared systems and equipment, imaging software

Organization:	Nicolet Instrument Corporation
Component:	Spectra Tech Inc.
Address:	652 Glenbrook Rd, PO Box 2190-G Stamford, CT 06906
Contact:	Donald Sting
Position:	CEO
Notes:	Infrared spectroscopy instruments and applications.

Organization:	Night Vision Equipment Co., Inc.
Component:	
Address:	P.O. Box 266 Emmaus, PA 18049
Contact:	Gene Adcock
Position:	Dir. U.S. Govt. Programs
Notes:	e/o systems, infrared systems and equipment, night vision equipment

Organization:	Norman Axelrod, Associates
Component:	Norman N. Axelrod Associates Development Laboratory
Address:	28 W 44th St New York, NY 10036
Contact:	Norman Axelrod
Position:	Pres
Notes:	Planning, development, and fabrication of electro-optical, laser, and machine vision systems for on-line sensing and control, digital and analog information; computer automated optical systems.

Organization:	North Atlantic Industries, Inc.
Component:	
Address:	60 Plant Avenue Hauppauge, NY 11788-3890
Contact:	Marvin Friedman
Position:	Director of Marketing
Notes:	Thermal imaging

Organization:	North Carolina State University
Component:	Department of Physics
Address:	Raleigh, NC 27695-8202
Contact:	P.K. Baumann
Position:	
Notes:	Authored for 92 MCT workshop "Growth of HgSe and HgCdSe Thin Films by Molecular Beam Epitaxy"

Organization:	North Texas State University
Component:	Department of Physics
Address:	Denton, TX
Contact:	Chris L. Littler
Position:	
Notes:	Authored July 1990 "Two-Photon Absorption Characterization of HgCdTe"

Organization:	Northrop Corp.
Component:	Electronics Systems Division
Address:	600 Hicks Road Rolling Meadows, IL 60008-1098
Contact:	Laurel Chivari
Position:	Manager, Public Relations
Notes:	infrared systems and equipment

Organization:	Northrop Corporation
Component:	Hawthorne Site
Address:	2301 W120th St Hawthorne CA 90250-5032
Contact:	Kent Kresa
Position:	CEO
Notes:	Precision inertial sensors and lasers.

Organization:	Northrop Corporation
Component:	Rolling Meadows Site
Address:	600 Hicks Rd. Rolling Meadows, IL 60008
Contact:	James Owlswey
Position	VP
Notes:	Development of electronic and infrared detection systems.

Organization:	Northwestern University
Component:	
Address:	
Contact:	Manijeh Razeghi
Position:	Dr.
Notes:	Presented at December 1992 DARPA IRFPA Technology Program Reviews on "Physics and Performance of GaInP/GaAs Quantum Wells and New Infrared III-V Compound InTiSb

Organization:	Northwick Park Hospital
Component:	Dept of Orthopaedics
Address:	Watford Road Harrow, UNITED KINGDOM
Contact:	Leonard Klenerman
Position:	Dr.
Notes:	active in infrared biomedical thermography

Organization:	Notre Dame University
Component:	Physics Department
Address:	255 Nieuwland Hall Notre Dame, IN 46556
Contact:	Hong Luo
Position:	
Notes:	Attended 1992 MCT workshop

Organization:	O R S Automation
Component:	
Address:	402 Wall St. Princeton, NJ 08540
Contact:	Edward Kornstein
Position:	Pres
Notes:	Controls and guidance directed towards problems in machine vision for individual use.

Organization:	Officine Galileo
Component:	
Address:	V.A. Einstein 35 50013 Campi Bisenzio, Florence ITALY
Contact:	Michele Pimpinenelli
Position:	Marketing
Notes:	Night vision, thermal iamging, infrared systems & equipment

Organization:	Ohio State Univeristy
Component:	
Address:	469 Dreese Lab 2015 Knil Avenue Columbus, OH 43210-1210
Contact:	Kim Boyer
Position:	
Notes:	active in infrared process control

Organization:	Omnidata International Inc.
Component:	
Address:	750 W 200 North, PO Box 3489 Logan, UT 84321
Contact:	Gilbert Larson
Position:	Pres
Notes:	Development of environmental and industrial sensors, hardware and software for data collection systems.

Organization:	Optical Energy
Component:	
Address:	472 Westover Rd Stamford, CT 06902
Contact:	Gerald Falbel
Position:	Chmn
Notes:	Research into electro-optical engineering.

Organization:	Optical Radiation Corp.
Component:	
Address:	1300 Optical Dr. Azusa, CA 91702
Contact:	Richard Wood
Position:	Pres
Notes:	Development of electro-optical systems.

Organization:	Optical Research Associates
Component:	
Address:	550 N Rosemead Blvd. Pasadena, CA 91107
Contact:	Thomas Harris
Position:	Pres
Notes:	Research in optical design engineering.

Organization:	Optical Semiconductors Inc.
Component:	
Address:	8 John Walsh Blvd, Suite 421 Peekskill, NY 1[illegible]66-5330
Contact:	Brian Fitzpatrick
Position:	President
Notes:	Manufacture of ZnS and ZnSe for infrared systems.

Organization:	Optical Technologies, Inc.
Component:	
Address:	Suite 1200, 360 Herndon Pkwy Herndon, VA 22070
Contact:	Robert Einzig
Position:	Pres
Notes:	Research and development of fiber optic sensors for the measurement of physical parameters.

Organization:	Optoelectronics- Textron
Component:	
Address:	1309 Dynamics St. PO Box 750039 Petaluma, CA 94975-0039
Contact:	Peter McGrath
Position:	General Manager
Notes:	Manufactures lead salt infrared detectors and related components

Organization:	Optotex, Ltd.
Component:	
Address:	62 Stencic Drive Kanata, Ontario, CANADA K2K 2A9
Contact:	David Kennedy
Position:	Marketing Manager
Notes:	GaAs gate arrays, infrared systems and equipment, rf systems and components

Organization:	Oriel Corp
Component:	
Address:	250 Long Beach Blvd., PO Box 872, Stratford, CT 06497
Contact:	Eugene Arthurs
Position:	Dir
Notes:	Optics and detectors for ultraviolet through infrared systems.

Organization:	Osprey Sub-Sea, Inc
Component:	
Address:	1225 Stone Dr. San Marcos, CA 92069
Contact:	Tony Gardiner
Position:	Pres
Notes:	Night vision equipment and acoustic tracking systems.

Organization:	Overhead Door Corp
Component:	Horton Automatics Division
Address:	1900 Crown Dr. Farmers Branch, TX 75234
Contact:	Robert Haugh
Position:	Pres
Notes:	Microwave and infrared sensing technology.

Organization:	Overhoff Technologies Corporation
Component:	
Address:	1160 US RT 50, PO Box 182 Millford, OH 45150
Contact:	Dr MW Overhoof PhD
Position:	Pres
Notes:	Infrared, other optical, ultraviolet and nuclear, gaging.

Organization:	Oxley Developments Co., Ltd.
Component:	
Address:	Priory Park Ulverston Cumbria, UK LA12 9QG
Contact:	J.A. Pickup
Position:	Sales Admin. Manager
Notes:	detectors and sensors, infrared systems and equipment

Organization:	Oxley, Inc.
Component:	
Address:	25 Business Park Drive P.O. Box 814 Branford, CT 06405
Contact:	Audra Kurelaitis
Position:	Sales Manager
Notes:	c/o systems, night vision, infrared systems & equipment

Organization:	Pacer Systems, Inc.
Component:	
Address:	900 Technology Park Drive Billerica, MA 01803
Contact:	Joe Straub
Position:	Manager, Signal Processing Systems
Notes:	infrared systems & equipment

Organization:	Paramax Systems Corp.
Component:	
Address:	8201 Greensboro Drove, Suite 1000 McLean, VA 22102
Contact:	Gary Teagarden
Position:	Dir. Marketing Communications
Notes:	passive and active e/o systems, e/o systems, infrared systems and equipment

Organization:	Pattern Processing Technologies
Component:	
Address:	Suite 170, 10025 Valley View Rd. Eden Prairie, MN 55344
Contact:	Joseph Christenson
Position:	Pres
Notes:	Product oriented machine vision systems.

Organization:	PCI Inc.
Component:	
Address:	50 West Wilmot Street, Unit 3 Richmond Hill, Ontario L4B 1M5 CANADA
Contact:	
Position:	
Notes:	REMOTE SENSING SYSTEMS, THERMAL INFRARED, MULTISPECTRAL

Organization:	Peda-Scan Infrared Service, Inc.
Component:	
Address:	1932 Olde Eisenbath Ln. Foristell, MO 63348
Contact:	Steven Eisenbath
Position:	Pres
Notes:	Research for industry; thermal evaluation of performance of products.

Organization:	Perceptronics Incorporated
Component:	
Address:	21135 Erwin Street Woodland Hills, CA 91365-4198
Contact:	Christopher Harz
Position:	VP Mkt.
Notes:	Has been awarded several government contracts to conduct research and development of computer aided manufacturing processes for IRFPAs.

Organization:	Pharm-Eco Laboratories
Component:	
Address:	2355 Chain Dr. Simi Valley, CA 93065
Contact:	DR Kurt Grimm
Position:	Pres
Notes:	Infrared research, gas chromatography and wet chemical tests.

Organization:	Pharos Inc.
Component:	Agema Infrared Systems
Address:	595 Skippack Pike Blue Bell, PA 19128
Contact:	Phillip Smith
Position:	Pres
Notes:	Infrared measurement systems.

Organization:	Phase 4 Infrared
Component:	
Address:	P.O. Box 2647 Acton, MA 01720
Contact:	R. Gentilman
Position:	Pres.
Notes:	Manufacturer of ZnS and ZnSe for infrared applications.

Organization:	Philadelphia Electric Company
Component:	Peach Bottom Atomic Power Station
Address:	Rd #1 Box 208 Delat, PA 17314
Contact:	Robert N. Wurzbach
Position:	Mr.
Notes:	active in infrared predictive maintenance

Organization:	Philips Infrared Defense Components
Component:	
Address:	Milbrook Industrial Estate, Southampton, SO9 7BH UNITED KINGDOM
Contact:	
Position:	
Notes:	A large producer of 64X64 HgCdTe FPAs. Primarily sold to GEC Sensors for use on a wide variety of systems. Manufactures and supplies infrared detectors based on MCT, TGS, and other materials for use in night vision and industrial applications.

Organization:	Photon Energy
Component:	
Address:	El Paso, TX
Contact:	
Position:	
Notes:	Mass production of CdTe for solar applications.

Organization:	Photox Optical Systems
Component:	
Address:	P.O. Box 274 Headington, Oxford, OX3 OBJ UNITED KINGDOM
Contact:	Jean Aitchison
Position:	Gen Mgr.
Notes:	Manufacture of GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications.

Organization:	Photronics Corp.
Component:	
Address:	270 Motor Parkway P.O. Box 11368 Hauppauge, NY 11788
Contact:	Peter C. Connolly
Position:	Business Development Manager
Notes:	e/o systems, infrared systems and equipment, night vision

Organization:	Picker International, Ltd.
Component:	Engineering Dept
Address:	P.O. Box 2, East Lane Wembley, HA9 7PR, UNITED KINGDOM
Contact:	James E. Culley
Position:	
Notes:	active in infrared biomedical thermography

Organization:	Pilkington Optronics
Component:	
Address:	Caxton Street Anniesland, Glasgow GL13 1HZ
Contact:	Tom O'Neill
Position:	CEO
Notes:	Thermal imaging and surveillance systems, laser rangefinders, etc. visible and IR optical systems. Producer of HgCdTe-based FPSs for a variety of military systems, including the IRST on the EFA.

Organization:	Pilkington Visioncare
Component:	Coburn Optical Industries
Address:	Suite 200, 4606 S Garnett Tulsa, OK 74146
Contact:	John Blocha
Position:	President
Notes:	Development of infrared products for military and commerical applications.

Organization:	PJ Wolfson Co Inc
Component:	
Address:	50 Kewanee Road New Rochelle, NY 10804
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	Plasma Physics Corp.
Component:	
Address:	PO Box 548 Locust Valley, NY 11560
Contact:	John Coleman
Position:	CEO
Notes:	Development and manufacture of photoreceptor drums, solar cells and imaging, polymer laminating, and laser isotope separation.

Organization:	Plessey Semiconductors Ltd.
Component:	
Address:	Unit 1, Crompton Road Groundwell Ind. Estate, Seindon, Wilts SN2 5AY UNITED KINGDOM
Contact:	Ernie Pusey
Position:	Mkt. Dir.
Notes:	Manufacture of a wide variety of HgCdTe-based infrared systems.

Organization:	PPM Pure Metals
Component:	
Address:	111 Richmond Street, West, Suite 418 Toronto, Ontario, CANADA M5H 2G4
Contact:	Raymond Wary
Position:	Sls Mgr
Notes:	Manufacture of germanium for infrared technologies.

Organization:	Preh Electronic Inc.
Component:	
Address:	470 E. Main Lake Zurich, IL 60047
Contact:	Pat Jones
Position:	Sales Manager
Notes:	Infrared systems & equipment

Organization:	Pulse Instruments
Component:	
Address:	1234 Francisco Street Torrance, CA 90502
Contact:	Ron Perry
Position:	Dir. Sales and Marketing
Notes:	e.o systems, infrared systems & equipment

Organization:	Pure Tech Inc.
Component:	
Address:	P.O. Box 1319 Carmel, NY 10512
Contact:	Earle Ellefsen
Position:	Pres.
Notes:	Manufacture of CdTe, germanium, silicon, ZnS, and ZnSe for infrared applications.

Organization:	Qingdao University
Component:	Department of Computer and Information Science
Address:	Qingdao, Shandong, CHINA
Contact:	Yan Jing-Xuan
Position:	
Notes:	Co-authored for 1992 SPIE conference on IRFPAs "The Dependence of Fermi Level of HgCdTe on Impurity Concentration and Temperature"

Organization:	R&D Institute for Semiconductor Devices
Component:	
Address:	ROMANIA
Contact:	E.T. Harlmagean
Position:	
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Accurate Method for Neutraon Fluence Control Used in Improving Neutron-Transmutation-Doped Silicon Detectors"

Organization:	Ramey Aerospace
Component:	
Address:	Box 39 Carmel, CA 93924
Contact:	Tom Ramey
Position:	President
Notes:	Thermal Imaging, Infrared systems & equipment

Organization:	Ramtek Corporation
Component:	
Address:	1525 Atteberry Lane San Jose, CA
Contact:	
Position:	
Notes:	remote sensing systems, multispectral

Organization:	Ranco, Inc
Component:	Paragon Electric Comp.
Address:	606 Parkway Blvd. Two Rivers, WI 54241
Contact:	T Growcock
Position:	VP
Notes:	Photo-electric controls.

Organization:	Raytheon Submarine Signal Division
Component:	
Address:	1847 West Main Road Portsmouth, RI 02871
Contact:	Paul Hitchen
Position:	Marketing Comm. Mgr.
Notes:	Thermal imaging, detectors and sensors

Organization:	Recognition Concepts, Inc.
Component:	
Address:	5200 Convair Drive Carson City, NV 89706
Contact:	Debra Withrow
Position:	Advertising Manager
Notes:	infrared systems & equipment, imaging software

Organization:	Renssalaer Polytechnic Institute
Component:	Physics Department and Center for Integrated Electronics
Address:	Troy, NY 12180
Contact:	E.Y. Lee
Position:	
Notes:	Co-authored for 1992 meeting of SPIE on IRFPAs "Fundamental Studies of Schottky Barrier IR Detectors by Ballistic Electron Emission Microscopy"

Organization:	Rensselaer Polytechnic Institute
Component:	ECSE Department
Address:	Troy, NY 12180
Contact:	Ishwara B. Bhat
Position:	
Notes:	Co-authored "Improved CdTe Layers on GaAs and Si Substrates, Grown by Atomic Layer Epitaxy" for 1992 MCT Workshop. Co-authored for 1991 MCT Workshop "Low Temperature Epitaxy of HgTe, CdTe, and HgCdTe Using Flow Modulation Techniques" and "Reduced Metal-Insulator Semiconductor Tunneling in MOCVD MC(111)Te Films"

Organization:	Research Devices, Inc.
Component:	
Address:	121 Ethel Road West Piscataway, NJ 08854
Contact:	Michael Schneider
Position:	Mr.
Notes:	AUthored for 1992 SPIE Workshop on MCT "Hybridizing Focal Plane Arrays."

Organization:	Research Opportunities, Inc.
Component:	
Address:	2200 Hamipola Court Suite 101 Torrance, CA 90501
Contact:	William De La Torre
Position:	Mr,
Notes:	infrared non-destructive evaluation

Organization:	RGB Spectrum
Component:	
Address:	950 Marine Village Parkway Alameda, CA 94501
Contact:	Robert P. Marcus
Position:	President
Notes:	Thermal imaging

Organization:	RICOR Ltd.
Component:	
Address:	En Haros (IHUD) 18960 Israel
Contact:	N. Pundak
Position:	Mr.
Notes:	Authored for 1992 SPIE IRFPA workshop "Miniature Closed Cycle Cooler for FPA Detectors"

Organization:	Robotron Corp.
Component:	
Address:	21300 W Eight Mile Rd. PO Box 5090, Southfield, MI 48086
Contact:	Leonard Brzozwski
Position:	Pres
Notes:	Ion processing and other non-traditional heat treating processes, welding of ferrous and non ferrous metals

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Organization:	Rockwell Engineering Co., Inc.
Component:	
Address:	2121 E. 45th St Indianapolis, IN, 46205
Contact:	Tom Rockwell
Position:	CEO
Notes:	Optical radiation research.

Organization:	Rockwell International Corp.
Component:	Government Business Division
Address:	1201 S Second St. Milwaukee, WI 53204
Contact:	George Brooks
Position:	Group Vice President
Notes:	Passive electronic components.

Organization:	Rockwell International Corporation
Component:	Defense Electronics
Address:	3370 Miraloma Ave. Anaheim, CA 92803
Contact:	J.A. McLuckey
Position:	President
Notes:	Electro-optical products and systems.

Organization:	Rockwell International Corporation
Component:	Electro-Optical Center
Address:	3370 Miraloma Ave. Anaheim, CA 92803
Contact:	J.B. Gilpin
Position:	Manger Detector Products
Notes:	Also their representative in the JM consortium

Organization:	Rockwell International Corporation
Component:	Industrial Control Group
Address:	1201 S Second St. Milwaukee, WI 53204
Contact:	Larry Yost
Position:	SrVP
Notes:	Automation systems and industrial controls.

Organization:	Rockwell International Corporation
Component:	Science Center
Address:	1049 Camino Do Rios PO Box 1085 Thousand Oaks, CA 91358
Contact:	Joseph Longo
Position:	VP
Notes:	Basic applied research in electro-optics.

Organization:	Rocky Mountain Instrument Co.
Component:	
Address:	1501S Sunset St. Longmont, CO, 80501
Contact:	Yubong Hahn
Position:	Pres
Notes:	Manufacture of precision optical components and multilayer thin film coatings.

Organization:	Rodenstock Industrial Optics
Component:	
Address:	P.O. Box 14 04 40 Jsartalstrasse 43 D-8000 Munich 5, GERMANY
Contact:	Mangred Schuck
Position:	Senior Manager
Notes:	infrared systems & equipment, e/o systems, thermal imaging

Organization:	Rosemount Inc.
Component:	Aerospace Division
Address:	14300 Judicial Road Burnsville, MN 55337
Contact:	Sol Mirelez
Position:	Marketing Communications Manager
Notes:	

Organization:	S.I. Vavilov State Optical Institute
Component:	
Address:	Moscow, RUSSIA
Contact:	M.M. Miroshnikov
Position:	Mr.
Notes:	Authored for 1991 SPIE meeting on Infrared Technology "Infrared in the USSR: Brief HIstorical Survey of Infrared Development in the Soviet Union"

Organization:	Sam Houston State University
Component:	Department of Physics
Address:	Huntsville, TX 77341
Contact:	W. Covington
Position:	
Notes:	Co-authored "Properties of InAs/(Ga,In)Sb Strained Layer Superlattices Grown on the (111) Orientations" for 1992 MCT Workshop

Organization:	Sandia National Labs
Component:	
Address:	ORG 8246 P.O. Box 969 Livermore, CA 94511
Contact:	Elizabeth A. Fuchs
Position:	Ms.
Notes:	active in infrared remote sensing

Organization:	Santa Barbara Focalplane
Component:	
Address:	69 Santa Felicia Drive Goleta, CA 93117
Contact:	Brett Rosner
Position:	Senior Engineer
Notes:	

Organization:	SAT
Component:	
Address:	41, rue Cantagrel F-75361 Paris Cedex 13 FRANCE
Contact:	Bernard Christophe
Position:	
Notes:	Along with Thomson CSF, places HgCdTe-based sensors on a variety of military products, including the Rafale fighter. Also produces own InSb-based IRFPAs for use in missile guidcance.

Organization:	Satcon Technololgy Corp.
Component:	
Address:	12 Emily ST. Cambridge, MA 02139-4507
Contact:	David Eisenhaure
Position:	Pres
Notes:	Power electronics and system integration.

Organization:	Scandinavian Avionics
Component:	
Address:	Billund Airport P.O. Box 59 7190 Billund, DENMARK
Contact:	E.M. Talund
Position:	Defece Sales
Notes:	infrared systems and equipment, thermal imaging, night vision

Organization:	Schlumberger Limited
Component:	Statham Transducers
Address:	2230 Statham Rd. Oxnard, CA 93033
Contact:	Malcom Unsworth
Position:	Gmgr
Notes:	Micromachined silicone and thin film sensors.

Organization:	Schott Glaswerke
Component:	
Address:	Mainz, Germany
Contact:	
Position:	
Notes:	Manufacture of ZnS and ZnSe for infrared applications.

Organization:	Schwartz Electro-Optics
Component:	
Address:	3404 N Orange Blossom Trail Orlando, FL 32804
Contact:	WC Schwartz
Position:	President
Notes:	Medical and industrial applications of mid infrared solid state systems.

Organization:	Science & Engineering Consultants, Inc.
Component:	
Address:	Suite 300, 1820 discovery St. Reston, VA 22090-5610
Contact:	Dr Joseph Siewick
Position:	CEO
Notes:	Research in imaging and remote sensing.

Organization:	Science & Technology Corp
Component:	
Address:	101 Research Dr., PO Box 7390 Hampton, VA 23666
Contact:	A. Deepak
Position:	Presidnent
Notes:	Development and manufacture of electro-optic sensors.

Organization:	Scisco Inc
Component:	
Address:	6020 Academy, NE PO Box 25446 Albuquerque, NM 87125)
Contact:	AZ Lazzara
Position:	Pres
Notes:	Optical sensor data reduction.

Organization:	Scott-White Clinic
Component:	
Address:	Temple, TX 76501
Contact:	Mitchell R. Smigield
Position:	Dr.
Notes:	active in infrared biomedical thermography

Organization:	Semcor Inc
Component:	
Address:	815 E Gate Dr. Mount Laurel,NJ 08054
Contact:	Vincent Vidas
Position:	CEO
Notes:	Optical, infrared, and ultraviolet detection systems.

Organization:	Semi-conductor Devices, Inc.
Component:	
Address:	D.N. Misgav 20179 ISRAEL
Contact:	A. Kepten
Position:	Mr.
Notes:	Co-authored for 1992 SPIE Workshop on IRFPAs "p-Channel MIS Double-Metal Process InSb Monolithic Unit Cell for Infrared Imaging"

Organization:	Semiconductor Processing Co., Inc.
Component:	
Address:	409 East First Street Boston, MA 02127
Contact:	Nicholas Sink
Position:	Gen. Mgr.
Notes:	Manufacturer of GaAs, germanium, and silicon for infrared applications.

Organization:	Sensor Control Corporation
Component:	Gentran
Address:	49050 Milmont Dr. Fremont, CA 94538
Contact:	Paul Page
Position:	Mgr
Notes:	Infrared temperature measurements.

Organization:	Sensors Unlimited, Inc.
Component:	
Address:	Princeton, NJ
Contact:	Greg Olsen
Position:	Mr.
Notes:	Start up company founded by former persident and CEO of EPITAXX, Inc., to advance recent developments in III-V compound device tech fro sensing and imaging applications in the 1000-3000 nm near-infrared spectrym. Ongoing development projects include a monolithic InGaAs detector for NASA Jet Propulsion Labs and 2000-5000 DFB lasers for Kirtland Air Force Base Phillips Lab.

Organization:	Sequa Corporation
Component:	Kollsman Military Systems
Address:	220 Daniel Webster Merrimack, NH 03054
Contact:	Ronald Wright
Position:	President
Notes:	A variety of infrared research using primarily HgCdTe and InSb. Most HgCdTe is reportedly supplied by Sofradir.

Organization:	Servo Corporation of America
Component:	
Address:	111 New South Road Hicksville, NY 11802
Contact:	Alan Doctor
Position:	Sales & Marketing Manager
Notes:	

Organization:	Shandong University
Component:	Infrared and Remote Sensing
Address:	Jinan, Shandong, CHINA
Contact:	Hu Xierong
Position:	
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Study of the Recombination Mechanisms and Carrier Lifetimes in HgCdTe Alloy"

Organization:	Shanghai Institute of Technical Physics
Component:	Academia Sinica
Address:	China 200083
Contact:	Xu Guosen
Position:	
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "The Effect of Shockley-Read Recombination on Minority Carrier Lifetime of HgCdTe"

Organization:	Siemens AG
Component:	
Address:	SI SM MA Landsluter Strasse 26 8044 Unterschleissheim, GERMANY
Contact:	U. Zinnegger
Position:	Marketing Manager
Notes:	Infrared systems & equipment, night vision

Organization:	Silicon Casting Inc.
Component:	
Address:	2616 Mercantile Drive Rancho Cordova, CA 95742
Contact:	Joseph DeSimone
Position:	Pres.
Notes:	Manufacturer of silicon for infared applications.

Organization:	Silicon Sensor Inc
Component:	
Address:	Hwy 18 E PO Box 137 Dodgeville, WI 53533
Contact:	Robert Bachner
Position:	CEO
Notes:	Manufacture of light sensitive products.

Organization:	Silicon Valley Group, Inc.
Component:	
Address:	2240 Ringwood Ave. San Jose CA 95131
Contact:	Vahne Farkissian
Position:	Pres
Notes:	Semiconductor wafer processing equipment.

Organization:	Silonex Inc
Component:	Silonex, Inc
Address:	2150 Ward St. Montreal CANADA PQ H4M 1T7
Contact:	Alex Kalil
Position:	Pres
Notes:	Optoelectronics automation of manufacturing.

Organization:	Societe Anonyme de Telecommunications
Component:	
Address:	41, rue Cantagrel 75631 Paris, Cedex 13 FRANCE
Contact:	D. Lorans
Position:	Mr.
Notes:	Co-authored for 1992 MCT Workshop "Substrate Issues for Mercury Cadmium Telluride"

Organization:	Societe de Fabrication d'Instruments de Mesure
Component:	
Address:	13 avenue Ramolfo Garnier F91344 Massy Dedex FRANCE
Contact:	Ginette Sarrazin
Position:	Service Publicite
Notes:	thermal imaging, night vision equipment

Organization:	Sofradir
Component:	
Address:	43-47 rue Camille-Pelletan 92290 Chatenay-Malabry, FRANCE
Contact:	
Position:	
Notes:	Thomson CSF owns 40 percent, SAT owns 40 percent, and CEA owns 20 percent of this company, which is France's largest producer of infrared materials. There are currently over 20 programs underway utilyzing HgCdTe.

Organization:	Sogem-Afrimet Inc.
Component:	
Address:	1212 Avenue of the Americas New York, NY 10036
Contact:	Edward Kielty
Position:	Mr.
Notes:	Manufacturer of germanium for infrared applications.

Organization:	Solar Power Engineering Company
Component:	
Address:	PO Box 91 Morrison, CO 80465
Contact:	Harrison Wroton
Position:	Pres
Notes:	Tracking photovotaic tracking power systems.

Organization:	Soreq Nuclear Research Center
Component:	
Address:	ISRAEL
Contact:	D. Eger
Position:	Mr.
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Anodic Oxides on HgZnTe"

Organization:	Southern Illinois Univ School of Medecine
Component:	
Address:	P.O. Box 9230 Springfield, IL 62794-9230
Contact:	Roger B. Traycoff
Position:	Dr.
Notes:	active in infrared biomedical thermography

Organization:	Southern Methodist University
Component:	
Address:	
Contact:	A.R. Khotanzad
Position:	
Notes:	Co-authored for 1992 SPIE meeting on Machine Vision "Automated Vision System for INspection of Wedge Bonds"

Organization:	Southern Nuclear Operating Center
Component:	
Address:	40 Inverness Center Parkway Birmingham, AL 35242
Contact:	Albert E. Hammett
Position:	Mr.
Notes:	active in infrared predictive maintenance

Organization:	Southwest Engineering
Component:	
Address:	714 First National Bank Bldg. Fort Smith, AR 72901
Contact:	Myles Friedman
Position:	Pres MyPres
Notes:	Computer/electronic controls for manufacturing processes.

Organization:	SPAR Aerospace, Ltd.
Component:	Advanced Technology Systems Group
Address:	9445 Airport Road Brampton, Ontario, CANADA L6S 4J3
Contact:	G. Stan Boyington
Position:	Director Business Development
Notes:	Infrared systems and equipment, e/o systems, thermal imaging

Organization:	Spar Aerospace, Ltd.
Component:	Applied Systems Group
Address:	365 March Road Kanata, Ontario, CANADA K2K 1X3
Contact:	Bruce Hinman
Position:	Dir. Business Development and Contracts
Notes:	e.o systems, infrared systems & equipment, night vision

Organization:	SPEC Industries
Component:	
Address:	Edison, NJ
Contact:	
Position:	
Notes:	Produces a 1024 X 256 pixel format CCD detector array that doubles the specral coverage avilable from SPEC industries

Organization:	Specac Ltd.
Component:	
Address:	River House, Lagoon Rd. St. Mary Cray, Orpington, Kent BR5 3QX UNITED KINGDOM
Contact:	W.R. Bradbury
Position:	Mktg. Dir.
Notes:	Manufacture of germanium, silicon, ZnS, and ZnSe for infrared applications.

Organization:	Spectrogram Corp.
Component:	
Address:	385 State St. North Haven, CT 06473
Contact:	Herbert Gram
Position:	Pres
Notes:	General research in the field of electro-optics, with a major effort on computer-based optical spectrum analysis as applied to analytical systems.

Organization:	Spectron Engineering Inc.
Component:	
Address:	255 Yuma Court Denver, CO 80223
Contact:	
Position:	
Notes:	remote sensing systems, thermal infrared, multispectral

Organization:	Spire Corp
Component:	
Address:	One Patriots Park Bedford, MA 01730
Contact:	Roger Little
Position:	President
Notes:	Photovoltaics, solar cells, compound, semiconductor thin films, and high temperature super conductors. Recently opened a new facility in Oman to produce solar cells. Manufacture of CdTe, GaAs, germanium, and silicon for infrared applications.

Organization:	SRI International
Component:	
Address:	Menlo Park, CA 94025
Contact:	M.A. Berding
Position:	
Notes:	Co-Authored "Native Defect Equilibria in HgZnTe and HgCdTe Alloys" for 1992 MCT Workshop. For 1991 Workshop, "Defect Equilibrium in HgTe"

Organization:	SRS Technology
Component:	
Address:	Suite 402 3501 Jamboree Newport Beach, CA 92660
Contact:	MS Sandhu
Position:	Pres
Notes:	Development of smart sensors, conformal-array antennas, image processing, field measurements, and process control systems.

Organization:	Stanford University
Component:	
Address:	McCullough MS 251 Stanford, CA 94305
Contact:	Jose L. Melendez
Position:	
Notes:	Attended 1992 MCT Workshop

Organization:	State Univ of NY at Buffalo
Component:	Dept of Elec & Computer Engineering
Address:	Bell Hall Buffalo, NY 14214
Contact:	Darold C. Wobschall
Position:	Dr.
Notes:	active in infrared biomedical thermography

Organization:	State University of NY at Buffalo
Component:	Dept of Biophysiacl Sciences
Address:	120 Cary Hall Buffalo, NY 14214
Contact:	Robert A. Spangler
Position:	Dr.
Notes:	active in infrared biomedical thermography

Organization:	Stocker & Yale, Inc
Component:	
Address:	133 Brimbal Ave. Beverly, MA 01915
Contact:	J Bickman
Position:	Pres
Notes:	Optical measuring units for manufacturing controls.

Organization:	Structure Probe
Component:	
Address:	569 E Gray St., PO Box 656 West Chester, PA 19381-0656
Contact:	Dr Charles Garber
Position:	Pres
Notes:	X-ray diffraction and thermal analysis.

Organization:	Sumitomo Metal Mining Co. Ltd
Component:	
Address:	Tokyo, Japan
Contact:	
Position:	
Notes:	Manufacture of CdTe and GaAs for infrared applications.

Organization:	Sunstrand Corp.
Component:	Analytical Productions Division
Address:	820 Linden Ave. Rochester, NY 14625
Contact:	Harry Stonecipher
Position:	Pres
Notes:	Image analysis equipment systems and color spectrometry.

Organization:	SUNY at Stony Brook
Component:	Department Materials Sci & Eng
Address:	Stony Brook, NY 11794-2275
Contact:	Michael Dudley
Position:	Mr.
Notes:	Attended 1992 MCT conference

Organization:	SUNY College of Technology
Component:	
Address:	
Contact:	Abdelrahman Rabie
Position:	
Notes:	AUthored 1983 "The Use of Sensors in Part Handling" available from S.M.E.

Organization:	Superior Evaporants
Component:	
Address:	6965 Highway 9 Felton, CA 95018
Contact:	Christopher Toth
Position:	President
Notes:	Manufacturer of germanium, silicon, ZnS, and ZnSe for infrared systems.

Organization:	Surveillance Research Laboratory
Component:	
Address:	DSTO O,I, Bix 1500 Salisbury, South Australia, 5108
Contact:	R.H. Hartley
Position:	Mr.
Notes:	Co-authored for 1991 MCT Workshop "Real Time Control of the MBE Growth of CdHgTe and CdTe/GhTe Superlattices Using Ellipsometry"

Organization: Swedish Space Corporation
Component:
Address: PO Box 4207, S-171 04
Solna, SWEDEN
Contact:
Position:
Notes: remote sensing systems, thermal infrared

Organization: Syracuse Research Corp.
Component: Defense Electronics Engineering
Address: Merrill Ln.
Syracuse, NY 13210
Contact: Kenneth Kun
Position: Pres
Notes: Optical and IR systems analysis.

Organization: Target Corp.
Component:
Address: 8400 Lakeview Parkway, Suite 200
Kenosha, WI 53142-7404
Contact: Carol L. Oxley
Position: President
Notes: infrared systems and equipment, passive and active e/o devices

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Organization: Tau Corporation
Component:
Address: Los Gatos, CA
Contact: Donald Hutchinson
Position: Marketing Director
Notes:

Organization:	Technical Research Center of Finland
Component:	Building Laboratory
Address:	P.O. Box 167 SF-90101 Oulu, FINLAND
Contact:	Timo Kaupinnen
Position:	
Notes:	infrared non-destructive evaluation

Organization:	Technion University
Component:	
Address:	Technion City Haifa, Israel 3200
Contact:	Yael Nemirovsky
Position:	IIT Department of Electrical Engineering
Notes:	Attended 1992 MCT Workshop

Organization:	Technische Universtat
Component:	Phsik-Department E-16
Address:	mUNCHEN, d-8046 GERMANY
Contact:	F. Koch
Position:	
Notes:	Co-authored for 1991 MCT Workshop "Influece of Resonant Defect States on Subband Structures in HgCdTe"

Organization:	Technology, Architectural, and Engineering Services
Component:	Public Works Canada
Address:	Riverside Drive Ottawa, Ontario, CANADA K1A OM2
Contact:	Antonio Colantonio
Position:	Mr.
Notes:	infrared non-destructive evaluation

Organization:	Tektronix, Inc.
Component:	
Address:	26600 Southwest Parkway Beaverton, OR 97077
Contact:	Robert Dixon
Position:	Mr.
Notes:	infrared non-destructive evaluation

Organization:	Teltron, Inc.
Component:	
Address:	2 Riga Ln. Birdsboro, PA 19508
Contact:	Arthur Mengel
Position:	Pres
Notes:	Development and production of UV, IR, and TV cameras.

Organization:	Texas Brazing Inc
Component:	Microwave Products Grp
Address:	400 E Highway 80 Forney, TX 75126
Contact:	
Position:	
Notes:	cyrogenic equipment

Organization:	Texas Instruments
Component:	Central Research Laboratories
Address:	P.O. Box 655936, MS 154 Dallas, TX 75265
Contact:	Luigi Colombo
Position:	Mr.
Notes:	

Organization:	Texas Instruments
Component:	Defense Systems and Electronics Group
Address:	POB 660246 MS 3139 Dallas, TX 75266
Contact:	Ronny Dunn
Position:	Infrared Program Manager
Notes:	

Organization:	Texas Instruments
Component:	Infrared Devices Laboratory
Address:	Dallas, TX 75265
Contact:	J.D. Luttmer
Position:	Mr.
Notes:	The Microelectronics Manufacturing Science and Technology Progarm at TI is developing a generaic semiconductor device manufacturing technology for the mid-1990's. Although the program goal is to develop and demonstrate low volume, fast cycle time, cost effective silicon microelectronic manufacturing the technology also is applicble to MCT, Ga As and other materials.

Organization:	Texas Instruments
Component:	Infrared Materials Laboratory
Address:	POB 655936 MS150 Dallas, TX 75265
Contact:	M.A. Kinch
Position:	Dr.
Notes:	Head of their IR producibility effort; representative to JM consortium on producibility

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Organization:	Texas Instruments Inc
Component:	Central Research Laboratories
Address:	PO Box 655936, MS 136 Dallas, TX 75265
Contact:	Robert Stratton
Position:	VP
Notes:	Production of HgCdTe-based infrared imagers.

Organization:	Texas Tech University
Component:	Department of Physics and Engineering Physics
Address:	Lubbock, TX 79409-1051
Contact:	Charles W. Myles
Position:	
Notes:	Co-authored for 1991 MCT workshop "Critical Stress of HgCdTe Solid Solutions." and "Microhardness of Hg-Containing II-VI Alloys"

Organization:	Textron Defense Systems
Component:	
Address:	201 Lowell Street Wilmington, MA 01887
Contact:	Nancy Parker
Position:	Business Communications
Notes:	Infrared systems and equipment, GaAs arrays, active and passive e/o systems, detectors and sensors

Organization:	Textron Inc
Component:	Sensor Systems
Address:	201 Lowell St Wilmington, MA 01887
Contact:	Robert Wilson
Position:	VP
Notes:	Sensor systems for target discriminations, detections, and tracking.

Organization:	The Aerospace Corporation
Component:	Electronic Technology Center
Address:	P.O. Box 92957 Los Angeles, CA 90009
Contact:	R.C. Lacoe
Position:	Mr.
Notes:	Co-authored for 1992 SPIE workshop on IRFPAs "Modified Wuantum Well Infrared Photodector Designs for High Temperature and Long Wavelength Operation"

Organization:	The Boeing Company
Component:	
Address:	7755 E Marginal Way S, PO Box 3707 Seattle, WA 98124
Contact:	Frank Schrontz
Position:	CEO
Notes:	Research in the field of aerospace including sensor systems.

Organization:	The Pyrometer Instrument Company
Component:	
Address:	234 Industrial Pkwy. Northvale, NJ 07647
Contact:	EK Matthews
Position:	Pres
Notes:	Design and production of infrared temperature measurement systems.

Organization:	Thermo Electron Corp.
Component:	
Address:	101 First Ave., Waltham, MA 02254
Contact:	George Hatsopoulos
Position:	Pres
Notes:	Production of optics, electro-optics, electro-acoustic systems.

Organization:	Thomson Components & Tubes Corp
Component:	TCS Division
Address:	40 G Commerce Eay Totowa, NJ 07511
Contact:	Gregg Herbison
Position:	National Sales Manager
Notes:	Infrared systems and equipment, GaAs gate arrays, detectors & sensors

Organization:	Thomson Composants Militarires et Spatiaux
Component:	
Address:	50, rue j.-Pierre Thimbaud Courbevoie, 92402, FRANCE
Contact:	R. Besamat
Position:	Chief Executive
Notes:	Manufactures semiconductors for the high end professional, military, and space amrkets. Oferrs linear and matrtic CCDs.

Organization:	Thomson CSF
Component:	
Address:	Cedex 67 F-92056 Paris- La Defense FRANCE
Contact:	
Position:	
Notes:	Producer of a variety of HgCdTe-based military sensors, including the IRST for the Rafale.

Organization:	Thorton Associates Inc
Component:	
Address:	1432 Main St. Waltham, MA 02154
Contact:	Charles Staples
Position:	Pres
Notes:	Production of electronic control devices.

Organization:	Timeco Inc
Component:	
Address:	1035 26th St. Huntington, WV 25705
Contact:	Wilson Twohig
Position:	Pres
Notes:	Timing controls, photoelectric controls, and load sensors.

Organization:	Titronics Inc
Component:	
Address:	RR 1, Box 53B Oxford, IA 52322
Contact:	Roger Titrone
Position:	Pres
Notes:	*Infrared terrain scanning.*

Organization:	Tomsk Polytechnic Institute
Component:	
Address:	Tomsk, RUSSIA
Contact:	V.P. Vavilov
Position:	
Notes:	Authored for 1991 SPIE meeting on IR Technology "Soviet IR IMagers and THeir Applications: Short State of the Art"

Organization:	Toshiba Corporation
Component:	Research and Development Center
Address:	Komukai Works Kawasaki, Japan
Contact:	K. Shigenaka
Position:	Mr.
Notes:	Co-authored for 1992 MCT Workshop "Effects of Growth Rate and Mercury Partial Pressure on Twin Formation in HgCdTe (111) Layers Grown by MOCVD"

Organization:	Total Vision Photonics
Component:	
Address:	39 Vaughn Street, Suite 202 Ottawa, CANADA K1M1W9
Contact:	Peter Gaylord
Position:	Mr.
Notes:	active in infrared process control

Organization:	TRW Inc
Component:	TRW Electronic Systems Group
Address:	E Bldg., Rm 5076, One Space Park Redondo Beach, CA 90278
Contact:	Timothy Hannemann
Position:	VP
Notes:	Development of advanced infrared sensor technologies.

Organization:	TSI Thermo-Scan Energy Management
Component:	
Address:	15658 North Gray Road, Box 705 Carmel, IN 46032
Contact:	Phillip C. McMullan
Position:	Mr.
Notes:	active in infrared predictive maintenance

Organization:	Tsing-Hua University
Component:	Material Center
Address:	101, Sec 2 Kunag-Rd. Hsingchu, Taiwan, ROC
Contact:	Chao Huang
Position:	
Notes:	

Organization:	Tufts University
Component:	Electro-Optics Technology Center
Address:	Medford, MA 02155
Contact:	Jorge Jimenez
Position:	
Notes:	Co-authored for 1992 meeting of SPIE on IRFPAs "Fundamental Studies of Schottky Barrier IR Detectors by Ballistic Electron Emission Microscopy"

Organization:	UDT Sensors Inc
Component:	
Address:	12525 Chadron Ave. Hawthorne, CA 90250
Contact:	Deepak Chopra
Position:	Pres
Notes:	Development of light-based sensors.

Organization:	Union Miniere
Component:	
Address:	A. Greinerstraat 14 B-2660 Hoboken-Belgium
Contact:	Guy Knockaert
Position:	Technico-commercial Manager
Notes:	

Organization:	United Mineral and Chemical Corp.
Component:	
Address:	1100 Valley Brook Avenue Lyndhurst, NJ 07071-3608
Contact:	Irwin Drangel
Position:	Sales Manager
Notes:	Manufacture of CdTe, GaAs, germanium, and ZnS for infrared applications.

Organization:	United Technologies Corp.
Component:	United Technologies Research Center
Address:	Silver Ln. East Hartford, CT 06108
Contact:	Dr Wayne Burwell
Position:	Dir[illegible]
Notes:	Development of advanced infrared electronic systems.

Organization:	Unitron, Inc
Component:	
Address:	170 Wilbur Pl., PO Box 469 Bohemia NY 11716
Contact:	Thomas Zappetti
Position:	Pres
Notes:	Development of advanced optical systems.

Organization:	Univ of Illinois College of Medecine
Component:	Carle Foundation
Address:	611 West Park Street Urbanna, IL 61801
Contact:	Ralph Nelson
Position:	Dr.
Notes:	active in infrared biomedical thermography

Organization:	Univeristy of Texas at Arlington
Component:	Dept of Computer Science Engineering
Address:	P.O. Box 19015 Arlington, TX 76019-0015
Contact:	Diane Cook
Position:	
Notes:	active in infrared process control

Organization:	Universal Energy Systems
Component:	
Address:	4401 Dayton-Xenia Rd. Dayton, OH 45432
Contact:	Shan Joshi
Position:	Pres
Notes:	Development and application of laser and electro-optic systems.

Organization:	Universal Sensors, Inc.
Component:	
Address:	Suite D, 5258 Veterans Blvd. Metairie, LA 70006
Contact:	George Guilbalt
Position:	President
Notes:	Development of advanced biosensors and immunosensors for medical applications.

Organization:	Universal Technology Corp.
Component:	
Address:	4031 Colonel Glenn Hwy. Dayton, OH 45431
Contact:	Robert Guyton
Position:	Pres
Notes:	Development of advanced manufacturing technologies for metal working and electronic research and development.

Organization:	Universitat de Barcelona
Component:	
Address:	Avd. Diagonal 647 E-08028 Barcelona, SPAIN
Contact:	Elisanda Roca
Position:	
Notes:	Co-author at 1992 SPIE IRFPA meeting of "Comparative Study of SWIR and MWIR Schottky-barrier Imagers"

Organization:	University of Arizona
Component:	Arizona Remote Sensing Center
Address:	845 North Park Avenue Tucson, AZ 45719
Contact:	Stuart E. Marsh
Position:	Mr.
Notes:	active in infrared remote sensing

Organization:	University of Arizona
Component:	Optical Sciences Center
Address:	Tucson, AZ 85721
Contact:	E.L. Derenial
Position:	
Notes:	Co-Author in 1992 SPIE meeting of "Development of a High-Speed PtSi IRCCD Camera System"

Organization:	University of Arizona
Component:	Optical Sciences Center
Address:	Tucson, AZ 85721
Contact:	Thorsten Graeve
Position:	Mr.
Notes:	active in infrared process control

Organization:	University of California in Los Angeles
Component:	
Address:	
Contact:	T. Maxworthy
Position:	
Notes:	Authored February 1991 study "Laboratoty Modelling of the Dynamics of Coastal Upwelling" which studies the dynamics of the filamentary structured that have been repeatedly observed by satellite by IR imagery taken from the West Cost.

Organization:	University of California, Los Angeles
Component:	Department of Chemical Engineering
Address:	Los Angeles, CA 90024-1592
Contact:	F. Hicks
Position:	
Notes:	Co-authored for 1991 MCT Workshop "Photoassisted Organometallic VPE on CdTe"

Organization:	University of California, Los Angeles
Component:	Electrical Engineering Department
Address:	Los Angeles, CA 90024
Contact:	C.R. Viswanathan
Position:	
Notes:	For 1991 MCT Workshop, wrote "Compositional Analysis of HgCdTe Epitaxial Layers Using Secondary Ion Mass Spectrometry"

Organization:	University of Erlangen
Component:	
Address:	Erlangen, GERMANY
Contact:	W.A. Cabanski
Position:	
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Electronic and Optical Properties of Silicide/ Silicon IR Detectprs"

Organization:	University of Florida
Component:	Department of Electrical Engineering
Address:	Gainesville, FL 32611
Contact:	Sheng S. Li
Position:	
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "A Noval Grating Coupled Step-Bound-to-Miniband Transition InGaAs/GaAs/AlGaAs Multiquantum Well Infrared Photodetector"

Organization:	University of Houston
Component:	Department of Physics and Space Vacuum Epitaxy Center
Address:	Houston, TX 77204
Contact:	T.D. Golding
Position:	
Notes:	Co-authored "Properties of InAs/(Ga,In)Sb Strained Layer Superlattices Grown on the (111) Orientations" for 1992 MCT Workshop

Organization:	University of Illinois at Chicago
Component:	Microphysics Laboratory, Physics Department
Address:	P.O. Box 4348 Chicago, IL 60680
Contact:	Y.P. Chen
Position:	
Notes:	Authored "Structure of CdTe(111)B grown by MBE on Misoriented Si(001)" for 1992 MCT Workshop. For 1991 Workshop, "Current Status of Direct Growth of CdTe and HgCdTe on Silicon by MBE"

Organization:	University of Maryland
Component:	
Address:	College Park, MD
Contact:	J.R. Anderson
Position:	
Notes:	Co-authored 1987 study "Magnetophonon Effect in HgCdTe" Co-authored 1987 study "Phase Differences between Quantum Oscillations of the Magnetoresistance and the Hall Effect in HgMnTe and HgCdTe"

Organization:	University of Maryland
Component:	Maryland Agricultural Experiment Station
Address:	College Park, MD 20742
Contact:	Gary Stutte
Position:	Mr.
Notes:	active in infrared remote sensing

Organization:	University of Maryland
Component:	Medical School
Address:	Baltimore, MD
Contact:	Joseph Lakowicz
Position:	Mr.
Notes:	Speaking at OE/LASE Laser Market '93 seminar on wavelength requirements for medical diagnostics in the near-infrared spectral regions. The wavelength in such ap[plications determines not only which molecules will absorb the light, but how deeply the light will penetrate biological tissues.

Organization:	University of Michigan
Component:	Department of Electrical Engineering and Computer Science
Address:	Ann Arbor, MI 48109
Contact:	J. Singh
Position:	
Notes:	Co-Authored "Recent Advances on HgCdTe Mid Infrared Diode Lasers" for 1992 MCT Workshop.

Organization:	University of Minnesota School of Medecine
Component:	Minneapolis Clinic of Neurology
Address:	305 East Nichola Boulevard Ridgeview Medical Bldg, Suite 185 Burnesville, MN 55337
Contact:	Jack Hubbard
Position:	Dr.
Notes:	active in infrared biomedical thermography

Organization:	University of Montana
Component:	School of Forestry
Address:	Missoula, MT 59812
Contact:	Lars L. Pierce
Position:	Mr.
Notes:	active in infrared remote sensing

Organization:	University of Nebraska
Component:	Center for Electro-Optics
Address:	Lincoln, NE 69588
Contact:	Ram M. Narayanen
Position:	
Notes:	active in infrared remote sensing

Organization:	University of New South Wales
Component:	School of Physics
Address:	Kensington 2033 AUSTRALIA
Contact:	M. Gal
Position:	
Notes:	Co-Authored "In-Situ Ellipsometric Measurements of the MBE Growth of CdTe/HgTe and CdTe/AnTe Superlattices" for 1992 MCT Workshop

Organization:	University of Nort Texas
Component:	Department of Physics
Address:	Denton, TX 76203
Contact:	C.L. Littler
Position:	
Notes:	Co-Authored "Heavily Accumulated Surfaces of MCT Detectors: Theory and Experiment" for 1992 MCT Workshop. For 1991 Workshop, "Investigation of Mercury Interstititals in MCT alloys Using Resonant Impact-Ionization Spectroscopy"

Organization:	University of North Carolina at Chapel Hill
Component:	Department of Physics and Astronomy
Address:	Chapel Hill, NC 27599-3255
Contact:	J.C. Austin
Position:	
Notes:	Co-Authored "Observation of Indium-Vacancy and Indium Hydrogen Interactions in (HgCd)Te Using PAC

Organization:	University of Notre Dame
Component:	
Address:	Notre Dame, IN 46556
Contact:	J.K. Furdyna
Position:	
Notes:	On Program Committee of 1992 MCT Workshop For 1991 Workshop co-authored "Magnetic Generation of Electrons and Holes in Semimetallic HgTe-CdTe Superlattices"

Organization:	University of Pittsburgh at Greensburg
Component:	
Address:	
Contact:	Guy M. Nicoletti
Position:	
Notes:	Authored 1988 "Optoelectronic Proximity Sensors for Automated Deburring"

Organization:	University of Southampton
Component:	Engineering Materials
Address:	Southampton, SO9 5NH UNITED KINGDOM
Contact:	N.A. Archer
Position:	
Notes:	Authored "Growth Method, Composition, and Defect Structure Dependence of Mercury Diffusion in CdHgTe" for 1992 MCT Workshop.

Organization:	University of Southern California
Component:	Department of Materials Science and Engineering
Address:	Los Angeles, CA 90089-0241
Contact:	K.T. Chang
Position:	
Notes:	Co-authored for 1991 MCT Workshop "Ordered Phase in (HgCd)Te Grown by LPE on CdTe (111)B Substrate"

Organization:	University of West Australia
Component:	Department of EE
Address:	Nedlands, Perth, Western Australia 6009
Contact:	Lorenzo Faraone
Position:	
Notes:	Attended 1992 MCT conference

Organization:	University of Wurzburg
Component:	
Address:	GERMANY
Contact:	R.N. Bicknell-Tassius
Position:	Mr.
Notes:	Authored for SPIE 1991 meeting on Growth of IR materials "Growth of CdTe-CdMnTe Heterostructures by MBE"

Organization:	USDA - ARS
Component:	Remote Sensing Research Unit
Address:	2413 E. Highway 83 Weslaco, TX 79586
Contact:	David E. Escobar
Position:	Mr.
Notes:	active in infrared remote sensing

Organization:	UTI Instruments
Component:	
Address:	
Contact:	Hugh Danaher
Position:	Mr.
Notes:	

Organization:	Vicon Infrared
Component:	
Address:	Four Seneca Court Acton, MA 01720
Contact:	Ralph Rotolante
Position:	Mr.
Notes:	Former founder and president of the now defunct New England Research Center. Private consultant

Organization:	Vinten-Penarroya Inc.
Component:	
Address:	17151 Newhope Street, Suite 208 Fountain Valley, CA 92708
Contact:	F. Fernandez
Position:	President
Notes:	Manufacture of germanium for infrared applications.

Organization:	Virginia Polytechnic Institute
Component:	
Address:	
Contact:	P.R. Norton
Position:	
Notes:	On Program Committee of 1992 MCT Workshop. On Program Committee of 1991 MCT Workshop, as a representative of SBRC.

Organization:	Virginia University
Component:	Department of Electrical Engineering
Address:	Charlottesville, VA
Contact:	Boris Gelmont
Position:	
Notes:	Co-authored May 1992 report "Monte Carlo Simulation of Elecron Transport in HgCdTe"

Organization:	Visidyne Inc
Component:	
Address:	10 Corporate Pl., Burlington, MA 01803
Contact:	J Carpenter
Position:	Pres
Notes:	Development of electro-optical instrumentation.

Organization:	Vision Harvest
Component:	
Address:	HCR Box 36 Hatch, NM 87937
Contact:	Craig Davidson
Position:	Mr.
Notes:	active in infrared process control

Organization:	Wahl Instruments, Inc.
Component:	
Address:	5750 Hunnum Ave., Culver City, CA 90231
Contact:	Carol Smith
Position:	Ms.
Notes:	Production of non-contact IR thermometers for industrial processes.

Organization:	Washington University
Component:	Department of Materials Science and Engineering
Address:	Seattle, WA
Contact:	Ryoichi Kikuchi
Position:	
Notes:	Authored February 1988 study "Migration and Stability of HgCdTe Lattice Defects"

Organization:	Wayne State University
Component:	
Address:	Detroit, MI
Contact:	L.D. Favro
Position:	
Notes:	Authored in 1990 a 7 page "Noise Suppresion in IR Thermal-Wave Video Images by Real-Time Processing in Synchronism with Active Stimulation of the Target"

Organization:	Wayne State University
Component:	Department of Physics
Address:	Detroit MI
Contact:	S. Goettig
Position:	
Notes:	Co-authored 1990 "FOrmation Mechanisms of Interstitial Defect States"

Organization:	Wayne State University
Component:	Dept of Physics and Inst for Manufacturing Research
Address:	Detroit, MI 48202
Contact:	D.J. Crowther
Position:	
Notes:	infrared non-destructive evaluation

Organization:	Wayne State University
Component:	Institute for Manufacturing Research
Address:	Detroit,MI
Contact:	T. Ahmed
Position:	
Notes:	Authored in 1991 an 8 page "Infrared Thermal Wave Studies of Composites." Authored 1990 paper entitled "Real-time Thermal wave Imaging of Plasma-Sprayed Coatings and Adhesive Bonds Using a Box-Car Video Technique." Authored 1989 paper "Parallel Thermal Wave IR Video Imaging of Polymer Coatings and Adhesive Bonds." Authored 1987 paper "Characterization of Plasma Sprayed Coatings Using Thermal Wave IR Video Imaging."

Organization:	West Virginia University
Component:	
Address:	P.O. Box 6315 Morgantown, WV 26506-6315
Contact:	Thomas H. Myers
Position:	Physics Department
Notes:	Attended 1992 MCT Workshop

Organization:	Westinghouse
Component:	Research Center
Address:	Westinghouse Building, Gateway Center Pittsburg, PA 15222
Contact:	
Position:	
Notes:	Producer of a variety of PtSi staring IRFPAs for the Army. The Center is also involved in DARPA's electronic sciences program.

Organization:	Westinghouse Corp.
Component:	Advanced Technology Division
Address:	Baltimore, MD 21203
Contact:	Arthur S. Jensen
Position:	Mr.
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Superconductive Circuits for On-FPA IR Digital Signal Processing"

Organization:	Westinghouse Electric Corp.
Component:	Electronics Systems Division
Address:	P.O. Box 17319 MS A255 Baltimore, MD 21203-6812
Contact:	Ann Grizzel
Position:	Manager, Pubilc Relations
Notes:	Infrared systems and equipment, detectors and sensors, c/o systems

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Organization:	Westmark Systems, Inc
Component:	Tracor-GIE
Address:	1652 W 820 North Provo, UT 84601
Contact:	william Wallace
Position:	Pres
Notes:	Development of infared and far-infared systems.

Organization:	Whittaker Electronics
Component:	
Address:	1785 Voyager Avenue Simi Valley, CA 93063-3349
Contact:	R. La Polla
Position:	Marketing Manager
Notes:	infrared systems & equipment

Organization:	Willey Corporation
Component:	
Address:	PO Box 670 Melbourne, FL 32902
Contact:	Ronald Willey
Position:	Pres
Notes:	R&D of unique and sophisticated infrared reflectance spectrophotometry.

Organization:	Williamson Corporation
Component:	
Address:	70 Domino Dr., PO Box 1270 Concord, MA 01742
Contact:	CF Langenhagen
Position:	Pres
Notes:	R&D of infrared radiometers for temperature measurement and control.

Organization:	Worcester Polytechnic Institute
Component:	
Address:	Worchester, MA 01609
Contact:	L.R. Ram-Mohan
Position:	
Notes:	Co-authored for 1991 MCT Workshop "Magnetic Generation of Electrons and Holes in Semimetallic HgTe-CdTe Superlattices"

Organization:	Worcester Polytechnic Institute
Component:	Department of Physics
Address:	Worcester, MA 01609
Contact:	L.R. Ram-Mohan
Position:	
Notes:	Co-Authored "States Confined in the Barriers of Type-III HgTe/CdTe Superlattices" for 1992 MCT Workshop

Organization:	Worchester Institute of Technology
Component:	Center for Imaging Science
Address:	One Lomb Memorial Drive Rochester, NY 14623
Contact:	James R. Schott
Position:	Mr.
Notes:	active in infrared remote sensing

Organization:	Xedar Corp
Component:	
Address:	2500 Central Avenue Boulder, CO 80301
Contact:	Cindy Zeidler
Position:	Ms.
Notes:	infrared non-destructive evaluation

Organization:	Young Design
Component:	
Address:	7110 Sea Cliff Road McLean, VA 22101
Contact:	Michael F. Young
Position:	President
Notes:	Infrared systems & equipment

Appendix E

Professional and Trade Organizations

Serving the Infrared Community

Air Force Association
1501 Lee Highway
Arlington, VA 22209
(703) 247-5800

American Association of Engineering Societies
1111 19th Street, NW, #608
Washington, DC 20036
(202) 296-2237

American Chemical Society
1155 16th Street, NW
Washington, DC 20036
(202) 872-4600

American Consulting Engineers Council
1015 15th St., NW, #802
Washington, DC 20005
(202) 347-7474

American Defense Preparedness Association
2101 Wilson Boulevard, Suite 400
Arlington, VA 22201
(703) 522-1820
Their annual symposium and exhibition on night operations brings together experts on IR technologies in night vision equipment, military applications of smart sensors, technology for autonomous weapons, and electro-optic applications. All sessions are unclassified. It is scheduled usually in September.

American Electronics Association
1225 Eye Street, NW #950
Washington, DC 20005
(202) 682-9110

American Gear Manufacturers Association
1500 King Street, #201
Alexandria, VA 22314
(703) 684-0211

American Institute of Aeronautics and Astronautics
370 L'Enfant Promenade, SW #1000
Washington, DC 20024
(202) 646-7400

American Institute of Chemical Engineers
1707 L Street, NW #333
Washington, DC 20036
(202)223-0650

American Institute of Physics
335 E. 45th Street
New York, NY 10017
(212) 661-9404
Publishes the Journal of Vacuum Science and Technology, which prints articles on state of the art technological breakthroughs on semiconductor materials, much of it on Mercury cadmium telluride. Also help organize annual US Workshop on Physics and Chemistry of Mercury Cadmium Telluride and Other II-VI Compounds, held usually in October.

American Institute of Thermography
138 Church Street, NE, Suite C
Vienna, VA 22180
(703) 938-6140
Kathryn Werner heads the office. Recently formed to inform public about prospects for infrared biomedical imaging. Its members are predominantly researchers at universities and at small, start-up businesses. Chairman is Dr. Michael Anbar at the State University of New York in Buffalo. Publishes occasional Journal of Thermology which is on hold until funding can be found to print it. Apparently funding was pulled from the IR imaging companies which sought military business rather than what they saw as the small biomedical market.

American Iron and Steel Institute
1101 17th Street, NW, #1300
Washington, DC 20036
(202) 452-7100

American Machine Tool Distributors Association
1335 Rockville Park, #300
Rockville, MD 20852
(202) 738-1200

American Paper Institute
1250 Connecticut Avenue, NW #210
Washington, DC 20036
(202) 463-2420

American Public Power Association
2301 M Street, NW, #300
Washington, DC 20037
(202) 775-8300

American Society of Mechanical Engineers
1828 L Street, NW #906
Washington, DC 20036
(202) 785-3756

American Society for Metals International
Materials Park, OH 44073
(216) 338-5151
This is the major metallurgical society worldwide. Since IRFPAs are being increasingly used in metallurgy for thermal imaging of steel, aluminum, etc. in real-time as they roll off the production line, this society may become valuable. They do not have a working group, however, concerned with non-destructive testing.

American Society for Nondestructive Testing
4153 Arlingdale Plaza
Columbus, OH 43228
(614) 274-6003
Thermal sensors are becoming increasingly important in non-destructive testing, and the ASNT is taking an interest in infrared technology. Although it has no working groups or smaller societies on IR work, it will be able to refer us to people in specific industries who can speak about using IR sensors in their production systems.

American Society for Photogrammetry and Remote Sensing
5401 Grosvenor Lane #210
Bethesda, MD 20814
(301) 493-0290

American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103
(215) 299-5400
Among the oldest and broadest based organizations in its field in the U.S. They have no working groups or publications which address the use of IRFPAs or IR technology in industrial sensors, but they are taking an increasing interest in the industrial applications and will offer names in specific industries if we need them.

American Society for Quality Control
611 E. Wisconsin Avenue
Milwaukee, WI 53202-4606
(414) 272-8575
Since they are a society to which quality control managers belong, IR sensor may play a growing part in their field. They have both a measurement division, led by Joel Simmons at 301-975-2005, and an inspections division, headed by Charles Carter at 214-234-3296. They have both been extremely helpful in locating articles and experts.

Armed Forces Communications and Electronics Association
4400 Fair Lakes Court
Fairfax. VA 22033
(703) 631-6100

Association for Manufacturing Technology
7901 Westpark Drive
McLean, VA 22102
(703) 893-2900

Association of Science- Technology Centers
1025 Vermont Avenue, NW #500
Washington, DC 20005
(202) 783-7200

Association of the United States Army
2425 Wilson Boulevard
Arlington, VA 22201
(703) 841-4300

Center for Non-Destructive Evaluation
Iowa State University
1915 Scholl Road
Ames, IA 50011
This center organizes the annual Review of Progress in Quantitative Nondestructive evaluation confernce, and publishes its proceedings. The conference serves as an annual meeting place for engineers and scientists working on highly analytical and complex nondestructive evaluation. Although ultrasonic techniques are more often discussed, specifically eddy current, thermal imaging has been discussed increasingly. This conference and its attendees have been at the forefront of aging aircraft inspection.

Chemical Manufacturers Association.
2501 M Street, NW 20037
Washington, DC 20037
(202) 887-1100

Electric Power Research Institute
1019 19th Street, NW #1000
Washington, DC 20036
(202) 872-9222

Electronics Industries Association
2001 Pennsylvania Avenue, NW #1100
Washington, DC 20006
(202) 457-4900

Infrared Information Analysis Center
P.O. Box 134001
Ann Arbor, MI 48113-4001
(313) 994-1200
At the Environmental Research Institute of Michigan, the IRIA is a DTIC- sponsored DoD Information Analysis Center. It is the leading training facility for program managers in military-industrial work on classified IR projects. It can not disburse any papers or professional lists or program of events until we have a DTIC identification number.

Infraspection Institute

1971 Shelburne Road Suite C
Shelburne, VT 05482
(802) 985-2500

Headed by Paul Grover, the Institute supports those who use and provide infrared thermographic services through their training, continuing education, and certification programs. It is a leader in training inspectors who use IR in their factories and plants. Their newsletter is seasonal, and called simply the "Infraspection Institute Newsletter."

Institute for Electrical and Electronic Engineers (IEEE)

345 East 47th Street
New York NY 10017
(212) 705-7900

A society which has a wealth of information on IR technologies, especially concerning applications. They have many working groups which publish papers with a decidedly technical bent, and working groups which may be of interest are "Aerospace and Electronic Systems," "Components, Hybrids, and Manufacturing Technology," and "Lasers and Electro-Optics." They have a yearly meeting on "Thermosense," organized usually by Professor Bill Wolfe at the University of Arizona.

Institute of the Ironworking Industry

1750 New York Avenue, NW #400
Washington, DC 20006
(202) 783-3998

International Society for Optical Engineering (SPIE)

P.O. Box 10
Bellingham, WA 98227-0010

The oldest and grandest of the societies to which infrared researchers belong. In addition to working groups addressing optical technologies, they hold their annual Thermosense meeting in April, which is the major crossroads for commercial infrared detector manufacturers. They also organize yearly conference on FTIR spectrometers, surveillance, machine vision and automated inspection, remote sensing, and scientific research using IR detectors.

Laser Institute of America

12424 Research Parkway, SUite 130
Orlando, FL 32826
(407) 380-1553
John Sallik

National Academy of Engineering
2101 Constitution Avenue, NW #218
Washington, DC 20418
(202) 334-3200

National Aeronautic Association of the U.S.A.
1815 N. Fort Myer Drive, #700
Arlington, VA 22209
(703) 527-0226

National Assocation of Manufacturers
1331 Pennsylvania Avenue, NW #1500
Washington, DC 20004
(202) 637-3000

National Electrical Contractors Association
7315 Wisconsin Avenue, #1300-W
Bethesda, MD 20814
(301) 657-3110

National Electrical Manufacturers Association
2101 L Street, NW, #300
Washington, DC 20037
(202) 457-8400

National Society of Professional Engineers
1420 King Street
Alexandria, VA 22314
(703) 684-2800

National Tooling and Machining Association
9300 Livingston Road
Fort Washington, MD 20744
(301) 248-6200

Palisades Institute for Research Services, Inc.
201 Varick Street, Suite 1140
New York, N.Y. 10014
(212) 620-3371
Organizes a yearly Workshop on the Physics and Chemistry of Mercury Cadmium Telluride and Related II-VI Materials. The organizer is Jay Morreale.

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, MI 48106
(313) 994-6088
Incorporates three other associations of interest to infrared firms: Robotic Industries Association, Automated Imaging Asosciation, National Service Robot Association. All are leading associations for manufacturers and integrators of automated inspection and machine guidance machines and systems. Almost all the CCD manufacturers are members, as are the major photonics firms that are interested in the imaging market. Organizes an annual International Robots & Vision Automation Conference in APril, and another International Symposium on Industrial Robots, usually in October.

Society of American Military Engineers
607 Prince Street
Alexandria, VA 22314
(703) 549-3800

Society for Imaging Science and Technology
7003 Kilworth Lane
Springfield, VA 22151
(703) 642-9090

Society of Manufacturing Engineers (SME)
1 SME Drive
P.O. Box 930
Dearborn, MI 48121-0930
(313) 271-2861
The SME, through its publication Manufacturing Engineering Magazine, is very concerned with thermal imagers, because it boosts productivity, saves on maintenance, is a form of non destructive testing, etc. They do not have any working groups or individual societies focused on infrared sensors, but they have groups by industry, so several industries may be interesting to DFI research because they employ IR sensors.

Society for the Advancement of Materials and Process Engineering
1161 Park View Drive
Covina, CA 91724
(818) 331-0616
Their technical director, Dr. Hammernesh, says that they do not yet cover IRFPAs materials, or IRFPAs as used by process engineers, because they have not yet become prevalent. However, they will be able to put us in touch with engineers and research scientists in specific industries when we target a few industries.

Specialty Steel Industry of the U.S.
3050 K Street, NW #400
Washington, DC 20007
(202) 342-8400

Valve Manufacturers Association of America
1050 17th Street, NW #701
Washington, DC 20036
(202) 331-8105

Appendix F
Individuals Carrying out Research on Applications of Sensitive Infrared Materials Database

Contact Name:	Margaret Abernathy
Position:	Medical Doctor
Organization:	Georgetown University Medical Center
Component:	
Address:	Kober-Cogan 320 3800 Reservoir Road Washington, D.C. 20007
Notes:	Active in development of infrared biomedical thermography applications, systems design. Active in American Academy of Thermology.

Contact Name:	Warren Achenbaum
Position:	President
Organization:	Cox & Company, Inc.
Component:	
Address:	200 Varick St. New York, NY 10014
Notes:	Electronic and mechanical engineering, aerodynamics, thermal engineering, mostly for military markets.

Contact Name:	Roshan L. Aggarwal
Position:	Materials Scientist
Organization:	MIT
Component:	Electronics Research Lab
Address:	Room 13-3030 77 Massachusetts Avenue Cambridge, MA 02139
Notes:	Materials scientist on program committee of 1991 and 1992 MCT workshop hosted by Palisades Research Center. Co-authored January 1987 "Infrared Nonlinear Optics"

Contact Name:	Jean Aitchison
Position:	Gen Mgr.
Organization:	Photox Optical Systems
Component:	
Address:	P.O. Box 274 Headington, Oxford, OX3 OBJ UNITED KINGDOM
Notes:	Manufacture of GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications.

Contact Name:	Peter Albers
Position:	Sales Manager
Organization:	Carl Zeiss
Component:	
Address:	Sondertechnik Postfach 1380 7082 Oberkochen, GERMANY
Notes:	Thermal Imaging, Detectors and Sensors, Night Vision for military markets.

Contact Name:	John V. Alexander
Position:	Public Relations
Organization:	AlliedSignal Aerospace
Component:	
Address:	2525 W. 190th Street Torrance, CA 90504
Notes:	Thermal Imaging, detectors and sensors, for military

Contact Name:	James Alexiou
Position:	Pres
Organization:	Irvine Sensors Corp.
Component:	
Address:	3001 Redhill Ave Bldg 3 Costa Mesa, CA 92626
Notes:	Applied research in military detection system (infrared sensing). Designs, develops and manufactures proprietary focal planes and focal plane assemblies, Proprietary assemblies include proprietary line arrays amd stacked-circuitry mosaic with on-focal-plane signal processing.

Contact Name:	R.R. Alfano
Position:	Research PhD
Organization:	Institute for Ultrafast Spectroscopy and Lasers
Component:	Photonics Appl. Lab
Address:	Department of Electrical Engineering and Physics, Graduate Center of the City Univ of NY, New York, NY 10031
Notes:	Active in infrared biomedical thermography as system designer for multi-wavelength, MCT-based systems which overcome emissivity problems.

Contact Name:	Charles Alicandro
Position:	Commercial Sales
Organization:	Inframetrics
Component:	
Address:	16 Esquire Road North Billerica, MA 01862
Notes:	Manufactures IR thermal imaging systems (radiometers) for noncontact temperature measurements. Radiometers feature TV compatible color and b/w imaging with direct temperature measurement capabilities. Image processing systems provide easy detailed analysis of data collected with the thermal camera. A leading supplier for non-destructive evaluaton, predictive maintenance IR camer markets.

Contact Name:	Lee Allen
Position:	
Organization:	Allen Infrared Associates
Component:	
Address:	RR #1, Box 239K Coward, SC 29530
Notes:	Active in infrared predictive maintenance development regimes and community

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Contact Name:	Robert Allen
Position:	CEO
Organization:	American Telephone and Telegraph
Component:	AT&T Bell Labs
Address:	600 Mountain Ave. Murray Hill, NJ 07974
Notes:	Wide range of research in electronics, focusing on emerging technologies including opto-electronics.

Contact Name:	Robert Allen
Position:	CEO
Organization:	American Telephone and Telegraph company
Component:	AT&T Bell Labs
Address:	600 Mountain Ave. Murray Hill, NJ 07974
Notes:	Wide range of research in electronics, focusing on emerging technologies including opto-electronics.

Contact Name:	Andrew Allen
Position:	VP Sales
Organization:	EG&G, Inc.
Component:	EG&G Judson
Address:	221 Commerce Dr. Montgomeryville, PA 18936
Notes:	Manufactures infrared detectors and arrays, including Ge, InAs, InSb, MCT, and doped GE. Appliations include carbon dioxide laser detection, fiberoptics, spectroscopy, and radiometry.

Contact Name:	Kurt Ammer
Position:	Dr.
Organization:	Ludwig Boltzmann Forschungsstelle fue
Component:	Physikalische Diagnostik
Address:	Heinrick Collinstr. 30 A-1140 Wien AUSTRIA
Notes:	Active in infrared biomedical thermography system design

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Contact Name:	Michael Anbar
Position:	Dr.
Organization:	State University of NY at Buffalo
Component:	Dept of Biophysical Sciences
Address:	120 Cary Hall Buffalo, NY 14214
Notes:	Active in infrared biomedical thermography. Has own biomedical marketing firm to sell infrared technology. Current advisor of the American Institute of Thermology.

Contact Name:	Michael Anbar
Position:	Chairman, Department of Biophysical Sciences
Organization:	SUNY Buffalo
Component:	School of Medicine
Address:	120 Cary Hall Buffalo, NY 14214
Notes:	Also has own biomedical ir company called AMARA, Inc. at his home address, 145 Deer Run Road, Williamsville, NY 14221. Chief advisor to American Institute of Thermography. Has worked on biomedical IR for 8 years; grants from NSF and NIH.

Contact Name:	Christine Anderson
Position:	Ms.
Organization:	Cray Research
Component:	
Address:	925 First Avenue Chippewa Falls, WI 54729-1402
Notes:	Active in infrared process control.

Contact Name:	Kenneth Anderson
Position:	Pres
Organization:	Monitek Technologies, Inc.
Component:	
Address:	1495 Zephyr Ave. Hayward, CA 94544
Notes:	Optical and electronic measurement systems to detect particulate matter, oils and color in fluids.

Contact Name:	J.R. Anderson
Position:	
Organization:	University of Maryland
Component:	
Address:	College Park, MD
Notes:	Co-authored 1987 study "Magnetophonon Effect in HgCdTe" Co-authored 1987 study "Phase Differences between Quantum Oscillations of the Magnetoresistance and the Hall Effect in HgMnTe and HgCdTe"

Contact Name:	Martin Andonian
Position:	President, Chief Scientist
Organization:	Andonian Cyrogenics Inc
Component:	
Address:	26 Farwell Street Newtonville, MA 02160
Notes:	Manufactures cryogenic equipment, storage dewars, cryorefrigerators, research cryostats, cold traps, transfer lines, level gauges, and control. Distributes cryogenic liquids, speciality gases, gas handling, and distribution equipment.

Contact Name:	N.A. Archer
Position:	
Organization:	University of Southampton
Component:	Engineering Materials
Address:	Southampton, SO9 5NH UNITED KINGDOM
Notes:	Authored "Growth Method, Composition, and Defect Structure Dependence of Mercury Diffusion in CdHgTe" for 1992 MCT Workshop.

Contact Name:	Eugene Arthurs
Position:	Dir
Organization:	Oriel Corp
Component:	
Address:	250 Long Beach Blvd., PO Box 872, Stratford, CT 06497
Notes:	Optics and detectors for ultraviolet through infrared systems.

Contact Name:	Monique Attar
Position:	Marketing Administrator
Organization:	Loral Fairchild Systems
Component:	
Address:	300 Robbins Lane Syosset, NY 11791
Notes:	Detectors and sensors, e/o systems, night vision, thermal imaging, predominantly for military markets.

Contact Name:	B Austin
Position:	CEO
Organization:	Affiliated Manufacturers, Inc. (AMI)
Component:	
Address:	PO Box 5049 North Branch, NJ 08876
Notes:	Process and manufacturing considerations of the microelectronics manufacturing industry; innovative manufacturing processes; thick film hybrid circuits.

Contact Name:	J.C. Austin
Position:	
Organization:	University of North Carolina at Chapel Hill
Component:	Department of Physics and Astronomy
Address:	Chapel Hill, NC 27599-3255
Notes:	Co-Authored "Observation of Indium-Vacancy and Indium Hydrogen Interactions in (HgCd)Te Using PAC

Contact Name:	Ronald Autos
Position:	drR&D
Organization:	Burleigh Instruments, Inc.
Component:	
Address:	Burleigh Park Fishers, NY 14453
Notes:	Product oriented research in lasers, optical equipment, and micropositioning equipment. Sells a leading tunable solid-state IR laser good from 1.45 to 1.75 microns, or 2.3 to 3.45 microns.

Contact Name:	K. Awamoto
Position:	
Organization:	Fujitsu Laboratories, Ltd.
Component:	Atsugi Infrared Devices Laboratory
Address:	10-1 Morinosato-Wakamiya Atsugi 243-01 JAPAN
Notes:	Co-authored for 1992 SPIE Workshop on IRFPAs "Resolution Improvement for HgCdTe IRCCD"

Contact Name:	Norman Axelrod
Position:	Pres
Organization:	Norman Axelrod, Associates
Component:	Norman N. Axelrod Associates Development Laboratory
Address:	28 W 44th St New York, NY 10036
Notes:	Planning, development, and fabrication of electro-optical, laser, and machine vision systems for on-line sensing and control, digital and analog information; computer automated optical systems.

Contact Name:	J.W. Baars
Position:	
Organization:	Fraunhofer-Institut fur Angewandte Festkorperphysik
Component:	
Address:	Tullastr. 72 D-7800 Freiburg, Germany
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Characterization of Anodic Fluoride Films on HgCdTe"

Contact Name:	Marino Babbricotte
Position:	
Organization:	ESA-ESTEC
Component:	
Address:	Keplerlaan 1, NL-2200 AZ Noordwijk, THE NETHERLANDS
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Comparative Study of SWIR and MWIR Schottky-Barrier Imagers."

Contact Name:	Robert Bachner
Position:	CEO
Organization:	Silicon Sensor Inc
Component:	
Address:	Hwy 18 E PO Box 137 Dodgeville, WI 53533
Notes:	Manufacture of light sensitive products. Manufactureres of SI semiconductor detectors and optocouplers\optoisolators, custom assembly for OEMs, long-line strip detectors, optics hybrid assemblies, etc.

Contact Name:	R.B. Bailey
Position:	Dr.
Organization:	Rockwell International Science Center
Component:	
Address:	1049 Camino Dos Rios Thousand Oaks, CA 91360
Notes:	One of top few scientists conducting Rockwell's alternative substrate programs.

Contact Name:	George S. Baird
Position:	
Organization:	Baird Infrared Technology, Inc.
Component:	
Address:	110 South Poplar Street #310 Wilmington, DE 19801-5046
Notes:	Active in infrared predictive maintenance as private consultant conducting inspections

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Contact Name:	Francis Baker
Position:	CEO
Organization:	Andersen Group
Component:	
Address:	1280 Blue Hills Ave. Bloomfield, CT 06002
Notes:	Research and development in photonics, telecommunications and high tech industries.

Contact Name:	Roy Ball
Position:	President
Organization:	Imago Machine Vision Inc.
Component:	
Address:	1354 Wellington Street Ottaws, Ontario, CANADA K1Y 3C3
Notes:	Security systems and equipment, robotics, e/o systems, infrared systems and equipment, commercial and military.

Contact Name:	Michel Balle
Position:	
Organization:	HGH Ingeneric Systemes
Component:	
Address:	au Parc d'Activities du Moulin de Massy 3, rue du Saule Trapu Massy, 91300 FRANCE
Notes:	Active in infrared process control at HGH Ingenerie.

Contact Name:	Probal Banerjee
Position:	Graduate student
Organization:	Auburn University
Component:	College of Engineering and Engineering Experiment Station
Address:	Materials Engineering 201 Ross Hall Auburn University, AL 36849-5351
Notes:	Co-authored 1991 "Weld Quailty Control in Gas Tungsten Arc Welding Process" as graduate student for Dr. Chin.

Contact Name:	Ed Bangs
Position:	
Organization:	Infrared Monitoring Systems
Component:	
Address:	10 West 35th Street Chicago, IL 60616
Notes:	Active in development of infrared process control regimes. Integrator and consultant.

Contact Name:	George Barringer
Position:	Pres
Organization:	Groton Technology, Inc.
Component:	
Address:	45 Winthrop St. Concord, MA 01742
Notes:	Applied and product-oriented research in optical inferometry and solid state optical detectors. Application of infrared technologies to scientific spectroscopy.

Contact Name:	Barry Bassin
Position:	President
Organization:	Infrared Optical Products, Inc.
Component:	
Address:	P.O. Box 3033 South Farmingdale, NY 11735
Notes:	Manufacture of CdTe, GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications, both military and commercial.

Contact Name:	P.K. Baumann
Position:	
Organization:	North Carolina State University
Component:	Department of Physics
Address:	Raleigh, NC 27695-8202
Notes:	Authored for 92 MCT workshop "Growth of HgSe and HgCdSe Thin Films by Molecular Beam Epitaxy"

Contact Name:	Bill Bauson
Position:	
Organization:	Delco Electronics
Component:	
Address:	700 East Firman Avenue Kokomo, IN 46901
Notes:	Active in infrared non-destructive evaluation. His firm conducts research in automotive audio equipment and systems, vehicular heat and air conditioner controls, automotive microcomputer-based control systems, integrated circuits, semiconductor devices, thick film hybrid microcircuits, printed circuit boards, automotive electronics, automotive sensors, automotive instruments and displays.

Contact Name:	P. Bean
Position:	
Organization:	MIT
Component:	
Address:	Dept. of Materials Sci. & Eng. Room 13-5099 Cambridge, MA 02139
Notes:	Author of "Growth and Characterization of Device Quality Bulk HgZnTe Crystals" at 1992 MCT Workshop For 1991 Workshop "Nonlinear Optical Effects in Rotationally Twinned CdTe and CdMnTe Crystals," and "Long Wavelength HgMnTe Avalanche Photodiodes"

Contact Name:	Piotr Becla
Position:	
Organization:	MIT
Component:	Electronics Research Lab
Address:	77 Massachussets Avenue Cambridge, MA 02139
Notes:	Co-authored January 1987 "Infrared Nonlinear Optics"

Contact Name:	C.P. Beetz, Jr.
Position:	
Organization:	Advanced Technology Materials
Component:	Semiconductor Products Department
Address:	7 Commerce Drive Danbury, CT 06810
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Buffer Layers for Deposition of Supercondcuting YBaCuO Thin Film on Polycrystalline Diamond"

Contact Name:	R.A. Bell
Position:	Director of Marketing
Organization:	Loral Corporation
Component:	Loral Infrared & Imaging Systems, Inc.
Address:	2 Forbes Rd. Lexington, MA 02173
Notes:	

Contact Name:	Brandon Belote
Position:	Director Marketing Communications
Organization:	ITT Defense and Electronics
Component:	
Address:	1000 Wilson Boulevard, Suite 3000 Arlington, VA 22209
Notes:	Night vision, active and passive e/o systems, infrared systems and components for military applications.

Contact Name:	Valery Belov
Position:	President
Organization:	Belov Technology Co. Inc.
Component:	
Address:	345 Sandford Street New Brunswick, NJ 07891
Notes:	Manufactures MCT, DTGS, TGS pyroelectric detectors and detector electronic systems, and multi-element arrays. MCT room temperature detectors, and related components.

Contact Name:	Alan Bennett
Position:	V Pres R&D
Organization:	Imo
Component:	Varian Industries
Address:	3100 Hansen Way Palo Alto, CA 94304
Notes:	Producer of a wide variety of military thermal systems. Development of InP- and HgCdTe-based infrared sensors, as well as the use of GaAs materials.

Contact Name:	Tucker Bens
Position:	Marketing
Organization:	Loral Fairchild Imaging Sensors
Component:	
Address:	1801 McCarthy Blvd Milpitas, CA 95035
Notes:	

Contact Name:	Tom Benson
Position:	CEO
Organization:	Innovation Industries, Inc.
Component:	
Address:	Hwy 64E PO Box K Russellville, AR 72801
Notes:	Opto-electronics product oriented for patent and manufacture, interest in IR detectors.

Contact Name:	R.G. Benz
Position:	
Organization:	Georgia Tech Research Institute
Component:	Physical Sciences Laboratory
Address:	Room 128 Baker Bldg Atlanta, GA 30332
Notes:	Authored "CdTe and HgTe Growth Kinetics During Gas SOurce Molecular Beam Epitaxy" for 1992 MCT Workshop For 1991, "Selected-area Epitaxy of CdTe"

Contact Name:	M.A. Berding
Position:	
Organization:	SRI International
Component:	
Address:	Menlo Park, CA 94025
Notes:	Co-Authored "Native Defect Equilibria in HgZnTe and HgCdTe Alloys" for 1992 MCT Workshop. For 1991 Workshop, "Defect Equilibrium in HgTe"

Contact Name:	Leif Bergstron
Position:	Chairman
Organization:	Pharos Inc.
Component:	Agema Infrared Systems
Address:	595 Skippack Pike Blue Bell, PA 19128
Notes:	Pharos is the parent company for Agema in Secaucus.

Contact Name:	Enrique Bernal
Position:	VP Advanced Materials
Organization:	Morton International Advanced Materials
Component:	
Address:	185 New Boston Street Woburn, MA 01801
Notes:	Manufacture of ZnS and ZnSe for infrared applications.

Contact Name:	R. Besamat
Position:	Chief Executive
Organization:	Thomson Composants Militarires et Spatiaux
Component:	
Address:	50, rue j.-Pierre Thimbaud Courbevoie, 92402, FRANCE
Notes:	Manufactures semiconductors for the high end professional, military, and space amrkets. Oferrs linear and matrtic CCDs.

Contact Name:	A. Bezinger
Position:	
Organization:	Kidron Microelectronics Research Center
Component:	Department of Electrical Engineering
Address:	Technion-Israel Institute of Technology Haifa 32000, ISRAEL
Notes:	"UV Photon Assisted Control of Interface Charge Between CdTe Substrates and Metal Organic Chemical Vapor Deposition CdTe Epilayers" for 1992 MCT Workshop.

Contact Name:	Ishwara B. Bhat
Position:	
Organization:	Rensselaer Polytechnic Institute
Component:	ECSE Department
Address:	110 Eight Street Troy, NY 12180
Notes:	Co-authored "Improved CdTe Layers on GaAs and Si Substrates, Grown by Atomic Layer Epitaxy" for 1992 MCT Workshop. Co-authored for 1991 MCT Workshop "Low Temperature Epitaxy of HgTe, CdTe, and HgCdTe Using Flow Modulation Techniques" and "Reduced Metal-Insulator Semiconductor Tunneling in MOCVD MC(111)Te Films"

Contact Name:	Ravi Bhatla
Position:	
Organization:	Motorola Corporation
Component:	
Address:	1303 East Algonquin Road Schaumberg, IL 60196
Notes:	Designs infrared non-destructive evaluation techniques at Motorola.

Contact Name:	Jacob Biali
Position:	Sales Manager
Organization:	ISPRA - Israel Product Research Co. Ltd.
Component:	
Address:	Galgal Haplada Street, Industrial Zone Herzelia, Israel 052-555464
Notes:	Manufacture of germanium, silicon, ZnS, and ZnSe for infrared applications.

Contact Name:	Lucien Biberman
Position:	
Organization:	Institute for Defense Analysis
Component:	
Address:	1801 North Beauregard Street Alexandria, VA 22311
Notes:	Delivered an August 1987 speech delivered to IRIS meeting entitled "Perspective on Focal Plane Arrays" in which he argues that the military establishes hard-to-achieve standards for its IRFPAs, and that costs could be readily reduced without such stringency.

Contact Name:	J Bickman
Position:	Pres
Organization:	Stocker & Yale, Inc
Component:	
Address:	133 Brimbal Ave. Beverly, MA 01915
Notes:	Optical measuring units for manufacturing controls.

Contact Name:	R.N. Bicknell-Tassius
Position:	
Organization:	University of Wurzburg
Component:	
Address:	GERMANY
Notes:	Authored for SPIE 1991 meeting on Growth of IR materials "Growth of CdTe-CdMnTe Heterostructures by MBE"

Contact Name:	Rollo Black
Position:	Business Development
Organization:	Eastman Kodak Co.
Component:	Government Systems Div.
Address:	1447 St. Paul Street Rochester, NY 14653
Notes:	IR Detectors work, mostly PtSi.

Contact Name:	Edward Blanchet
Position:	President
Organization:	Santa Barbara Infrared Inc.
Component:	
Address:	312A North Nopal Street Santa Barbara, CA 93101
Notes:	Manufactures commercial and military IR test equipment. Products include differential blackbody sources, collimators, IR target projects, FLIR test equipment. ALsdo provides applications engineering and custom design engineering for commercial , custom and militarized IR test systems for laboratory and field use.

Contact Name:	John Blocha
Position:	President
Organization:	Pilkington Visioncare
Component:	Coburn Optical Industries
Address:	Suite 200, 4606 S Garnett Tulsa, OK 74146
Notes:	Development of infrared products for military and commerical applications.

Contact Name:	Betty Blodgett
Position:	Marketing
Organization:	Datametrics Corp.
Component:	
Address:	8986 Comanche Avenue Chatsworth, CA 91311
Notes:	Thermal Imaging for military applications.

Contact Name:	Glenn D. Boreman
Position:	
Organization:	University of Central Florida
Component:	Electrical Engineering Department and Center for Research in Electro-Optics and Lasers
Address:	12424 Research Parkway, Suite 400 Orlando, FL 32828
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Use of Narrowband Laser Speckle for MTF Characterization of CCDs"

Contact Name:	John D. Bossler
Position:	
Organization:	Ohio State University
Component:	Center For Mapping
Address:	1216 Kinnear Road Columbus, OH 43212
Notes:	Active in infrared remote sensing for scientific research.

Contact Name:	K.A. Bowers
Position:	
Organization:	North Carolina State University
Component:	Department of Physics
Address:	Raleigh, NC 27695-8202
Notes:	Co-Authored for 1991 MCT Workshop "Properties of CdZnTe Crystals Grown by a High Pressure Bridgman Method"

Contact Name:	Kim Boyer
Position:	
Organization:	Ohio State Univeristy
Component:	
Address:	469 Dreese Lab 2015 Knil Avenue Columbus, OH 43210-1210
Notes:	Active in process control community as leader of SPIE's workshop on machine vision. Has good overview of machine vision markets.

Contact Name:	G. Stan Boyington
Position:	Director Business Development
Organization:	SPAR Aerospace, Ltd.
Component:	Advanced Technology Systems Group
Address:	9445 Airport Road Brampton, Ontario, CANADA L6S 4J3
Notes:	Infrared systems and equipment, c/o systems, thermal imaging for military applications.

Contact Name:	W.R. Bradbury
Position:	Mktg. Dir.
Organization:	Specac Ltd.
Component:	
Address:	River House, Lagoon Rd. St. Mary Cray, Orpington, Kent BR5 3QX UNITED KINGDOM
Notes:	Manufacture of germanium, silicon, ZnS, and ZnSe for infrared applications.

Contact Name:	Marvin L. Braman
Position:	Director of Public Relations
Organization:	Lockheed Sanders, Inc.
Component:	
Address:	NHQ-1-735 68 Spit Brook Road Nashua, NH 03061
Notes:	Infrared systems and equipment, passive and active c/o devices for military markets.

Contact Name:	Maruice J. Brau
Position:	
Organization:	Colorado Research Lab
Component:	
Address:	Walsenburg, CO
Notes:	Authored January 1991 report "Ultra-high-purity Starting Materials for Infrared Detector Crystal Growth" and January 1991 "Traveling Heater Method Growth of Bulk Compound Semiconductor Alloy Crystals"

Contact Name:	Richard A. Bredthauer
Position:	
Organization:	MIT
Component:	Lexington Lincoln Lab
Address:	244 Wood Street Lexington, MA 02173-9108
Notes:	Co-authored August 1989 study entitled "128 X 128 Element IrSi Schottky-Barrier Focal Plane Arrays for LWIR Imaging"

Contact Name:	D. Brink
Position:	
Organization:	Fraunhofer-Institut fur Angewandte Festkorperphysik
Component:	
Address:	Tullastr. 72 D-7800 Freiburg, Germany
Notes:	AUthor of "Characterization of MCT Heterostructures by Thermoelectric Measurements"

Contact Name:	George Brooks
Position:	Group Vice President
Organization:	Rockwell International Corp.
Component:	Government Business Division
Address:	1201 S Second St. Milwaukee, WI 53204
Notes:	Passive electronic components, including IR detectors.

Contact Name:	Mark Broughton
Position:	Head of public Relations
Organization:	Marconi Radar and Control Systems, Ltd.
Component:	
Address:	P.O. Box 133 Chobham Road, Frimley Camberley, Surrey, UK GU16 5PE
Notes:	Thermal Imaging, detectors and sensors, night vision for military markets.

Contact Name:	Lloyd Brunkhorst
Position:	VPeng
Organization:	Brown Group, Inc.
Component:	Research and Development Laboratory
Address:	8400 Maryland Ave. Saint Louis, MO 63166
Notes:	Basic research for new manufacturing processes, including IR detectors.

Contact Name:	Robert Bruno
Position:	VP Marketing
Organization:	Inframetrics
Component:	
Address:	16 Esquire Road North Billerica, MA 01862
Notes:	

Contact Name:	Leonard Brzozwski
Position:	Pres
Organization:	Robotron Corp.
Component:	
Address:	21300 W Eight Mile Rd. PO Box 5090, Southfield, MI 48086
Notes:	Ion processing and other non-traditional heat treating processes, welding of ferrous and non ferrous metals

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Contact Name:	L.O. Bubulac
Position:	
Organization:	Fraunhofer-Institut fur Angewandte Festkorperphysik
Component:	
Address:	Tullastr. 72 D-7800 Freiburg, Germany
Notes:	AUthor of "Characterization of MCT Heterostructures by Thermoelectric Measurements"

Contact Name:	Hans Bucher
Position:	Pres
Organization:	Xedar Corp.
Component:	
Address:	2500 Central Ave., Boulder, CO 80301
Notes:	Electro-optical research applied to field of infrared and thermal imagery.

Contact Name:	Hans Bucher
Position:	
Organization:	Xedar Corp.
Component:	
Address:	2500 Central Avenue Boulder, CO 80301
Notes:	infrared non-destructive evaluation

Contact Name:	H. Budzier
Position:	
Organization:	Dresden University of Technology
Component:	Institut fur Festkorperelektronik
Address:	Dresden, FEDERAL REPUBLIC OF GERMANy
Notes:	Co-authored for 1992 SPIE IRFPA meeting "Pyroelectric IR Single-Element Detectors and Arrays Based on LiNbO3 and LiTaO3" Co-authored for 1991 SPIE meeting on Growth of IR Materials "Pyroelectric Linear Array IR Detectors with CCD Multiplexer"

Contact Name:	J. Buic
Position:	Marketing Manager
Organization:	Honeywell, Inc.
Component:	Solid State Sensors Group
Address:	830 E. Arapaho Road Richardson, TX 75081
Notes:	Manufactures IR optoelectronic components and assemblies, fiberoptic components, and modules.

Contact Name:	RIchard Buonauito
Position:	
Organization:	Alpha Omega Instruments Corp
Component:	
Address:	253 Mansfield Drive, P.O. Box DE Norton, MA 02766
Notes:	Has developed an approach to manufacturing a low cost, two-dimensional array uing lead selenide or other resistive type detectors, with a targeted manufacturing cost of under $500 in quantitities.

Contact Name:	Kelly Burke
Position:	Operations Manager
Organization:	Crystal Specialties International
Component:	
Address:	2853 Janitall Road Colorado Springs, CO 80906
Notes:	Production of GaAs and germanium for infrared applications for both military and commercial markets.

Contact Name:	Richard Burkel
Position:	Manager, Inspection Automation
Organization:	General Electric Co.
Component:	General Electric Aircraft Engines
Address:	1 Neumann Way, P.O. Box 156301 Cincinnati, OH 45215-6301
Notes:	Designed GEAE's thermographic inspection equipment for non-destructive evaluation of jet engine parts, orginally from Air Force funding

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Contact Name:	Douglas Burleigh
Position:	
Organization:	General Dynamics
Component:	Space Systems Division
Address:	2945 Arcola Avenue Sand Diego, CA 92117
Notes:	Active in infrared remote sensing, predictive maintenance, non-destructive evaluation, for both military and commercial applications.

Contact Name:	William J. Burns
Position:	President
Organization:	Emcore Corp.
Component:	
Address:	35 Elizabeth Avenue Somerset, NJ 08873
Notes:	Material production of GaAs, CdTe, silicon, ZnS, and ZnSe for infrared applications, both military and commercial.

Contact Name:	Bernard Burns
Position:	Director of Sales
Organization:	II-VI Inc.
Component:	
Address:	375 Saxonburg Blvd Saxonburg, PA 16056
Notes:	

Contact Name:	Dr Wayne Burwell
Position:	Dir
Organization:	United Technologies Corp.
Component:	United Technologies Research Center
Address:	Silver Ln. East Hartford, CT 06108
Notes:	Development of advanced infrared electronic systems.

Contact Name:	H. Buskes
Position:	
Organization:	BHP Research
Component:	Melbourne Laboratories
Address:	P.O. Box 264 Clayton, 3168, AUSTRALIA
Notes:	Co-authored for 1992 MCT Workshop "In-Sity Ellipsometric Measurements of the MBE Growth of CdTe/HgTe and CdTe/ZnTe Superlattices."

Contact Name:	Walter Butler
Position:	Gmgr
Organization:	General Electric Company
Component:	Electronics Laboratory
Address:	Bldg 3, Electronic Park Syracuse, NY 13221
Notes:	Development of infrared arrays with particular focus on HgCdTe and InSb-based systems. Programs include the IRST for the F-14D and AADEOS.

Contact Name:	W.A. Cabanski
Position:	
Organization:	University of Erlangen
Component:	
Address:	Erlangen, GERMANY
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Electronic and Optical Properties of SIlicide/ SIlicon IR Detectprs"

Contact Name:	C. Caillas
Position:	
Organization:	Carnegie-Mellon University
Component:	Robotics Institute
Address:	5000 Forbes Avenue Pittsburgh, PA 15213
Notes:	Authored an April 1990 study, 100 pages, on "Thermal Imaging for Robotic Applications in Outdoor Scenes" available from DTIC. Artificial intelligence automation inspection his speciality.

Contact Name:	Duncan Campbell
Position:	Corp. V.P.
Organization:	BDM Federal, Inc.
Component:	
Address:	1501 BDM Way McLean, VA 22102-3204
Notes:	Thermal Imaging, imaging software, for military.

Contact Name:	Tony Canning
Position:	
Organization:	Atlantic Research Canada, Inc.
Component:	
Address:	1900 City Park Drive, Suite 400 Gloucester, Ontario CANADA K1J 1A3
Notes:	Thermal Imaging, predominantly for military applications

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Contact Name:	R.W. Capps
Position:	
Organization:	California Institute of Technology
Component:	
Address:	1201 East California Boulevard Pasadena, CA 91125
Notes:	Co-authored for 1990 IEEE Meeting on Advanced IR Detectors "Space Science APplications of Infrared Detector Technology: A Review"

Contact Name:	Pamela E. Carey
Position:	Ms.
Organization:	BDM Inc.
Component:	
Address:	4001 North Fairfax Drive Arlington, VA 22203
Notes:	Authored for 1992 SPIE workshop on IRFPAs "Modeling the Cost and Producibility Impacts of IRFPA Operability." Expert on cost-operability tradeoffs with focal plane arrays.

Contact Name:	G.P. Carey
Position:	
Organization:	Fraunhofer-Institut fur Angewandte Festkorperphysik
Component:	
Address:	Tullastrasse 72 D-7800 Freiburg, GERMANY
Notes:	Authored "XPD Investigation of Substrate Crystallinity at HgCdTe (111B) and CdTe(111)B Surfaces Upon Ag and Al Overlayer Formation."

Contact Name:	Jim Carey
Position:	Marketing Director
Organization:	Loral Electro-Optical Systems
Component:	
Address:	300 North Halstead Street Pasadena, CA 91107
Notes:	Infrared systems and equipment, c/o systems predominantly for military applications.

Contact Name:	Frederick M. Carlson
Position:	
Organization:	Clarkson University
Component:	
Address:	Potsdam, NY 13699
Notes:	Attended 1992 MCT conference. Works on MCT related semiconductor research.

Contact Name:	DR James Carnesca
Position:	Pres
Organization:	SRI International
Component:	David Sarnoff Research Center
Address:	201 Washington Rd Princeton, NJ 08543-5300
Notes:	Manufacturing materials, consumer electronics and information sciences, and solid state systems.

Contact Name:	J Carpenter
Position:	Pres
Organization:	Visidyne Inc
Component:	
Address:	10 Corporate Pl., Burlington, MA 01803
Notes:	Development of electro-optical instrumentation.

Contact Name:	Melvin J. Carr
Position:	President
Organization:	Galtech Semiconductor Materials Corp.
Component:	
Address:	265 North State Street Mt. Pleasant, UT 84647
Notes:	Manufacture of CdTe infrared materials, germanium, wafers and ingots, monocrystalline and polycrystallins. Polishing and slicing series for CdTe and CdZnTe.

Contact Name:	John C. Carson
Position:	Senior Vice President
Organization:	Irvine Sensors Corp.
Component:	
Address:	3001 Redhill Ave Bldg 3 Costa Mesa, CA 92626
Notes:	Applied research in military detection system (infrared sensing).

Contact Name:	Kent Carson
Position:	Director, Infrared Materials Lab
Organization:	Texas Instruments
Component:	
Address:	P.O. Box 655936, MS 150 Dallas, TX 75265
Notes:	

Contact Name:	Kent R. Carson
Position:	Director
Organization:	Texas Instruments
Component:	Infrared Materials Laboratory
Address:	P.O. Box 655936, MS 150 Dallas, TX 75265
Notes:	

Contact Name:	JoElaine Cary
Position:	CEO
Organization:	International Advanced Materials Inc.
Component:	
Address:	2 North Circle Avenue Spring Valley, NY 10977
Notes:	Manufacture of CdTe, GaAs, germanium, silicon, ZnS, and ZnSe materials for infrared systems, military and commercial.

Contact Name:	Richard Caserio
Position:	Sales Manager
Organization:	ITI Electro-Optics Corp.
Component:	
Address:	11500 W Olympic Blvd Los Angeles, CA 90064
Notes:	Manufacture of CdTe, GaAs, germanium, ZnS, and ZnSe for infrared technologies.

Contact Name:	J-P. Chamonal
Position:	
Organization:	LETI (CEA- Technologies Avancees)
Component:	DOPT - CEN/G - 85 X-
Address:	38041 Grenoble Cedex FRANCE
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Recent Developments on 12.5 um Infrared Detection Buttable Linear Arrays."

Contact Name:	Tin-Fung Chang
Position:	
Organization:	Chung-Shan Institute of Science and Technology
Component:	
Address:	Lung-Tan, Taiwan, REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE IRFPA meeting "Electrolyte Electroreflectance Spectroscopies for the Ion-Implanted HgCdTe with Thermal Annealing"

Contact Name:	C. Chang
Position:	
Organization:	University of Maryland
Component:	
Address:	Baltimore, MD
Notes:	Co-authored for 1992 SPIE meeting on Infrared Imaging Systems "Single-frame Multispectral Thermal Imagery"

Contact Name:	K.T. Chang
Position:	
Organization:	University of Southern California
Component:	Department of Materials Science and Engineering
Address:	Los Angeles, CA 90089-0241
Notes:	Co-authored for 1991 MCT Workshop "Ordered Phase in (HgCd)Te Grown by LPE on CdTe (111)B Substrate"

Contact Name:	Shi-Chen Chao
Position:	
Organization:	National Taiwan University
Component:	Department of Electrial Engineering
Address:	Taipei, Taiwan, REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Electrolyte Eletroreflectance Specrtoscopics for the Ion-Implanted HgCdTe with Thermal Annealing"

Contact Name:	Tuvia Charmey
Position:	Advertising Manager
Organization:	Elop-Electro Optics Industries
Component:	
Address:	P.O. Box 1165 Rehovot, Israel 76110
Notes:	Infrared systems and equipment, thermal imaging, detectors and sensors, night vision for military applications.

Contact Name:	J.P. Chatard
Position:	Dr.
Organization:	Sofradir
Component:	
Address:	43/47 rue Camille Pelletan 92290 Chatenay-Malabry FRANCE
Notes:	Head research scientist working on SOFRADIR's process for reduction of IRFPA costs, presented paper on analysis criteria selection for IRFPA detector production at 1992 SPIE Orlando meeting.

Contact Name:	An-Ban Chen
Position:	
Organization:	Auburn University
Component:	Physics Department
Address:	Auburn, AL 36849
Notes:	Author of "Comparison of InTiSb and HgCdTe as Infrared Material." at 1992 MCT Workshop. Has done MCT producibility-related research.

Contact Name:	C.K. Chen
Position:	
Organization:	MIT
Component:	Lexington Lincoln Lab
Address:	244 Wood Street Lexington, MA 02173-9108
Notes:	Co-authored April 1990 study entitled "PtSi Schottky-Barrier Focal Plane Arrays for Multispectral Imaging in Ultraviolet, Visible, and Infrared Spectral Bands"

Contact Name:	Y.P. Chen
Position:	
Organization:	University of Illinois at Chicago
Component:	Microphysics Laboratory, Physics Department
Address:	P.O. Box 4348 Chicago, IL 60680
Notes:	Authored "Structure of CdTe(111)B grown by MBE on Misoriented Si(001)" for 1992 MCT Workshop. For 1991 Workshop, "Current Status of Direct Growth of CdTe and HgCdTe on Silicon by MBE"

Contact Name:	Arthur Chester
Position:	VP
Organization:	General Motors Corporation
Component:	Hughes Aircraft Co., Research Laboratories
Address:	3011 Malibu Canyon Rd Malibu, CA 90265
Notes:	Production of GaAs and InP integrated circuits; infrared sensors, especially monolithic focal plane arrays, for military markets.

Contact Name:	Arthur N. Chester
Position:	Vice President and Director
Organization:	Hughes Research Laboratories
Component:	
Address:	3011 Malibu Canyon Road Malibu, CA 90265
Notes:	The research laboratories conduct long range applied scientific research in physics, chemistry, electronics, and information sciences.

Contact Name:	A.C. Childs
Position:	
Organization:	Rockwell International Corporation
Component:	Electro-Optics Center
Address:	3370 Miraloma Avenue Anaheim, CA 92803
Notes:	Production of MCT-based arrays on alternative substrates under company funding and PACE I and PACE II contracts from military.

Contact Name:	B.A. Chin
Position:	
Organization:	Auburn University
Component:	
Address:	
Notes:	Co-authored 1991 "Weld Quailty Control in Gas Tungsten Arc Welding Process"

Contact Name:	Bryan Chin
Position:	
Organization:	Auburn University
Component:	
Address:	
Notes:	Co-authored 1984 "Automatic Welding: Infrared Sensors for Process Control Computer Based Factory Automation"

Contact Name:	Brian Chin
Position:	Professor
Organization:	Auburn University
Component:	College of Engineering and Engineering Experiment Station
Address:	201 Ross Hall Auburn, AL 36849-5351
Notes:	Designs automated welding systems using IR detectors for machine vision.

Contact Name:	Laurel Chivari
Position:	Manager, Public Relations
Organization:	Northrop Corp.
Component:	Electronics Systems Division
Address:	600 Hicks Road Rolling Meadows, IL 60008-1098
Notes:	Infrared systems and equipment for military applications.

Contact Name:	James Chladek
Position:	Vice President
Organization:	CIC International, Ltd.
Component:	
Address:	38-01 23rd Avenue Astoria, NY 11105
Notes:	Detectors and Sensors, infrared systems and equipment, night vision equipment for military.

Contact Name:	J. Choi
Position:	
Organization:	University of Maryland
Component:	
Address:	College Park, MD
Notes:	Co-authored 1987 study "Magnetophonon Effect in HgCdTe"

Contact Name:	Deepak Chopra
Position:	President
Organization:	UDT Sensors Inc
Component:	
Address:	12525 Chadron Ave. Hawthorne, CA 90250
Notes:	Development of light-based sensors.

Contact Name:	Deepak Chopra
Position:	Pres
Organization:	UDT Sensors Inc
Component:	
Address:	12525 Chadron Ave. Hawthorne, CA 90250
Notes:	Development of light-based sensors.

Contact Name:	J.A. Christensen
Position:	Marketing Director
Organization:	Hughes Aircraft Co.
Component:	Electron Dynamics Division
Address:	3100 W. Lomita Torrance, CA 90509-2999
Notes:	

Contact Name:	Joseph Christenson
Position:	Pres
Organization:	Pattern Processing Technologies
Component:	
Address:	Suite 170, 10025 Valley View Rd. Eden Prairie, MN 55344
Notes:	Product oriented machine vision systems, some IR experience.

Contact Name:	Bernard Christophe
Position:	
Organization:	SAT
Component:	
Address:	41, rue Cantagrel F-75361 Paris Cedex 13 FRANCE
Notes:	Along with Thomson CSF, places HgCdTe-based sensors on a variety of military products, including the Rafale fighter. Also produces own InSb-based IRFPAs for use in missile guidcance.

Contact Name:	J.H. Chu
Position:	
Organization:	Shanghai Institute of Technical Physics
Component:	National Laboratory for INfrared Physics
Address:	Academia Sinica Shanghai 200083 CHINA
Notes:	Co-authored for 1991 MCT Workshop "Influece of Resonant Defect States on Subband Structures in HgCdTe"

Contact Name:	John Cicotta
Position:	Marketing Communications Manager
Organization:	Harris RF Communications
Component:	
Address:	1680 University Avenue Rochester, NY 14610
Notes:	Thermal imaging, digital imaging systems, imaging software for military.

Contact Name:	Ray P. Clark
Position:	Dr.
Organization:	King's College
Component:	Thermal Biology Research Unit
Address:	Campden Hill Road, Kensington London, W8 7AH, UNITED KINGDOM
Notes:	Active in infrared biomedical thermography as system designer and leading researcher, developing new applications. Widely published.

Contact Name:	Ray P. Clark
Position:	Dr.
Organization:	King's College London, University of London
Component:	Thermal Biology Research Unit
Address:	Campden Hill Road Kensington, Longon W8 7AH UNITED KINGDOM
Notes:	President of European Academy of Thermology 1993-1994.

Contact Name:	David Clist
Position:	Business Development Manager
Organization:	Marine-Air Systems
Component:	
Address:	24 Bridge Street P.O. Box 30-248 Lower Hutt, NEW ZEALAND
Notes:	E/o systems, detectors & sensors, infrared systems & equipment, thermal imaging for military markets.

Contact Name:	Robert L. Cockrell
Position:	Director, Business Development
Organization:	Amherst Systems, Inc.
Component:	
Address:	30 Wilson Road Buffalo, NY 14221
Notes:	Passive and Active electro-optical systems, infrared systems & equipment mainly for military.

Contact Name:	C.A. Cockrum
Position:	
Organization:	SBRC
Component:	
Address:	75 Coromar Drive Goleta, CA 93117
Notes:	Predominantly MCT-based IR systems, focal planes arrays, and components, including dewar assemblies, for military use. Research scientist involved in SBRC's MCT IRFPA projects; substrate work too.

Contact Name:	Antonio Colantonio
Position:	
Organization:	Technology, Architectural, and Engineering Services
Component:	Public Works Canada
Address:	Riverside Drive Ottawa, Ontario, CANADA K1A OM2
Notes:	infrared non-destructive evaluation

Contact Name:	AD Cole
Position:	Pres
Organization:	Adcole Corporation
Component:	
Address:	669 forest St. Marlborough, MA 01752
Notes:	Research on sun sensing systems, scientific instruments for rockets and satellites, linear and radial electro-optical measuring techniques, computer controlled cylindrical coordinate gauging equipment.

Contact Name:	Michael Coleman
Position:	Direng
Organization:	Advanced Design Corporation
Component:	
Address:	8560 Cinderbed Rd Newington, VA 22122
Notes:	Product oriented electro-optics; night vision devices both image intensification and thermal imaging. Military.

Contact Name:	John Coleman
Position:	CEO
Organization:	Plasma Physics Corp.
Component:	
Address:	PO Box 548 Locust Valley, NY 11560
Notes:	Development and manufacture of photoreceptor drums, solar cells and imaging, polymer laminating, and laser isotope separation.

Contact Name:	D.A. Collins
Position:	Dr.
Organization:	California Institute of Technology
Component:	
Address:	1201 East California Boulevard Pasadena, CA 91125
Notes:	Reported at the DARPA Program Review on Infrared Focal Plane Array Technology in December, 1992, on "InAs/GaInSb Superlattices: Growth Involving Anion Switching"

Contact Name:	Luigi Colombo
Position:	
Organization:	Texas Instruments
Component:	Central Research Laboratories
Address:	P.O. Box 655936, MS 154 Dallas, TX 75265
Notes:	

Contact Name:	R. Coltart
Position:	Press Officer
Organization:	GEC Marconi Dynamics, Ltd.
Component:	
Address:	The Grove Warren Lane Stanmore, Middlesex, UK HA7 4LY
Notes:	Infrared systems and equipment, MMW radar, etc. for military applications

Contact Name:	Ervin Colton
Position:	Chief Executive
Organization:	Cerac Inc.
Component:	
Address:	P.O. Box 1178 Milwaukee, WI 53201
Notes:	Manufacturer of infrared materials, as well as specialty inorganic chemicals, evaporation materials, and sputtering targets in both R&D and bulk quantities. Specializes in materials of well defined purity and size including oxides, fluorides, silicides, borides, nitrides, carbides, sulfides, and intermetallic powders.

Contact Name:	Thomas Connolly
Position:	
Organization:	Oriel Corp.
Component:	
Address:	250 Long Beach Blvd Stratford, CT 06497
Notes:	Manufacture of GaAs, germanium, silicon, and ZnSe for infrared applications, for both military and commercial markets.

Contact Name:	Peter C. Connolly
Position:	Business Development Manager
Organization:	Photronics Corp.
Component:	
Address:	270 Motor Parkway P.O. Box 11368 Hauppauge, NY 11788
Notes:	E/o systems, infrared systems and equipment, night vision for miltiary applications.

Contact Name:	Augusto Conte-Matos
Position:	
Organization:	Georgia Tech Research Institute
Component:	Physical Sciences Laboratory
Address:	Room 128 Baker Bldg Atlanta, GA 30332
Notes:	Co-authored for 1991 MCT Workshop "Gas Source Iodine Doping and Characterization of MBE Grown CdTe"

Contact Name:	J.W. Cook
Position:	
Organization:	North Carolina State University
Component:	Department of Physics
Address:	Raleigh, NC 27695-8202
Notes:	Co-AUthored "Integrated Heterostructure Devices Based on II-VI Compound Semiconductors" for 1992 MCT Workshop Co-Authored for 1991 MCT Workshop "Quantum Hall Effect adn Setback Modulation Doping HgTe-CdTe Heterostructures"

Contact Name:	J.W. Cook
Position:	
Organization:	North Carolina State University
Component:	Department of Physics
Address:	Raleigh, NC 27695-8202
Notes:	Authored for 92 MCT workshop "Growth of HgSe and HgCdSe Thin Films by Molecular Beam Epitaxy"

Contact Name:	Diane Cook
Position:	
Organization:	Univeristy of Texas at Arlington
Component:	Dept of Computer Science Engineering
Address:	P.O. Box 19015 Arlington, TX 76019-0015
Notes:	active in infrared process control

Contact Name:	R.P. Cooper
Position:	
Organization:	Ford Motor Co.
Component:	Scientific Research Laboratory
Address:	P.O. Box 2053 Dearborn, MI 48121
Notes:	Interested in designing IR systems to nondestructively test cars for paint delamination and rust

Contact Name:	W. Covington
Position:	
Organization:	Sam Houston State University
Component:	Department of Physics
Address:	Huntsville, TX 77341
Notes:	Co-authored "Properties of InAs/(Ga,In)Sb Strained Layer Superlattices Grown on the (111) Orientations" for 1992 MCT Workshop

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Contact Name:	David H. Cowling
Position:	
Organization:	Lousiana Tech University
Component:	College of Engineering
Address:	Tech Station, P.O. Box 10348 Ruston, LA 70803-0301
Notes:	Co-authored 1990 "A Simplified Vision System With Robotic Assembly and Manufacturing Applications"

Contact Name:	Edward Cox
Position:	
Organization:	Digital Equipment Corp
Component:	
Address:	Mail Stop MLO5-4/E22 Maynard, MA 01754
Notes:	Has conducted research on the use of infrared non-destructive evaluation of integrated circuit boards

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Contact Name:	Robert Cox
Position:	President
Organization:	Emerson Electric Co
Component:	Rosemount Inc.
Address:	12001 technology Dr. Eden Prairie, MN 55344
Notes:	Applied research on sensors and instruments for measurements of temperature, flow level, pressure, and other industrial applications. Uses IR detectors for various spectrometers, FTIR, gas analysis and detection applications.

Contact Name:	Steve Cox
Position:	Pres
Organization:	Lasermike, Inc.
Component:	
Address:	6060 Executive Blvd Dayton, OH 45424
Notes:	Development of intelligent sensors; although work is more involved in software and image processing, some work with IR sensors.

Contact Name:	Elliot Cramer
Position:	
Organization:	NASA
Component:	Langley Research Center
Address:	MS 231 Hampton, VA 23665
Notes:	Infrared non-destructive evaluation, mainly advanced composites, esp. aging aircraft skins.

Contact Name:	Dr Clara Craver
Position:	COO
Organization:	Craver & Craver Inc
Component:	
Address:	761 W Kirkham Ave. Saint Louis, MO 63122
Notes:	Computer-assisted database searches in infrared spectroscopy; reference spectra for IR.

Contact Name:	B. Scott Crews
Position:	
Organization:	NASA
Component:	Langley Research Center
Address:	Analytical Services and Materials, Inc. MS 231 Hampton, VA 23655
Notes:	Infrared non-destructive evaluation, mainly of aging aircraft skins.

Contact Name:	Paul D. Croissant
Position:	Dr.
Organization:	
Component:	
Address:	1711 Woodward Avenue Bloomfield, MI 48103
Notes:	Doctor in private practive active in infrared biomedical thermography associations

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Contact Name:	D.J. Crowther
Position:	
Organization:	Wayne State University
Component:	Dept of Physics and Inst for Manufacturing Research
Address:	Detroit, MI 48202
Notes:	infrared non-destructive evaluation

Contact Name:	James E. Culley
Position:	
Organization:	Picker International, Ltd.
Component:	Engineering Dept
Address:	P.O. Box 2, East Lane Wembley, HA9 7PR, UNITED KINGDOM
Notes:	Active in infrared biomedical thermography, has written extensively about the broad applications for IR thermography.

Contact Name:	Darrell Curtis
Position:	Director Business Development
Organization:	DBA Systems, Inc.
Component:	
Address:	P. O. Box 550 Melbourne, FL 32902
Notes:	Thermal Imaging, infrared systems and equipment for military applications

Contact Name:	Richard Curtiss
Position:	Gmgr
Organization:	Raytheon Comp.
Component:	Electromagnetic Systems Division
Address:	6380 Hollister Ave. Goleta, CA 93117
Notes:	Infrared countermeasures and high frequency microwave and antennas.

Contact Name:	Arthur Cussen
Position:	Pres
Organization:	Channel Technologies
Component:	Electro-optical Industries, Inc.
Address:	859 Ward Dr. Santa Barbara, CA 93111
Notes:	Research on infrared and visible blackbody radiant energy standards, radiometry, electro-optical instrumentation, microwave standards, low-level instrumentation, industrial temperature measurement, and radiation thermometry.

Contact Name:	J.A. Cutts
Position:	
Organization:	California Institute of Technology
Component:	
Address:	1201 East California Boulevard Pasadena, CA 91125
Notes:	Co-authored for 1990 IEEE Meeting on Advanced IR Detectors "Space Science APplications of Infrared Detector Technology: A Review"

Contact Name:	John Dahmes
Position:	Executive Manager, Marketing
Organization:	Intergraph Corp.
Component:	
Address:	2051 Mercator Drive Reston, VA 22091
Notes:	Thermal Imaging, imaging software for military applications.

Contact Name:	M. Dal Colle
Position:	
Organization:	Fraunhofer-Institut fur Angewandte Festkorperphysik
Component:	
Address:	Tullastr. 72 D-7800 Freiburg, Germany
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Characterization of Anodic Fluoride Films on HgCdTe"

Contact Name:	Hugh Danaher
Position:	
Organization:	UTI Instruments
Component:	
Address:	
Notes:	

Contact Name:	Craig Davidson
Position:	
Organization:	Vision Harvest
Component:	
Address:	HCR Box 36 Hatch, NM 87937
Notes:	active in infrared process control

Contact Name:	C. de Cambray
Position:	Public Relations Executive
Organization:	SAGEM
Component:	
Address:	6, avenue d'Iena 75783 Paris, Decex 16, FRANCE
Notes:	Infrared equipment & systems, detectors and sensors, c.o systems, night vision, robotics for military applications.

Contact Name:	William De La Torre
Position:	Mr,
Organization:	Research Opportunities, Inc.
Component:	
Address:	2200 Hamipola Court Suite 101 Torrance, CA 90501
Notes:	Designer of infrared non-destructive evaluation system at research opportunities.

Contact Name:	Li De-Chun
Position:	
Organization:	Shandong University
Component:	Infrared and Remote Sensing Re.
Address:	Jinan, Shandong, CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "The Dependence of Fermi Level of HgCdTe on Impurity Concentration and Temperature"

Contact Name:	A. Deepak
Position:	Presidnent
Organization:	Science & Technology Corp
Component:	
Address:	101 Research Dr., PO Box 7390 Hampton, VA 23666
Notes:	Remote sensing, laser beams, e/o sensors, and lidars, aerosols, fogs and hazes, climate, space, and environmental quailty.

Contact Name:	John Dehne
Position:	Pres
Organization:	Loral Corporation
Component:	Loral Infrared & Imaging Systems, Inc.
Address:	2 Forbes Rd. Lexington, MA 02173
Notes:	R&D of electro-optical systems and components.

Contact Name:	Nancy C. DelGrande
Position:	Ms.
Organization:	Lawrence Livermore National Laboratories
Component:	
Address:	Livermore, CA 94551
Notes:	Active in infrared remote sensing, designed dual-band IR system using MWIR and LWIR detectors simulateneously to overcome emissivity problems.

Contact Name:	Brian Denley
Position:	
Organization:	Loral Corporation
Component:	Loral Infrared & Imaging Systems, Inc.
Address:	2 Forbes Rd. Lexington, MA 02173
Notes:	

Contact Name:	Roberta L. Denny
Position:	Ms.
Organization:	Rockwell International Corporation
Component:	Electro-Optics Center
Address:	3370 Miraloma Avenue Anaheim, CA 92803
Notes:	Leader of Rockwell EOC's Man/Tec research including producibility work on focal plane arrays.

Contact Name:	Dave Derby
Position:	Pres
Organization:	Datron Systems, Inc.
Component:	
Address:	200 W Los Angeles Ave. Simi Valley, CA 93065-1650
Notes:	Production and research in infrared optical and laser sensors.

Contact Name:	Eustace Dereniak
Position:	
Organization:	University of Arizona
Component:	Optical Sciences Center
Address:	Tucson, AZ 85721
Notes:	active in infrared process control

Contact Name:	E.L. Derenial
Position:	
Organization:	University of Arizona
Component:	Optical Sciences Center
Address:	Tucson, AZ 85721
Notes:	Co-Author in 1992 SPIE meeting of "Development of a High-Speed PtSi IRCCD Camera System"

Contact Name:	M.R. Descour
Position:	
Organization:	University of Arizona
Component:	Optical Sciences Center
Address:	Tucson, AZ 85721
Notes:	Co-authored for 1992 IRFPA SPIE meeting "Functional aspects of the retina relating to infrared focal plane arrays"

Contact Name:	Joseph DeSimone
Position:	Pres.
Organization:	Silicon Casting Inc.
Component:	
Address:	2616 Mercantile Drive Rancho Cordova, CA 95742
Notes:	Manufacturer of silicon in various shapes for infrared applications.

Contact Name:	G. Destefanis
Position:	
Organization:	LETI (CEA - Technologies Avancees)
Component:	DOPT - CEN/G - 85 X
Address:	F38041 Grenoble Cedex FRANCE
Notes:	Co-authored for 1992 MCT Workshop "Large Improvement in HgCdTe Photovoltaic Detector Performances at LETI"

Contact Name:	Bob Deuple
Position:	Dr.
Organization:	Thayer School of Engineering
Component:	Biophysics Dept
Address:	Hanover, NH 03755
Notes:	active in infrared biomedical thermography

Contact Name:	Roger DeVilbiss
Position:	Product Marketing Manager
Organization:	Marlow Industries, Inc.
Component:	
Address:	10451 Vista Park Road Dallas, TX 75238
Notes:	Manufactures thermoelectric cooling devices, thermoelectric cooling assemblies, and related power supplies and temperature controllers

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Contact Name:	C.F. Dewey
Position:	
Organization:	MIT
Component:	
Address:	Cambridge, MA 02139
Notes:	Co-authoerd for 1991 MCT Workshop "Nonlinear Optical Effects in Rotationally Twinned CdTe and CdMnTe Crystals"

Contact Name:	John Dimmock
Position:	Gmgr
Organization:	McDonnell Douglas Corporation
Component:	MD Research Laboratories
Address:	PO Box 516 Saint Louis, MO 63166
Notes:	Infrared detectors and fluid dynamics.

Contact Name:	Qian Dingrong
Position:	
Organization:	Laboratory for Infrared Physics
Component:	Academia Sinica
Address:	420 Zhong Shan Bei Yi Road Shanghai, 200083, CHINA
Notes:	Authored for 1992 SPIE meeting on IRFPAs "Element of a new Infrared Detector Plasma Edge Detector"

Contact Name:	Peter Direnzo
Position:	Gnl Mgr
Organization:	Cleveland Crystals, Inc.
Component:	
Address:	19306 Redwood Avenue, P.O Box 17157 Cleveland, OH 44117
Notes:	Manufacturer and research into CdTe, ZnS, and ZnSe infrared materials for both military and commercial markets.

Contact Name:	Robert Dixon
Position:	
Organization:	Tektronix, Inc.
Component:	
Address:	26600 Southwest Parkway Beaverton, OR 97077
Notes:	infrared non-destructive evaluation

Contact Name:	M. Dobrowolska
Position:	
Organization:	University of Notre Dame
Component:	Department of Physics
Address:	Notre Dame, IN 46556
Notes:	Co-authored for 1991 MCT Workshop "Magnetic Generation of electrons and Holes in Semimetallic HgTe-CdTe Superlattices"

Contact Name:	Alan Doctor
Position:	Sales & Marketing Manager
Organization:	Servo Corporation of America
Component:	
Address:	111 New South Road Hicksville, NY 11802
Notes:	Manufactures thermistors and pyroelectric IR detectosr, IR optical components, IR telescope assemblies, custom IR systems, and coating materials.

Contact Name:	Brad Doetzel
Position:	CEO
Organization:	Avimo USA, Inc.
Component:	
Address:	716 S Milwaukee Ave. Wheeling, IL 91702
Notes:	Product oriented research in night vision optics and custom optical components, used mainly by the military.

Contact Name:	Robert Donadio
Position:	Pres
Organization:	Morton International
Component:	CVD Incorporated
Address:	185 New Boston St. Woburn, MA 01801
Notes:	Material sciences, novel optical concepts and laser applications.

Contact Name:	D. Donnelly
Position:	
Organization:	Sam Houston State University
Component:	Department of Physics
Address:	Huntsville, TX 77341
Notes:	Co-authored "Properties of InAs/(Ga,In)Sb Strained Layer Superlattices Grown on the (111) Orientations" for 1992 MCT Workshop

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Contact Name:	F.P. Doty
Position:	
Organization:	Aurora Technologies Corp.
Component:	
Address:	San Diego, CA 92121-2410
Notes:	Co-authored for 1991 MCT Workshop "Properties of CdZnTe Crystals Grown by a High Pressure Bridgman Method." Has conducted CZT related research

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Contact Name:	Irwin Drangel
Position:	Sales Manager
Organization:	United Mineral and Chemical Corp.
Component:	
Address:	1100 Valley Brook Avenue Lyndhurst, NJ 07071-3608
Notes:	Manufacture of CdTe, GaAs, germanium, and ZnS for infrared applications.

Contact Name:	Alfred D. Ducharme
Position:	
Organization:	University of Central Florida
Component:	Electrical Engineering Department and Center for Research in Electro-Optics and Lasers
Address:	12424 Research Parkway, Suite 400 Orlando, FL 32828
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Use of Narrowband Laser Speckle for MTF Characterization of CCDs"

Contact Name:	Michael Dudley
Position:	
Organization:	SUNY at Stony Brook
Component:	Department Materials Sci & Eng
Address:	Stony Brook, NY 11794-2275
Notes:	Attended 1992 MCT conference

Contact Name:	Benjamin Duhow
Position:	V.P. Defense Programs
Organization:	Thomson-CSF
Component:	
Address:	2231 Crystal Drive, Suite 814 Arlington, VA 22202
Notes:	Infrared equipment and systems, detectors and sensors

Contact Name:	James Dunn
Position:	Pres
Organization:	Loral Corporation
Component:	Loral Fairchild Systems
Address:	300 Robbins Ln. Syosset, NY 11791
Notes:	Development of electro-optical imaging systems.

Contact Name:	Ronny Dunn
Position:	Infrared Program Manager
Organization:	Texas Instruments
Component:	Defense Systems and Electronics Group
Address:	POB 660246 MS 3139 Dallas, TX 75266
Notes:	

Contact Name:	J.A. Dura
Position:	
Organization:	University of Houston
Component:	Department of Physics and Space Vacuum Epitaxy Center
Address:	Houston, TX 77204
Notes:	Co-authored "Properties of InAs/(Ga,In)Sb Strained Layer Superlattices Grown on the (111) Orientations" for 1992 MCT Workshop

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Contact Name:	Dan Dusel
Position:	Vice President, marketing.
Organization:	Merlin Engineering
Component:	
Address:	1888 Embarcadero Road Palo Alto, CA 94303
Notes:	Thermal imaging, infrared systems & equipment for military markets.

Contact Name:	Frans Eberth
Position:	
Organization:	FLIR Systems, Inc.
Component:	
Address:	16505 SW 72nd Avenue Portland, OR 97224
Notes:	Infrared non-destructive evaluation specialist.

Contact Name:	Kip Edgley
Position:	Electrical/Instrumentation Specialist
Organization:	Envirotech Operating Services
Component:	
Address:	18820 Aurora Avenue North Vancouver, WA 98133
Notes:	Large western thermographic predictive maintenance firm, consultants

Contact Name:	D.D. Edwall
Position:	
Organization:	Fraunhofer-Institut fur Angewadnte Festkorperphysik
Component:	
Address:	Tullastr. 72 D-7800 Freiburg, Germany
Notes:	AUthor of "Characterization of MCT Heterostructures by Thermoelectric Measurements"

Contact Name:	Jeff Edwards
Position:	Communications Manager
Organization:	Evans & Sutherland
Component:	
Address:	600 Komas Drive Salt Lake City, UT 84108
Notes:	Night Vision, thermal imaging for military applications.

Contact Name:	D. Eger
Position:	
Organization:	Soreq Nuclear Research Center
Component:	
Address:	ISRAEL
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Anodic Oxides on HgZnTe"

Contact Name:	H. Ehrenreich
Position:	
Organization:	Harvard University
Component:	Division of Applied Sciences
Address:	29 Oxford Street Cambridge, MA 92138
Notes:	Co-Authored "Augur Lifetimes in Ideal InGaSb/InAs Superlattices" for 1992 MCT Workshop.

Contact Name:	Hassan Ehsani
Position:	
Organization:	Rensselaer Polytechnic Institute
Component:	
Address:	110 Eight Street Troy, NY 12180
Notes:	Co-authored "Improved CdTe Layers on GaAs and Si Substrates, Grown by Atomic Layer Epitaxy" for 1992 MCT Workshop Co-Authored for 1991 Workshop "Low Temperature Epitaxy of HgTe, CdTe, and HgCdTe Using FLow Modulation Techniques" and "Reduced Metal-Insulator Semiconductor Tunnelling in MOCVD HgCd(111)Te Films"

Contact Name:	Robert Einzig
Position:	Pres
Organization:	Optical Technologies, Inc.
Component:	
Address:	Suite 1200, 360 Herndon Pkwy Herndon, VA 22070
Notes:	Research and development of fiber optic sensors for the measurement of physical parameters.

Contact Name:	Steven Eisenbath
Position:	Pres
Organization:	Peda-Scan Infrared Service, Inc.
Component:	
Address:	1932 Olde Eisenbath Ln. Foristell, MO 63348
Notes:	Consultant doing research for industry; thermal evaluation of performance of products.

Contact Name:	David Eisenhaure
Position:	Pres
Organization:	Satcon Technololgy Corp.
Component:	
Address:	12 Emily ST. Cambridge, MA 02139-4507
Notes:	Power electronics and system integration.

Contact Name:	Jan Eklund
Position:	President
Organization:	Eklund Infrared
Component:	
Address:	142 Sunset Avenue Verona, NJ 07044
Notes:	Eklund Infrared markets AGEMA's systems in US. Eklund is on SPIE's Thermosense steering committee

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Contact Name:	Sylvester N. Ekpenuma
Position:	
Organization:	Claflin College
Component:	Department of Mathematics and Physics
Address:	Orangeburg, South Carolina 29115
Notes:	Co-authored for 1991 MCT Workshop "Critical Stress of HgCdTe Solid Solutions" and "Microhardness of Hg-Containing II-Vi Alloys"

Contact Name:	Joel Elftmann
Position:	Pres
Organization:	FSI International
Component:	
Address:	322 Lake Hazeltine Dr. Chaska, MN 55318
Notes:	Research for semiconductor production equipment.

Contact Name:	Dr. Herbert Elion
Position:	CEO
Organization:	International Optical Telecommuncations
Component:	
Address:	18 E Blithedale Ave. Mill Valley, CA 94941-1916
Notes:	Hardware and software market research including lab facilities, design improvement and patenting technology assistance.

Contact Name:	Earle Ellefsen
Position:	Pres.
Organization:	Pure Tech Inc.
Component:	
Address:	P.O. Box 1319 Carmel, NY 10512
Notes:	Manufacture of CdTe, germanium, silicon, ZnS, and ZnSe for infrared applications.

Contact Name:	WJ Elsdoefer
Position:	Pres
Organization:	International Machine & Tool Corp.
Component:	Instrument & Development Laboratory
Address:	115 Maple St. Warwick, RI 02888
Notes:	Electronic and optical measurement development.

Contact Name:	Earnest Emery
Position:	CEO
Organization:	E2 Technology corp.
Component:	
Address:	4475 Dupont Ct., No 9 Ventura, CA 93003
Notes:	Product oriented research in infrared blackholes.

Contact Name:	Michel Engelhardt
Position:	
Organization:	Grumman Aircraft Systems
Component:	
Address:	MS B46-35 Bethpage, NY 11714
Notes:	Active in infrared process control design and integration for Grumman.

Contact Name:	Gerald Entine
Position:	Pres
Organization:	Radiation Monitoring Devices, Inc.
Component:	
Address:	44 Hunt St. Watertown, MA 02172
Notes:	Manufacture of cadium telluride for infrared applications.

Contact Name:	David E. Escobar
Position:	
Organization:	USDA - ARS
Component:	Remote Sensing Research Unit
Address:	2413 E. Highway 83 Weslaco, TX 79586
Notes:	active in infrared remote sensing

Contact Name:	I. Esquivias
Position:	
Organization:	Fraunhofer-Institut fur Angewandte Festkorperphysik
Component:	
Address:	Tullastr. 72 D-7800 Freiburg, Germany
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Characterization of Anodic Fluoride FIlms on HgCdTe"

Contact Name:	Paul Everett
Position:	Manager, Business Development
Organization:	Litton Electron Devices
Component:	
Address:	1215 S. 52nd Street Tempe, AZ 85281
Notes:	E/O systems, night vision devices, infrared systems and equipment, produced for military markets.

Contact Name:	James H. Everitt
Position:	
Organization:	USDA - ARS
Component:	Remote Sensing Research Unit
Address:	2413 E. Highway 83 Weslaco, TX 79596
Notes:	active in infrared remote sensing

Contact Name:	Gerald Falbel
Position:	Chmn
Organization:	Optical Energy
Component:	
Address:	472 Westover Rd Stamford, CT 06902
Notes:	Research into electro-optical engineering.

Contact Name:	Mary Fallon
Position:	Ms.
Organization:	Inframetrics
Component:	
Address:	16 Esquire Drive Billerica, MA 01862
Notes:	

Contact Name:	T. Fanning
Position:	
Organization:	SUNY at Stony Brook
Component:	Department of Materials Science & Engineering
Address:	Stony Brook, NY 11794-2275
Notes:	AUthor of "White Beam X-ray Synchroton Topography Analysis of CdTe (111)B Substrates and Epilayers

Contact Name:	Lorenzo Faraone
Position:	
Organization:	University of West Australia
Component:	Department of EE
Address:	Nedlands, Perth, Western Australia 6009
Notes:	Attended 1992 MCT conference

Contact Name:	Frank Fariello
Position:	Pres
Organization:	EDO Corporation
Component:	Barnes Engineering Company
Address:	88 Long Hill Cross Rd. Shelton, CT 06484
Notes:	Manufactures thermal and photon detectors, micro-thermal imagers, spectrum analyzers, space instrumentation, ncluding horizon sensors, IR microscopes, and IR instrumentation for research and industry.

Contact Name:	Vahne Farkissian
Position:	Pres
Organization:	Silicon Valley Group, Inc.
Component:	
Address:	2240 Ringwood Ave. San Jose CA 95131
Notes:	Semiconductor wafer processing equipment.

Contact Name:	Cathleen M. Farley
Position:	Ms.
Organization:	BDM Inc.
Component:	
Address:	4001 North Fairfax Drive Arlington, VA 22203
Notes:	Authored for 1992 SPIE workshop on IRFPAs "Modeling the Cost and Producibility Impacts of IRFPA Operability"

Contact Name:	Diane Farrar
Position:	Ms.
Organization:	NASA Ames Research Center
Component:	
Address:	Mountain View, CA 94035-1000
Notes:	Designed airborne fire monitoring system used, most notably, to assist oakland firefighters during October 1991 blaze

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Contact Name:	Heinz Fassmer
Position:	
Organization:	Eltro GmBH, Gesellschaft fur Strahlungstechnik
Component:	Euromissile Group
Address:	W-2878 Berne 2/ Motzen-Weser Germany
Notes:	Produces HgCdTe-based infrared guidance systems for military applications.

Contact Name:	Jean-Paul Fauric
Position:	
Organization:	University of Illinois
Component:	Microphysics Lab
Address:	Chicago, IL
Notes:	Authored November 1989 "MBE Growth: Characterization and Electronic Device Processing of HgCdTe, HgZnTe. Related Heterojunctions and HgCdTe-CdTe Superlattics"

Contact Name:	J.P. Fauric
Position:	
Organization:	University of Illinois at Chicago
Component:	Microphysics Laboratory, Physics Department
Address:	PO Box 4348, M/C 273 Chicago, IL 60680
Notes:	Authored "Structure of CdTe(111)B grown by MBE on Misoriented Si(001)," and "Influence of CdZnTe(211)B Substrate on Elecrtical Propoerties of HgCdTe Grown by MBE" for 1992 MCT Workshop. On Program Committee of 1991 & 1992 MCT Workshop For 1991 Workshop, "Current Status of Direct Growth of CdTe and HgCdTe on Silicon by MBE"

Contact Name:	L.D. Favro
Position:	
Organization:	Wayne State University
Component:	Insitute for Manufacturing Research
Address:	Detroit, MI 48202
Notes:	Expert in infrared NDE. Authored in 1990 a 7 page "Noise Suppresion in IR Thermal-Wave Video Images by Real-Time Processing in Synchronism with Active Stimulation of the Target"

Contact Name:	Terry Feeley
Position:	Pres
Organization:	Laser Fare, Inc.
Component:	
Address:	One Industrial Dr S Esmond, RI 02917
Notes:	Applied laser technology to industrial materials processing; research in aerospace, medical and electronic applications, includes IR illumination.

Contact Name:	Wu Fei-fei
Position:	
Organization:	Shandong University
Component:	Infrared and Remote Sensing Re.
Address:	Jinan, Shandong, CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "The Dependence of Fermi Level of HgCdTe on Impurity Concentration and Temperature"

Contact Name:	A. Fenigstein
Position:	
Organization:	Kidron Microelectronics Research Center
Component:	Department of Electrical Engineering
Address:	Technion-Israel Institute of Technology Haifa 32000, ISRAEL
Notes:	For 1991 MCT Workshop Co-authored "Covered Electrode HgCdTe Photoconductor Under High Illumination Levels"

Contact Name:	F. Fernandez
Position:	President
Organization:	Vinten-Penarroya Inc.
Component:	
Address:	17151 Newhope Street, Suite 208 Fountain Valley, CA 92708
Notes:	Manufacture of germanium for infrared applications.

Contact Name:	E. Finkman
Position:	
Organization:	Kidron Microelectronics Research Center
Component:	Department of Electrical Engineering
Address:	Technion-Israel Institute of Technology Haifa 32000, ISRAEL
Notes:	For 1991 MCT Workshop Co-authored "Covered Electrode HgCdTe Photoconductor Under High Illumination Levels"

Contact Name:	Patrick Finney
Position:	
Organization:	FLIR Systems, Inc.
Component:	
Address:	16505 SW 72nd Avenue Portland, OR 97224
Notes:	Active in setting up infrared predictive maintenance and IC board inspection regimes for FLIR systems

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Contact Name:	John Fitts
Position:	Pres
Organization:	EOIS
Component:	
Address:	Suite 501, 710 Wilshire Blvd. Santa Monica, CA 90401
Notes:	High-energy laser beam control systems, smart sensor technology, moir interferometry, wavefront sensors, algorithm development.

Contact Name:	Brian Fitzpatrick
Position:	President
Organization:	Optical Semiconductors Inc.
Component:	
Address:	8 John Walsh Blvd, Suite 421 Peekskill, NY 10566-5330
Notes:	Manufacture of ZnS and ZnSe for infrared systems for both military and commercial markets.

Contact Name:	L.M. Flath
Position:	
Organization:	University of Arizona
Component:	Optical Sciences Center
Address:	Tucson, AZ 85721
Notes:	Author in 1992 SPIE meeting of "Development of a High-Speed PtSi IRCCD Camera System"

Contact Name:	Terry Fleener
Position:	Manager, Business Development
Organization:	Ball Electro-Optics and Cryogenics Div.
Component:	
Address:	P.O. Box 1062 Boulder, CO 80306
Notes:	Thermal Imaging, Active and Passive EO systems for military market.

Contact Name:	Michael Florimbi
Position:	CEO
Organization:	BEI Electronics Company, Inc.
Component:	BEI Defense Systems Company, Inc.
Address:	11312 S Pipeline Rd., PO Box 155429 Fort Worth, TX 76155
Notes:	Product-oriented research, development, testing and evaluation on photoelectric shaft position encoders.

Contact Name:	James Fogle
Position:	VP
Organization:	Kollmorgen Corporation
Component:	Photo Research
Address:	9330 DeSoto Dr. Chatsworth, CA 91311
Notes:	Optical and electromechanical light measuring devices.

Contact Name:	S. Robert Foley
Position:	VP Marketing and Planning
Organization:	Raytheon Company
Component:	
Address:	141 Spring Street Lexington, MA 02173
Notes:	

Contact Name:	M.A. Folkard
Position:	
Organization:	CMTEK Pty, Ltd
Component:	
Address:	P.O. Box 1500 Salisbury 5108, South Australia
Notes:	Co-authored for 1992 MCT Workshop "In-Situ Ellipsometric Measurements of the MBE Growth of CdTe/HgTe and CdTe/ZnTe Superlattices"

Contact Name:	John Ford
Position:	Public Relations Manager
Organization:	GEC Ferranti
Component:	
Address:	Ferry Road Edinburgh, Scotland EH5 2XS
Notes:	Night vision, detectors and sensors, active and passive eo systems for military applications.

Contact Name:	Leann M. Forister
Position:	Ms.
Organization:	EnTech Engineering, Inc.
Component:	
Address:	111 Marine Lane St. Louis, MO 63146
Notes:	Active in infrared remote sensing, having devised the IR/GPR technique.

Contact Name:	E.R. Fossum
Position:	
Organization:	Columbia University
Component:	
Address:	New York, NY
Notes:	Co-authored for 1990 SPIE workshop on IR Detectors "GaAs CCD Readout for Engineered Bandgap Detectors"

Contact Name:	Tom Fournier
Position:	President
Organization:	Dynatech Corporation
Component:	Sensors, Inc.
Address:	6812 S State Rd Saline MI 48176
Notes:	Commercial uses for infrared technology, infrared gas analysis, zirconia oxygen analyzer on OEM basis

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Contact Name:	David Fraser
Position:	Pres
Organization:	Fraser-Volpe Corporation
Component:	
Address:	Warminster Industrial Park, 1025 Thomas Dr. Warminster PA 18974
Notes:	Electro-optics and electronic systems; design and development of systems for inspection of fluid-filled vials and other glass containers to detect chips, cracks and foreign particles, stabilization systems for optical viewing devices, television and motion picture cameras, laser stabilization.

Contact Name:	James Frey
Position:	Pres
Organization:	Litton Industries, Inc.
Component:	Itek Optical Systems
Address:	10 Maguire Rd. Lexington, MA 02173
Notes:	Optics, electro-optics and systems research for image based systems.

Contact Name:	John Fried
Position:	Vice President
Organization:	Batelle Memorial Institute
Component:	Manufacturing Systems
Address:	505 King Ave. Columbus OH 43201
Notes:	Assists manufacturing with front-end planning and analysis aimed at increasing productivity and quality, reducing cost and improving capacity.

Contact Name:	Marvin Friedman
Position:	Director of Marketing
Organization:	North Atlantic Industries, Inc.
Component:	
Address:	60 Plant Avenue Hauppauge, NY 11788-3890
Notes:	Thermal imaging for military applications.

Contact Name:	Myles Friedman
Position:	Pres MyPres
Organization:	Southwest Engineering
Component:	
Address:	714 First National Bank Bldg. Fort Smith, AR 72901
Notes:	Computer/electronic controls for manufacturing processes, has experimented with IR detectors.

Contact Name:	James Fritz
Position:	
Organization:	ISI Group
Component:	
Address:	211 Conchas SE Albuquerque, NM 87123
Notes:	Active in infrared process control development. ISI group manufactures thermal-imaging TV systems based on pyroelectric vidicon tubes.

Contact Name:	Elizabeth Fuchs
Position:	Ms.
Organization:	Sandia National Laboratory
Component:	
Address:	ORG 8246 P.O. Box 969 Levermore, CA 94551
Notes:	Specialist in NDE thermal imagers. On SPIE's Thermosense steering committee.

Contact Name:	Elizabeth A. Fuchs
Position:	Ms.
Organization:	Sandia National Labs
Component:	
Address:	ORG 8246 P.O. Box 969 Livermore, CA 94511
Notes:	Active in infrared remote sensing system design, using dual-band MWIR and LWIR IR technology technique.

Contact Name:	Ken Fujiwara
Position:	President
Organization:	Epitaxx, Inc.
Component:	
Address:	3490 Route 1, Princeton, NJ 08540
Notes:	Long-wavelength high speed sources and detectors for fiberoptic communcations (InGaAs photodiodes, 1300 & 1500 nm edge LED and laser diode), large area InGaAs detectors for test and measurement rangefinding. Develops 512 element InGaAs arrays of cutoff wavelengths of 2.6um.

Contact Name:	J.K. Furdyna
Position:	
Organization:	University of Notre Dame
Component:	
Address:	Notre Dame, IN 46556
Notes:	On Program Committee of 1992 MCT Workshop For 1991 Workshop co-authored "Magnetic Generation of Electrons and Holes in Semimetallic HgTe-CdTe Superlattices"

Contact Name:	Kevin Fynn
Position:	
Organization:	University of Western Australia
Component:	Department of Electrical Engineering
Address:	Nedlands, Perth, Western Australia
Notes:	Attended 1992 MCT Workshop

Contact Name:	M. Gal
Position:	
Organization:	University of New South Wales
Component:	School of Physics
Address:	Kensington 2033 AUSTRALIA
Notes:	Co-Authored "In-Situ Ellipsometric Measurements of the MBE Growth of CdTe/HgTe and CdTe/AnTe Superlattices" for 1992 MCT Workshop

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Contact Name:	Dr Tom Galantowicz
Position:	CEO
Organization:	Newport Corporation
Component:	
Address:	18235 Mount Baldy Circle Fountain Valley, CA 92708
Notes:	Electro-optic and electro-mechanical components and systems for laser optical applications.

Contact Name:	Mosten Gale
Position:	
Organization:	SBRC
Component:	
Address:	75 Coromar Drive Goleta, CA 93117
Notes:	

Contact Name:	Dr Charles Garber
Position:	Pres
Organization:	Structure Probe
Component:	
Address:	569 E Gray St., PO Box 656 West Chester, PA 19381-0656
Notes:	X-ray diffraction and thermal analysis.

Contact Name:	Tony Gardiner
Position:	Pres
Organization:	Osprey Sub-Sea, Inc
Component:	
Address:	1225 Stone Dr. San Marcos, CA 92069
Notes:	Night vision equipment and acoustic tracking systems for military applications.

Contact Name:	Bruce Gardner
Position:	Pres.
Organization:	Janos Technology, Inc.
Component:	
Address:	HCR #33, Box 25 Townshead, VT 05353-7702
Notes:	Manufacturer of CdTe, GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications.

Contact Name:	James Garner
Position:	
Organization:	Infrared Research, Inc.
Component:	
Address:	100 Park City Road Roosville, GA 30741
Notes:	Active in infrared predictive maintenance as a consultant who helps set up inspection regimes.

Contact Name:	Bill Gary
Position:	
Organization:	Vision Harvest
Component:	
Address:	HCR Box 36 Hatch, NM 87937
Notes:	active in infrared process control

Contact Name:	Charles Gay
Position:	Pres
Organization:	Arco Solar Inc
Component:	
Address:	4650 Adohr Ln., PO Box 6032 Camarillo, CA 93010
Notes:	Advanced and applied research and development of photovotaic devices and systems. Production continues of square foot panels with Commer Indium Diselenide (CIS) coated with Cadmium Sulfide. CIS is increasingly viewed as the most promising material for solar power.

Contact Name:	Peter Gaylord
Position:	
Organization:	Total Vision Photonics
Component:	
Address:	39 Vaughn Street, Suite 202 Ottawa, CANADA K1M1W9
Notes:	active in infrared process control

Contact Name:	Boris Gelmont
Position:	
Organization:	Virginia University
Component:	Department of Electrical Engineering
Address:	Charlottesville, VA
Notes:	Co-authored May 1992 report "Monte Carlo SImulation of Elecron Transport in HgCdTe"

Contact Name:	R. Gentilman
Position:	Pres.
Organization:	Phase 4 Infrared
Component:	
Address:	P.O. Box 2647 Acton, MA 01720
Notes:	Manufacturer of ZnS and ZnSe for infrared applications, both military and commercial.

Contact Name:	John Georg
Position:	Public Relations Manager
Organization:	Litton Corporation
Component:	
Address:	1725 Jefferson Davis Highway Suite 601, Crystal Square Two Arlington, VA 22203
Notes:	E/o systems, night vision, infrared systems and equipment, detectors & sensors for military.

Contact Name:	S.K. Ghandhi
Position:	
Organization:	Rensselaer Polytechnic Institute
Component:	
Address:	110 Eight Street Troy, NY 12180
Notes:	Co-Chairman along with Loral's P.W. Norton of the 1992 MCT Workshop. On Program Committee of 1991 MCT Workshop Co-authored for 1991 WOrkshop "Low Temperature Epitaxy of HgTe, CdTe, HgCdTe using Flow Modulation Techniques"

Contact Name:	David Gilblom
Position:	
Organization:	Sierra Scientific
Component:	
Address:	605 West California Avenue Sunnyvale, CA 94086
Notes:	Active in infrared process control. Sierra designs, develops, and manufactures high performance CCD and tube cameras, video display monitors, x-ray image intensifiers and digital angiography subtraction systems. Used for machine vision, robotics, industrial radiology inspection, scientific research, microscopy and various custom applications.

Contact Name:	Ken Gilkey
Position:	VP for Marketing
Organization:	Cincinatti Electronics
Component:	Device & Microcircuits Labs Div
Address:	7500 Innovation Way Mason, OH 45040-9699
Notes:	Manufactures and designs IR detectors including single-element, linear and two dimensional arrays, discrete channel amplified, multiplexed, in Ge, MCT, InSb and InAs, 1-12 um.

Contact Name:	Bob Gill
Position:	President
Organization:	Laser Diode Inc.
Component:	
Address:	205 Forrest Street Metuchen, NJ 08840-1292
Notes:	Manufacturer of GaAs and germanium materials for infrared applications.

Contact Name:	John Gillespi
Position:	Pres
Organization:	Jodon Engineering
Component:	
Address:	62 Enterprise Dr. Ann Arbor, MI 48103
Notes:	Optical engineering for machine vision, interest in IR detectors.

Contact Name:	BM Gillespi
Position:	Pres
Organization:	Mobil Oil Corp.
Component:	Mobil Solar Energy Corp.
Address:	4 Suburban Park Dr. Billerica, MA 01821
Notes:	Solar cell and photovotaic power components and systems development.

Contact Name:	J.E. Gilpin
Position:	Manger Detector Products
Organization:	Rockwell International Corporation
Component:	Electro-Optical Center
Address:	3370 Miraloma Ave. Anaheim, CA 92803
Notes:	Has represented Rockwell EOC's representative in the JM consortium

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Contact Name:	S. Goettig
Position:	
Organization:	Wayne State University
Component:	Department of Physics
Address:	Detroit MI
Notes:	Co-authored 1990 "FOrmation Mechanisms of Interstitial Defect States"

Contact Name:	Merivn Goff
Position:	Dr.
Organization:	King's College
Component:	Thermal Biology Unit
Address:	Campden Hill Road, Kensington London, W8 7AH, UNITED KINGDOM
Notes:	Active in infrared biomedical thermography, widely published. System designer, longtime researcher.

Contact Name:	Martin Goland
Position:	Pres
Organization:	Southwestern Research Institute
Component:	
Address:	Program Development Office, PO Drawer 28510 San Antonio, TX 78228-0510
Notes:	Infrared research including automation and space research applications.

Contact Name:	T.D. Golding
Position:	
Organization:	Cambridge University
Component:	Cavendish Lab
Address:	Cambridge, UNITED KINGDOM
Notes:	Co-authored October 1988 "MBE of HgCdTe" available from DTIC. Active in MCT-based research for military applications.

Contact Name:	T.D. Golding
Position:	
Organization:	University of Houston
Component:	Department of Physics and Space Vacuum Epitaxy Center
Address:	Houston, TX 77204
Notes:	Co-authored "Properties of InAs/(Ga,In)Sb Strained Layer Superlattices Grown on the (111) Orientations" for 1992 MCT Workshop

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Contact Name:	E. Goo
Position:	
Organization:	University of Southern California
Component:	Department of Materials Science and Engineering
Address:	Los Angeles, CA 90089-0241
Notes:	Co-authored for 1991 MCT Workshop "Ordered Phase in (HgCd)Te Grown by LPE on CdTe (111)B Substrate"

Contact Name:	J.S. Goodling
Position:	
Organization:	Auburn University
Component:	
Address:	
Notes:	Co-authored 1988 "Adaptive Welding Using Infrared Sensing Techniques Manufacturing Processes, Machines and Systems"

Contact Name:	DAVID K. GORDON
Position:	Marketing Director
Organization:	Autometric, Inc.
Component:	
Address:	5301 Shawnee Road Alexandria, VA 22312
Notes:	Active in IR remote sensing. Broad spectrum remote sensing and reconnaissance systems organization, photogrammetric engineering, image interpretation and analysis, photogrammetric mapping and map-based information system development

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Contact Name:	Lawrence Goshorn
Position:	CEO
Organization:	Iri Vision
Component:	
Address:	Suite D, 6231 Yarrow Dr. Carlsbad, CA 92009
Notes:	Product-oriented research of light-based vision systems, interest in IR systems.

Contact Name:	Srini Govindan
Position:	Dr.
Organization:	
Component:	
Address:	Professional Center 1, Suite 206 Medical Park Wheeling, WV 26003
Notes:	Doctor in private practice, active in infrared biomedical thermography

Contact Name:	Thorsten Graeve
Position:	
Organization:	University of Arizona
Component:	Optical Sciences Center
Address:	Tucson, AZ 85721
Notes:	active in infrared process control

Contact Name:	Thorsten Graeve
Position:	
Organization:	University of Arizona
Component:	Optical Sciences Center
Address:	Tucson, AZ 85629
Notes:	Graduate student who oversaw the center's study on the use of infrared spectra reflectances to sort pecans. Believes his technique has many other applications in food sorting in general

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Contact Name:	Richard J. Graf
Position:	
Organization:	EnTech Engineering, Inc.
Component:	
Address:	111 Marine Lane St, Louis, MO 63146
Notes:	Active in infrared sensing. Designed joint IR/GPR technique.

Contact Name:	F.J. Graham
Position:	Marketing Support Exec
Organization:	GEC Ferranti Defence Systems, Ltd.
Component:	
Address:	Navigation and Electro Optics DIvision Silverknowes, Ferry Road Edinburgh, UK EH4 4AD
Notes:	Infrared systems and equipment, night vision c/o systems for military applications.

Contact Name:	Herbert Gram
Position:	Pres
Organization:	Spectrogram Corp.
Component:	
Address:	385 State St. North Haven, CT 06473
Notes:	General research in the field of electro-optics, with a major effort on computer-based optical spectrum analysis as applied to analytical systems.

Contact Name:	R. Granger
Position:	
Organization:	Lab de Physique des Solides/ INSA
Component:	
Address:	FRANCE
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Infrared Reflectivity: A tool for bond Investigation in II-VI Ternaries"

Contact Name:	R.W. Grant
Position:	
Organization:	California Institute of Technology
Component:	
Address:	1201 East California Boulevard Pasadena, CA 91125
Notes:	Reported at the DARPA Program Review on Infrared Focal Plane Array Technology in December, 1992, on "InAs/GaInSb Superlattices: Growth Involving Anion Switching"

Contact Name:	Steven E. Green
Position:	
Organization:	University of Nebraska
Component:	Center for Electro-Optics
Address:	Lincoln, NE 68588
Notes:	active in infrared remote sensing

Contact Name:	William Greenlaw
Position:	
Organization:	Martin Marietta
Component:	
Address:	103 Chesapeake Park Plaza Mail point 110 Baltimore, MD 21220
Notes:	

Contact Name:	C.H. Grein
Position:	
Organization:	Harvard University
Component:	Division of Applied Sciences
Address:	29 Oxford Street Cambridge, MA 02138
Notes:	Co-Authored "Augur Lifetimes in Ideal InGaSb/InAs Superlattices" for 1992 MCT Workshop.

Contact Name:	DR Kurt Grimm
Position:	Pres
Organization:	Pharm-Eco Laboratories
Component:	
Address:	2355 Chain Dr. Simi Valley, CA 93065
Notes:	Infrared research, gas chromatography and wet chemical tests.

Contact Name:	Manfred W. Grindel
Position:	President
Organization:	Continental Optical Corp.
Component:	
Address:	15 Power Drive Hauppauge, NY 11788
Notes:	Manufacturer of silicon, ZnS, and ZnSe infrared materials for both military and commercial markets.

Contact Name:	Ann Grizzel
Position:	Manager, Pubilc Relations
Organization:	Westinghouse Electric Corp.
Component:	Electronics Systems Division
Address:	P.O. Box 17319 MS A255 Baltimore, MD 21203-6812
Notes:	Infrared systems and equipment, detectors and sensors, c/o systems

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Contact Name:	K. Groom
Position:	
Organization:	Auburn University
Component:	
Address:	
Notes:	Co-authored 1988 "Adaptive Welding Using Infrared Sensing Techniques Manufacturing Processes, Machines and Systems"

Contact Name:	Paul Grover
Position:	
Organization:	Infraspection Institute
Component:	
Address:	1971 Shelburne Road, Suite C Shelburne, VT 05482
Notes:	Active in infrared predictive maintenance as a training and information dissemination and trade society for thermographers.

Contact Name:	George Guilbalt
Position:	President
Organization:	Universal Sensors, Inc.
Component:	
Address:	Suite D, 5258 Veterans Blvd. Metairie, LA 70006
Notes:	Development of advanced biosensors and immunosensors for medical applications.

Contact Name:	Xu Guo-Sen
Position:	
Organization:	Shanghai Institute of Technical Physics
Component:	Acadmia Sinica
Address:	Shanghai, 200081 CHINA
Notes:	Co-authored for 1992 SPIE conference on IRFPAs "The Dependence of Fermi Level of HgCdTe on Impurity Concentration and Temperature"

Contact Name:	Xu Guosen
Position:	
Organization:	Shanghai Institute of Technical Physics
Component:	Academia Sinica
Address:	China 200083
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "The Effect of Shockley-Read Recombination on Minority Carrier Lifetime of HgCdTe"

Contact Name:	Xu Guoxen
Position:	
Organization:	Shanghai Institute of Technical Physics
Component:	Academia Sinica
Address:	Shanghai, CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Study of the Recombination Mechanisms and Carrier Lifetimes in HgCdTe Alloy"

Contact Name:	Robert Guyton
Position:	Pres
Organization:	Universal Technology Corp.
Component:	
Address:	4031 Colonel Glenn Hwy. Dayton, OH 45431
Notes:	Development of advanced manufacturing technologies for metal working and electronic research and development.

Contact Name:	Omer Hageniers
Position:	Pres
Organization:	Difracto Ltd.
Component:	
Address:	2835 Kew Dr. Windsor, ON N8T 3B7
Notes:	Research in vision sensors and gas lasers for measuring purposes for industry.

Contact Name:	Yubong Hahn
Position:	Pres
Organization:	Rocky Mountain Instrument Co.
Component:	
Address:	1501S Sunset St. Longmont, CO, 80501
Notes:	Manufacture of precision optical components and multilayer thin film coatings.

Contact Name:	Robert G. Hammaker
Position:	
Organization:	Electric Power Research Institute
Component:	
Address:	3 Industrial Highway Eddystone, PA 19022
Notes:	Active in infrared predictive maintenance, activist among electric power utilities with inspecito of overhead power lines as well as plant equipment.

Contact Name:	Albert E. Hammett
Position:	
Organization:	Southern Nuclear Operating Center
Component:	
Address:	40 Inverness Center Parkway Birmingham, AL 35242
Notes:	Active in infrared predictive maintenance. Set up Southern nuclear's inspection regime, purchased their equipment.

Contact Name:	P.H. Handel
Position:	
Organization:	Minnesota University
Component:	Department of Electrical Engineering
Address:	Minneapolis, MN
Notes:	Co-authored August 1991 "Quantum Noise in Solid-State Devices in Particular HgCdTe Diodes"

Contact Name:	William Hanley
Position:	CEO
Organization:	Galileo Electro-Optics Corp.
Component:	
Address:	Galileo Park, PO Box 550 Sturbridge, MA 01566
Notes:	Develops fiber-optic and electro-optic components which transmit, intensify or sense light images.

Contact Name:	Timothy Hannemann
Position:	VP
Organization:	TRW Inc
Component:	TRW Electronic Systems Group
Address:	E Bldg., Rm 5076, One Space Park Redondo Beach, CA 90278
Notes:	Development of advanced infrared sensor technologies.

Contact Name:	Walter Hanser
Position:	Marketing Director
Organization:	Buck Werke GMBH & Co.
Component:	
Address:	Hans-Buck-Strasse 1 D-7844 Neuenburg, GERMANY 07631
Notes:	Services, Infrared Systems and Equipment for military markets.

Contact Name:	Yuan Haoxin
Position:	
Organization:	Shanghai Institute of Technical Physics
Component:	Chinese Academy of Sciences
Address:	Shanghai, 20092 CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "HgCdTe Photovoltaic Detectors and Some Related Aspects"

Contact Name:	Larry Hardin
Position:	President
Organization:	Hardin Optical Company
Component:	
Address:	P.O. Box 219 1320 Oregon Avenue Bandon, OR 97411
Notes:	Manufacture of GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications, commercial and military.

Contact Name:	E.T. Harlmagean
Position:	
Organization:	R&D Institute for Semiconductor Devices
Component:	
Address:	ROMANIA
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Accurate Method for Neutraon Fluence Control Used in Improving Neutron-Transmutation-Doped Silicon Detectors"

Contact Name:	Thomas Harris
Position:	Pres
Organization:	Optical Research Associates
Component:	
Address:	550 N Rosemead Blvd. Pasadena, CA 91107
Notes:	Research in optical design engineering, some for IR detectors.

Contact Name:	R.H. Hartley
Position:	
Organization:	Surveillance Research Laboratory
Component:	
Address:	DSTO O,I, Bix 1500 Salisbury, South Australia, 5108
Notes:	Co-authored for 1991 MCT Workshop "Real Time Control of the MBE Growth of CdHgTe and CdTe/GhTe Superlattices Using Ellipsometry"

Contact Name:	Christopher Harz
Position:	VP Mkt.
Organization:	Perceptronics Incorporated
Component:	
Address:	21135 Erwin Street Woodland Hills, CA 91365-4198
Notes:	Has been awarded several government contracts to conduct research and development of computer aided manufacturing processes for IRFPAs.

Contact Name:	J Hassan
Position:	Vice President for Technology
Organization:	AMP Incorporated
Component:	AMP Technology, Electro-optics Division
Address:	PO Box 3608 Harrisburg, PA 17105-3608
Notes:	Applied and product-oriented research and development on fiber optic, electro-optic, passive, and interconnection devices.

Contact Name:	George Hatsopoulos
Position:	Pres
Organization:	Thermo Electron Corp.
Component:	
Address:	101 First Ave., Waltham, MA 02254
Notes:	Production of optics, electro-optics, electro-acoustic systems.

Contact Name:	Patsy Hattox
Position:	Vice President
Organization:	Nichols Research Corp.
Component:	
Address:	4040 South Memorial Parkway Huntsville, AL 35802
Notes:	Infrared systems and equipment, imaging software for military markets.

Contact Name:	Greg Haug
Position:	
Organization:	Compaq Computer
Component:	
Address:	P.O. Box 692000 Houston, TX 77269-2000
Notes:	Set up infrared inspection regime for compaq's computer chips and IC boards

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Contact Name:	Robert Haugh
Position:	Pres
Organization:	Overhead Door Corp
Component:	Horton Automatics Division
Address:	1900 Crown Dr. Farmers Branch, TX 75234
Notes:	Applied researhc on pneumatics, electrical and fluidic technology, door-and-window automation and associated sensing devices, microwave and infrared sensing technology.

Contact Name:	Shahram Hejazi
Position:	Dr.
Organization:	Eastman Kodak Company
Component:	Health Sciences Division
Address:	100 Carlson Road Rochester, NY 14653-9015
Notes:	Formerly at SUNY Buffalo, where he patented a multi-band IR biomedical thermography instrument.

Contact Name:	Shahram Hejazi
Position:	Senior Engineer
Organization:	Eastman Kodak, Inc.
Component:	Health Sciences Division
Address:	100 Carlson Road Rochester, NY 14653-9015
Notes:	Doctoral research discussed in Nov. 92 OE article on using thermal imagers, MCT-based, at multiwavelengths, to determine skin temperature.

Contact Name:	Donald Heller
Position:	Sales and Marketing
Organization:	Agema Infrared Systems
Component:	
Address:	142 Sunset Avenue Verona, NJ 07044
Notes:	Active in infrared predictive maintenance application development at Agema

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Contact Name:	C.R. Helms
Position:	
Organization:	Stanford University
Component:	Solid State Lab
Address:	McCulloufh 114 Stanford, CA 94305
Notes:	On Program Committee of 1992 MCT Workshop, Co-Chairman of 1991 MCT WOrkshop. For 1991 Workshop, co-authored "Thermodynamic Description of metal Hg(Cd)Te Systems"

Contact Name:	alan Henry
Position:	Gmgr
Organization:	Harris Corporation
Component:	Government Communications Systems Division
Address:	256 SE Palm Bay Rd., PO Box 9100 Melbourne, FL 32902
Notes:	Satellite and terrestrial communications, electro-optics, imagery and voice privacy systems for military.

Contact Name:	Gregg Herbison
Position:	National Sales Manager
Organization:	Thomson Components & Tubes Corp
Component:	TCS Division
Address:	40 G Commerce Eay Totowa, NJ 07511
Notes:	Infrared systems and equipment, GaAs gate arrays, detectors & sensors

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Contact Name:	Mathew Heric
Position:	
Organization:	Autometric, Inc.
Component:	
Address:	5301 Shawnee Road Alexandria, VA 22312
Notes:	Also active in IR remote sensing research and system design

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Contact Name:	F.P. Hermann
Position:	Corp. Foreign Press and Adv. Mgr.
Organization:	Israel Aircraft Industries, Ltd.
Component:	
Address:	Ben-Gurion International Airport Israel 70100
Notes:	Passive and active e/o components, detectors and sensors, infrared systems and equipment for military applications.

Contact Name:	Theresa Herpst
Position:	Pres
Organization:	International Crystal Laboratories
Component:	
Address:	11 Eric St. Garfield, NJ 07026
Notes:	Applied research for growing crystals for infrared transmission.

Contact Name:	N. Hess
Position:	
Organization:	Dresden University of Technology
Component:	Institut fur Festkorperelektronik
Address:	Dresden, FEDERAL REPUBLIC OF GERMANY
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Pyroelectric Linear Array IR Detectors with CCD Multiplexer"

Contact Name:	F. Hicks
Position:	
Organization:	University of California, Los Angeles
Component:	Department of Chemical Engineering
Address:	Los Angeles, CA 90024-1592
Notes:	Co-authored for 1991 MCT Workshop "Photoassisted Organometallic VPE on CdTe"

Contact Name:	A. Ray Hilton
Position:	President
Organization:	Amorphous Materials Inc.
Component:	
Address:	3130 Benton Street Garland, TX 75042
Notes:	Infrared materials production of CdTe, GaAs, and silicon, mainly for military.

Contact Name:	Bruce Hinman
Position:	Dir. Business Development and Contracts
Organization:	Spar Aerospace, Ltd.
Component:	Applied Systems Group
Address:	365 March Road Kanata, Ontario, CANADA K2K 1X3
Notes:	E.o systems, infrared systems & equipment, night vision for military applications.

Contact Name:	LaVerne Hinsen
Position:	Sales Manager
Organization:	Fermionics Corp.
Component:	
Address:	4555 Runway Street Simi Valley, CA 93063
Notes:	

Contact Name:	Paul Hitchen
Position:	Marketing Comm. Mgr.
Organization:	Raytheon Submarine Signal Division
Component:	
Address:	1847 West Main Road Portsmouth, RI 02871
Notes:	Thermal imaging, detectors and sensors for military applications.

Contact Name:	G. Hofmann
Position:	
Organization:	Dresden University of Technology
Component:	Institut fur Festkorperelektronik
Address:	Dresden, FEDERAL REPUBLIC OF GERMANY
Notes:	Co-authored for 1992 SPIE IRFPA meeting "Pyroelectric IR Single-Element Detectors and Arrays Based on LiNbO3 and LiTaO3" Co-authored for 1991 SPIE meeting on Growth of IR materials "Pyroelectric Linear Array IR Detectors with CCD Multiplexer"

Contact Name:	D.K. Hohnke
Position:	
Organization:	Ford Motor Company
Component:	Scientific Research Laboratory
Address:	Room S-2308 P.O. Box 2053 Dearborn, MI 48121-2053
Notes:	Interested in designing IR inspection system to nondestructively test paint delaminations in cars

Contact Name:	David Holland
Position:	Managing Director
Organization:	Davin Optical, Ltd.
Component:	
Address:	9A Chester Road Borehamwood, Herts, UK WD6 1LD
Notes:	Night Vision, EO Systems, Infrared Systems and Equipment, Thermal Imaging for military applications

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Contact Name:	M. Hollander
Position:	National Sales Manager
Organization:	Atomergic Chemetals Corporation
Component:	
Address:	222 Sherwood Avenue Farmingdale, NY 11735
Notes:	Material processing of CdTe, GaAs, Germanium, Silicon, ZnS, and ZnSe, predominantly for military markets. For commercial markets, basic and applied research involving inorganic chemistry, rare elements and ultra-purity metals and chemicals, spherical and submicron powders, single crystald, electronic and solid state materials, hotpressed ceramics, stable isotopes deuterated compounds, liquid crystals, pharmaceuticals, etc.

Contact Name:	Dag Holmsten
Position:	
Organization:	Total Vision Photonics, Inc.
Component:	
Address:	39 Vaughn Street, Suite 202 Ottowa, CANADA K1M1W9
Notes:	active in infrared process control

Contact Name:	Ludwig Holtermann
Position:	owner
Organization:	Concept Engineering
Component:	
Address:	43 Ragged Rock Rd. Old Saybrook, CT 06475
Notes:	Manufactures optical tset and measurement equipment including IR thermoemters, radiant fluxmeters, and solar radiometers/ photometers. IR-technology sensor and detector development.

Contact Name:	Alexander Horvath
Position:	General Manager
Organization:	General Electric Company
Component:	Aerospace Electronics Systems Department
Address:	French Rd. Utica, NY 13503
Notes:	Research into pattern recognition, using IR detectors.

Contact Name:	Warren Howell
Position:	Dvmgr
Organization:	Bio-Rad Laboratories, Inc.
Component:	Digilab Division
Address:	237 Putnam Ave. Cambridge, MA 02139
Notes:	Product-oriented research in applications for existing technology in new fields including Transform-Infrared spectroscopy, gas chromatography and infrared technology.

Contact Name:	Patricia A. Howell
Position:	Ms.
Organization:	NASA, Langley Research Center
Component:	Analytical Services and Manufacturing, Inc.
Address:	c/o MS 231 Hampton, VA 23665
Notes:	Infrared non-destructive evaluation, mainly for aging aircraft skins and advanced composites.

Contact Name:	Kuo-Tung Hsu
Position:	
Organization:	Chung-Shan Institute of Science and Technology
Component:	
Address:	Lung-Tan, Taiwan, REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE IRFPA meeting "Electrolyte Electroreflectance Spectroscopies for the Ion-Implanted HgCdTe with Thermal Annealing"

Contact Name:	Kuo-Tung Hsu
Position:	
Organization:	National Taiwan University
Component:	Department of Electrial Engineering
Address:	Taipei, Taiwan, REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Electrolyte Eletroreflectance Specrtoscopies for the Ion-Implanted HgCdTe with Thermal Annealing"

Contact Name:	Chao Huang
Position:	
Organization:	Tsing-Hua University
Component:	Material Center
Address:	101, Sec 2 Kunag-Rd. Hsingchu, Taiwan, ROC
Notes:	

Contact Name:	Jack Hubbard
Position:	Dr.
Organization:	University of Minnesota School of Medecine
Component:	Minneapolis Clinic of Neurology
Address:	305 East Nichola Boulevard Ridgeview Medical Bldg, Suite 185 Burnesville, MN 55337
Notes:	active in infrared biomedical thermography

Contact Name:	Frank Huerta
Position:	
Organization:	SBRC
Component:	
Address:	75 Coromar Drive Goleta, CA 93117
Notes:	

Contact Name:	John Hughes
Position:	Dr.
Organization:	Clinical Research Centre
Component:	Division of Rheumatology
Address:	Watford Road, Harrow, UNITED KINGDOM
Notes:	Active in use of infrared biomedical thermography for arthritis and rheumatism.

Contact Name:	William C. Hughes
Position:	
Organization:	University of North Carolina at Chapel Hill
Component:	Department of Physics and Astronomy
Address:	Phillips Hall, CB #3255 Chapel Hill, NC 27599-3255
Notes:	Co-Authored "Observation of Indium-Vacancy and Indium Hydrogen Interactions in (HgCd)Te Using PAC"

Contact Name:	Paul Hughett
Position:	
Organization:	Hughett Research
Component:	
Address:	2110 Cedar Street #B Berkeley, CA 94709-1515
Notes:	Active in infrared predictive maintenance regime design.

Contact Name:	Donald Hutchinson
Position:	Marketing Director
Organization:	Tau Corporation
Component:	
Address:	Los Gatos, CA
Notes:	

Contact Name:	Ronald Huynh
Position:	Pres
Organization:	Advanced Kinetics
Component:	
Address:	Unit 108, 18281 Gothard St. Huntington Beach, CA 92648
Notes:	Research in laser physics and applications, including IR sources (black bodies).

Contact Name:	Dr. M.Y. Hwang
Position:	Ch. Sci
Organization:	JTT International Inc.
Component:	
Address:	3045 Technology Pkwy Orlando, FL 32826
Notes:	Manufacturer of germanium, silicon, ZnS, and ZnSe infrared systems.

Contact Name:	Anthony Charles Ibbott
Position:	
Organization:	California Institute of Technology
Component:	Jet Propulsion Laboratory
Address:	4800 Oak Grove Drive Pasadena, CA 91109-8099
Notes:	Designed airborne fire monitoring system for JPL

Contact Name:	Anthony C. Ibbott
Position:	
Organization:	California Institute of Technology
Component:	Jet Propulsion Laboratory
Address:	4800 Oak Grove Drive Pasadena, CA 91109-8099
Notes:	active in infrared remote sensing

Contact Name:	K. Irani
Position:	
Organization:	Mikron Instruments
Component:	
Address:	445 W. Main Street Wyckoff, NJ 07481
Notes:	Manufactures and markets non-contact infrared temperature measurement and control systems, portable infrared thermometers, thermal imaging systems, temperature sensors for OEM applications and black body calibration sources.

Contact Name:	Bernard J. Isker III
Position:	
Organization:	Hughes Aircraft Company
Component:	Technology Center
Address:	6155 El Camino Real Carlsbad, CA 92009
Notes:	Authored for 1992 SPIE Workshop on IRFPAs "Cryoprober Test Development"

Contact Name:	Anthony Jacobini
Position:	VP Mfg
Organization:	International Crystal Laboratories
Component:	
Address:	11 Eric St. Garfield, NJ 07026
Notes:	Manufacture of CdTe, GaAs, germanium, silicon, ZnS, and ZnSe for infrared products.

Contact Name:	Doug James
Position:	Systems Engineer
Organization:	Kollmorgen Corp.
Component:	
Address:	347 King Street Northampton, MA 01060
Notes:	Detectors and sensors, infrared systems and equipment, night vision for military applications.

Contact Name:	James Jamieson
Position:	President
Organization:	Jamieson Science and Engineering
Component:	
Address:	7315 Wisconsin Avenue, Suite 447W Washington, DC 20814
Notes:	Advocate of MCT being able to overcome cost barriers to break into commercial market. Long history of involvement in IR since advent.

Contact Name:	Gwo-Jen Jan
Position:	
Organization:	National Taiwan University
Component:	Department of Electrial Engineering
Address:	Taipei, Taiwan, REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Electrolyte Eletroreflectance Specrtoscopies for the Ion-Implanted HgCdTe with Thermal Annealing"

Contact Name:	P. Tom Jenkins
Position:	General Manager
Organization:	DALSA Inc, CCD Image Sensors
Component:	
Address:	605 McMurray Road Waterloo, Ontario CANADA N2V 2E9
Notes:	Specializes in manufacture, design, research and development of high performance, solid-state CCD image sensors and cameras. has a standard product line of 35 different CCD image sensors and 75 models of CCD imaging cameras, and actively pursues custom contracts and strategic alliances for CCD technology development.

Contact Name:	John Jenkofsky
Position:	Gmgr
Organization:	Irtronics Instruments, Inc.
Component:	
Address:	132 Forest Blvd. Ardsley, NY 10502
Notes:	Standard and custom infrared radiation pyrometers for measuring temperature in industrial research applications.

Contact Name:	Geir U. Jensen
Position:	
Organization:	Virginia University
Component:	Department of Electrical Engineering
Address:	Charlottesville, VA
Notes:	Co-authored May 1992 report "Monte Carlo Simulation of Elecron Transport in HgCdTe"

Contact Name:	Arthur S. Jensen
Position:	
Organization:	Westinghouse Corp.
Component:	Advanced Technology Division
Address:	Baltimore, MD 21203
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Superconductive Circuits for On-FPA IR Digital Signal Processing"

Contact Name:	Fang Jia-Xiong
Position:	
Organization:	Shanghai Institute of Technical Physics
Component:	Academia Sinica
Address:	Shanghai, 200081 CHINA
Notes:	Co-authored for 1992 SPIE conference on IRFPAs "The Dependence of Fermi Level of HgCdTe on Impurity Concentration and Temperature"

Contact Name:	Fang Jiaxiong
Position:	
Organization:	Shanghai Institute of Technical Physics
Component:	Academia Sinica
Address:	Shanghai, CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Study of the Recombination Mechanisms and Carrier Lifetimes in HgCdTe Alloy"

Contact Name:	Fang Jiaxong
Position:	
Organization:	Shanghai Institute of Technical Physics
Component:	Academia Sinica
Address:	Shanghai, China 200083
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "The Effect of Shockley-Read Recombination on Minority Carrier LIfetime of HgCdTe"

Contact Name:	Jorge Jimenez
Position:	
Organization:	Tufts University
Component:	Electro-Optics Technology Center
Address:	Medford, MA 02155
Notes:	Co-authored for 1992 meeting of SPIE on IRFPAs "Fundamental Studies of Schottky Barrier IR Detectors by Ballistic Electron Emission Microscopy"

Contact Name:	Yan Jing-Xuan
Position:	
Organization:	Qingdao University
Component:	Department of Computer and Information Science
Address:	Qingdao, Shandong, CHINA
Notes:	Co-authored for 1992 SPIE conference on IRFPAs "The Dependence of Fermi Level of HgCdTe on Impurity Concentration and Temperature"

Contact Name:	Yan Jingxuan
Position:	
Organization:	Qingdao University
Component:	Department of Computer and Information Science
Address:	266071 Qingdao, Shandong, CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Study of the Recombination Mechanisms and Carrier Lifetimes in HgCdTe Alloy"

Contact Name:	Raymond Johnson
Position:	General Manager
Organization:	General Electric Company
Component:	Aircraft Controls Systems Department
Address:	PO Box 5000 Binghamton, NY 13902
Notes:	Research and development of sensing and sensors, in part with IR detectors.

Contact Name:	B.R. Johnson
Position:	
Organization:	Honeywell Corp.
Component:	Sensor and System Development Center
Address:	10701 Lyndale Avenue South Bloomington, MN 55420
Notes:	Co-authored for 1992 SPIE Workshop on IRFPAs "YBa2Cu3O7 Superconducting Microbolometer Linear Arrays" supported by DARPA with Office of Naval Research as contracting agency.

Contact Name:	Carl Johnson
Position:	President and CEO
Organization:	II-VI Inc.
Component:	
Address:	375 Saxonburg Blvd Saxonburg, PA 16056
Notes:	Manufacture of CdTe, GaAs, germanium, silicon, ZnS, ZnSe for infrared applications.

Contact Name:	Jim Johnson
Position:	Dir. Commercial Products
Organization:	Loral Fairchild Imaging Sensors
Component:	
Address:	1801 McCarthy Boulevard Milpitas, CA 95035
Notes:	Detectors and sensors, c/o systems, infrared systems & equipment, predominantly for military.

Contact Name:	C. Barbara Johnson
Position:	Division Administrator
Organization:	Raytheon Co.
Component:	Electromagnetic Systems Div.
Address:	6380 Hollister Avenue Goleta, CA 93117
Notes:	Detectors & sensors, e/o systems, infrared systems & equipment

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Contact Name:	R.B. Johnson
Position:	
Organization:	University of Maryland
Component:	
Address:	College Park, MD
Notes:	Co-authored 1987 study "Phase Differences between Wuantum Oscillations of the Magnetoresistance and the Hall Effect in HgMnTe and HgCdTe"

Contact Name:	Rose Jones
Position:	Pres
Organization:	Muffoletto Optical Company, Inc
Component:	
Address:	6100 Everall Ave. Baltimore, MD 21206
Notes:	Design and development of optical systems for underwater, laboratory and space applications.

Contact Name:	Pat Jones
Position:	Sales Manager
Organization:	Preh Electronic Inc.
Component:	
Address:	470 E. Main Lake Zurich, IL 60047
Notes:	Infrared systems & equipment for military applications.

Contact Name:	A.M. Joshi
Position:	
Organization:	EPITAXX, Inx.
Component:	
Address:	3490 U.S. Route One Princeton, NJ 08540
Notes:	Co-authored for 1992 SPIE Workshop on IRFPAs "Popcorn Noise in Linear InGaAs Detector Arrays" Firm manufactures long-wavelength high speed sources and detectors for fiveroptic communications , esp. InGaAs.

Contact Name:	Shan Joshi
Position:	Pres
Organization:	Universal Energy Systems
Component:	
Address:	4401 Dayton-Xenia Rd. Dayton, OH 45432
Notes:	Development and application of laser and electro-optic systems.

Contact Name:	Feng-Yuh Juang
Position:	
Organization:	Chung-Shan Institute of Science and Technology
Component:	
Address:	Lung-Tan, Taiwan, REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE IRFPA meeting "Electrolyte Electroreflectance Spectroscopies for the Ion-Implanted HgCdTe with Thermal Annealing"

Contact Name:	Sue Justice
Position:	Marketing Director
Organization:	EG&G, Inc.
Component:	EG&G Judson
Address:	221 Commerce Dr. Montgomeryville, PA 18936
Notes:	Manufactures infrared detectors and arrays including Ge, InAs, InSb, MCT, and doped Ge

Contact Name:	David Kales
Position:	Senior Editor, Markets
Organization:	Laser Focus World
Component:	
Address:	One Technology Park Drive P.O. Box 989 Westford, MA 01886
Notes:	Wrote November 1992 article "Detector Makers Seek Dual-Use Technology for Survival." Friends with David Leech.

Contact Name:	Alex Kalil
Position:	Pres
Organization:	Silonex Inc
Component:	Silonex, Inc
Address:	2150 Ward St. Montreal CANADA PQ H4M 1T7
Notes:	Optoelectronics automation of manufacturing. Includes CdS photoconductive cells, optoisolators, LEDs, photodiodes and photodiode arrays, photovoltaic cells, photransistors and photodarlingtons.

Contact Name:	Herbert Kaplan
Position:	President
Organization:	Honeyhill Technical Corporation
Component:	
Address:	193 East Avenue Norwalk, CT 06855
Notes:	Contributing editor to Photonics Spectra, consultant in IR business, longtime SPIE leader of Thermosense meetings. Teaches courses for predictive maintenance engineers.

Contact Name:	Ronald Kappler
Position:	Pres.
Organization:	Kappler Crystal Optics Inc.
Component:	
Address:	1244 Highland Street Holliston, MA 01746
Notes:	Manufacturer of ZnS and ZnSe for infrared applications.

Contact Name:	N.H. Karam
Position:	
Organization:	Spire Corporation
Component:	
Address:	Bedford, MA 01730
Notes:	Co-authored for 1991 MCT Workshop "Low Temerpature Epitaxy on HgTe, CdTe, and HgCdTe Using Flow Modulation Techniques"

Contact Name:	James P. Karins
Position:	
Organization:	Mission Research Corporation
Component:	
Address:	735 State Street Santa Barbara, CA 93102
Notes:	Authored for 1992 SPIE workshop on IRFPAs "Models of Nonlinearities in Focal Plane Arrays"

Contact Name:	Dr Eskil Karlson
Position:	Dir
Organization:	Life Support, Inc.
Component:	
Address:	2926 State St. Erie, PA 16509
Notes:	Optical system design including IR detection and systems for both military and commercial markets.

Contact Name:	John Kasprazak
Position:	Marketing Director
Organization:	Brimrose Corporation of America
Component:	
Address:	5020 Campbell Blvd Baltimore, MD 21236
Notes:	Manufactures custom acousto-optic tunable filters , acousto-optic modulators and scanners, RF driver, and mercury manganese telluride infrared detectors. Provides to military and industry.

Contact Name:	Timo Kaupinnen
Position:	
Organization:	Technical Research Center of Finland
Component:	Building Laboratory
Address:	P.O. Box 167 SF-90101 Oulu, FINLAND
Notes:	infrared non-destructive evaluation

Contact Name:	Kenneth Kaylor
Position:	COO
Organization:	ATD, Inc.
Component:	Advanced Technology Division
Address:	PO Box 566 Woodinville, WA 90872
Notes:	Applied R&D of video instrument systems including high-speed, IR microscopic and related research.

Contact Name:	Michael Keebaugh
Position:	Pres
Organization:	E-Systems, Inc.
Component:	HRB Systems, Inc
Address:	300 Science Park Rd. State College, PA 16804
Notes:	Integration of sensors into systems capable of military surveillance missions.

Contact Name:	David Kennedy
Position:	Marketing Manager
Organization:	Optotex, Ltd.
Component:	
Address:	62 Stencie Drive Kanata, Ontario, CANADA K2K 2A9
Notes:	GaAs gate arrays, infrared systems and equipment, rf systems and components

Contact Name:	A. Kepten
Position:	
Organization:	Semi-conductor Devices, Inc.
Component:	
Address:	D.N. Misgav 20179 ISRAEL
Notes:	Co-authored for 1992 SPIE Workshop on IRFPAs "p-Channel MIS Double-Metal Process InSb Monolithic Unit Cell for Infrared Imaging"

Contact Name:	W.D. Kerns
Position:	
Organization:	Johns Hopkins University
Component:	Center for NDE and Applied Physics Laboratory
Address:	Laurel, MD 20723
Notes:	infrared non-destructive evaluation

Contact Name:	Lawrence Kessler
Position:	Pres
Organization:	Diversified Optical Products
Component:	
Address:	282 Main St. Salem, NH 03079
Notes:	Automated IR and visible automated MTF testing.

Contact Name:	David J. Kettler
Position:	
Organization:	Indiana State University
Component:	Department of Geography and Geology
Address:	Terre Haute, IN 47809
Notes:	Active in infrared remote sensing for a variety of natural resource assesments.

Contact Name:	A.R. Khotanzad
Position:	
Organization:	Southern Methodist University
Component:	
Address:	
Notes:	Co-authored for 1992 SPIE meeting on Machine Vision "Automated Vision System for INspection of Wedge Bonds"

Contact Name:	Edward Kielty
Position:	
Organization:	Sogem-Afrimet Inc.
Component:	
Address:	1212 Avenue of the Americas New York, NY 10036
Notes:	Manufacturer of germanium for infrared applications.

Contact Name:	Ryoichi Kikuchi
Position:	
Organization:	Washington University
Component:	Department of Materials Science and Engineering
Address:	Seattle, WA
Notes:	Authored February 1988 study "Migration and Stability of HgCdTe Lattice Defects"

Contact Name:	Sun Ung Kim
Position:	
Organization:	Korea University
Component:	
Address:	Chong Am Dong Sung-Buk-Ku Seoul, KOREA 11136-701
Notes:	Attended 1992 MCT Workshop, a materials researcher.

Contact Name:	Ki-Sang Kim
Position:	
Organization:	Virginia University
Component:	Department of Electrical Engineering
Address:	Charlottesville, VA
Notes:	Co-authored May 1992 report "Monte Carlo SImulation of Elecron Transport in HgCdTe"

Contact Name:	Toh Kim-Huat
Position:	V.P./ General Manager
Organization:	CEI Technologies, PTE Ltd.
Component:	
Address:	249 Jalan Boon Lay Singapore 2261
Notes:	Thermal imaging, night vision for military markets.

Contact Name:	M.A. Kinch
Position:	Dr.
Organization:	Texas Instruments
Component:	Infrared Materials Laboratory
Address:	POB 655936 MS150 Dallas, TX 75265
Notes:	Head of their IR producibility effort; representative to JM consortium on producibility

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Contact Name:	Tom Kinstle
Position:	Vice President Marketing
Organization:	Martin Marietta Corp.
Component:	
Address:	6801 Rockledge Drive Bethesda, MD 20817
Notes:	Night vision, infrared systems & equipment for military markets.

Contact Name:	R. Klauser
Position:	
Organization:	Fraunhofer-Institut fur Angewadnte Festkorperphysik
Component:	
Address:	Tullastr. 72 D-7800 Freiburg, Germany
Notes:	AUthor of "Characterization of MCT Heterostructures by Thermoelectric Measurements"

Contact Name:	Leonard Klenerman
Position:	Dr.
Organization:	Northwick Park Hospital
Component:	Dept of Orthopaedics
Address:	Watford Road Harrow, UNITED KINGDOM
Notes:	Active in research using infrared biomedical thermography for othopaedic medicine.

Contact Name:	Hans Kluge
Position:	President
Organization:	Automatic Switch Co
Component:	Division of Emerson Electric Co.
Address:	50-60 Hanover Road Florham Park, NJ 07932
Notes:	Cyrogenic equipment for both commercial and military markets. Also product-oriented research of electric-power controls and fluid control devices to automate machinery, equipment, and industrial processes.

Contact Name:	Larry M. Klynn
Position:	
Organization:	Lockheed Missiles & Space Co., Inc.
Component:	
Address:	1111 Lockheed Way Sunnyvale, CA 94088
Notes:	Infrared non-destructive evaluation of thermal profiles for smart missiles and automatic target recognition systems.

Contact Name:	Guy Knockaert
Position:	Technico-commercial Manager
Organization:	Union Miniere
Component:	
Address:	A. Greinerstraat 14 B-2660 Hoboken-Belgium
Notes:	

Contact Name:	F. Koch
Position:	
Organization:	Technische Universtat
Component:	Phsik-Department E-16
Address:	mUNCHEN, d-8046 GERMANY
Notes:	Co-authored for 1991 MCT Workshop "Influece of Resonant Defect States on Subband Structures in HgCdTe"

Contact Name:	Bill Kolander
Position:	Product Marketing Manager
Organization:	Marlow Indusrties, Inc.
Component:	
Address:	10451 Vista Park Road Dallas, TX 75238-1645
Notes:	Infrared systems & equipment, night vision, detectors and sensors, c/o systems for military markets.

Contact Name:	L. Kops
Position:	
Organization:	McGill University
Component:	
Address:	845 Sherbrook St. W., Montreal, PQ H3A 2T5
Notes:	Co-authored 1983 "Application of Infrared Radiation Measurements in Grinding Studies"

Contact Name:	Edward Kornstein
Position:	Pres
Organization:	O R S Automation
Component:	
Address:	402 Wall St. Princeton, NJ 08540
Notes:	Controls and guidance directed towards problems in machine vision for individual use, some work with IR.

Contact Name:	A.W. Koszykowski
Position:	Pres.
Organization:	Laser SOS Limited
Component:	
Address:	4B Bartholomew's Walk Cambridgeshire Bus. Pk., ANgel Drove Ely, Camb. CB74EAG
Notes:	Manufacture of CdTe, GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications.

Contact Name:	Lester J. Kozlowski
Position:	Dr.
Organization:	Rockwell International Science Center
Component:	
Address:	1049 Camino Dos Rios Thousand Oaks, CA 91360
Notes:	Chief scientist conducting their alternative substrate programs; probably best connected and longest tenured Rockwell scientist doing IR

Contact Name:	M.G. Krauss
Position:	
Organization:	Dresden University of Technology
Component:	Institut fur Festkorperelektronik
Address:	Dresden, FEDERAL REPUBLIC OF GERMANY
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Pyroelectric Linear Array IR Detectors with CCD Multiplexer"

Contact Name:	Harvey N. Kreisberg
Position:	Director Corporate Development
Organization:	AIL Systems, Inc.
Component:	
Address:	Commack Road Deer Park, NY 11729
Notes:	Manufactures Infrared systems & equipment, alongside RF & Microwave and other passive and active systems

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Contact Name:	Kent Kresa
Position:	CEO
Organization:	Northrop Corporation
Component:	Hawthorne Site
Address:	2301 W120th St Hawthorne CA 90250-5032
Notes:	Precision inertial sensors and lasers.

Contact Name:	Vikram Krishnamurthy
Position:	
Organization:	Stanford University
Component:	Department of Electrical Engineering
Address:	Stanford, CA 94305
Notes:	Co-Authored for 1991 MCT Workshop "Thermodynamic Description of metal HgCdTe Systems"

Contact Name:	Kenneth Kun
Position:	Pres
Organization:	Syracuse Research Corp.
Component:	Defense Electronics Engineering
Address:	Merrill Ln. Syracuse, NY 13210
Notes:	Optical and IR systems analysis.

Contact Name:	Pao-Kuang Kuo
Position:	
Organization:	Wayne State University
Component:	Inst for Manufacturing Research
Address:	Detroit, MI 48202
Notes:	infrared non-destructive evaluation

Contact Name:	Audra Kurelaitis
Position:	Sales Manager
Organization:	Oxley, Inc.
Component:	
Address:	25 Business Park Drive P.O. Box 814 Branford, CT 06405
Notes:	E/o systems, night vision, infrared systems & equipment for military applications.

Contact Name:	Ernest Kussmaul
Position:	Pres
Organization:	Kussmaul Electronics Company, Inc.
Component:	
Address:	170 Cherry Ave. West Sayville, NY 11796
Notes:	R&D of photoelectronic controls, interest in IR detectors.

Contact Name:	R. La Polla
Position:	Marketing Manager
Organization:	Whittaker Electronics
Component:	
Address:	1785 Voyager Avenue Simi Valley, CA 93063-3349
Notes:	infrared systems & equipment

Contact Name:	Stan Laband
Position:	Marketing Director
Organization:	Amber Engineering
Component:	
Address:	5756 Stonewood Drive Goleta, CA 93117
Notes:	Participant in DARPA's IRFPA team and producer of InSb used in medium-wave infrared systems for both commercial and military systems

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Contact Name:	Robert Lacer
Position:	Pres
Organization:	Infrared Scanning, Inc.
Component:	
Address:	3955 Pleasantdale Rd. Atlanta, GA 30340
Notes:	Anfrared inspection techniques and applications.

Contact Name:	R.C. Lacoe
Position:	
Organization:	The Aerospace Corporation
Component:	Electronic Technology Center
Address:	P.O. Box 92957 Los Angeles, CA 90009
Notes:	Co-authored for 1992 SPIE workshop on IRFPAs "Modified Wuantum Well Infrared Photodector Designs for High Temperature and Long Wavelength Operation"

Contact Name:	Dan Laerfeld
Position:	Marketing Manager
Organization:	Magnavox Electronic Systems Company
Component:	Elecrto-Optical Systems
Address:	46 Industrial Avenue Mahwah, NJ 07430-2206
Notes:	

Contact Name:	Joseph Lakowicz
Position:	
Organization:	University of Maryland
Component:	Medical School
Address:	Baltimore, MD
Notes:	Speaking at OE/LASE Laser Market '93 seminar on wavelength requirements for medical diagnostics in the near-infrared spectral regions. The wavelength in such ap[plications determines not only which molecules will absorb the light, but how deeply the light will penetrate biological tissues.

Contact Name:	K.C. Lamb
Position:	Marketing Manager
Organization:	MCP Wafer Technology
Component:	
Address:	Unit 34, Maryland Road, Tongwell, Milton Keynes, Bucks, MK158HJ UNITED KINGDOM
Notes:	Production of CdTe and GaAs for infrared applications.

Contact Name:	John Lamonica
Position:	President
Organization:	Farmers Investment Company
Component:	
Address:	P.O. Box 7 Ahuarita, AZ 85629
Notes:	Invests in technologies which could benefit local farmers. Invested in infrared sorting technique for pecans which shows promise for sorting of many other varieties of fruits and vegetables.

Contact Name:	M.D. Lange
Position:	
Organization:	University of Illinois at Chicago
Component:	Microphysics Laboratory, Physics Department
Address:	P.O. Box 4348 Chicago, IL 60680
Notes:	For 1991 Workshop, "Current Status of Direct Growth of CdTe and HgCdTe on Silicon by MBE"

Contact Name:	CF Langenhagen
Position:	Pres
Organization:	Williamson Corporation
Component:	
Address:	70 Domino Dr., PO Box 1270 Concord, MA 01742
Notes:	R&D of infrared radiometers for temperature measurement and control.

Contact Name:	Y. Lansari
Position:	
Organization:	North Carolina State University
Component:	Department of Physics
Address:	6 Cox Hall, M/S 8202 Raleigh, NC 27695-8202
Notes:	Authored "Integrated Heterostructure Devices Based on II-VI Compound Semiconductors"

Contact Name:	Y. Lansari
Position:	
Organization:	North Carolina State University
Component:	Department of Physics
Address:	Raleigh, NC 27695-8202
Notes:	Authored for 92 MCT workshop "Growth of HgSe and HgCdSe Thin Films by Molecular Beam Epitaxy" For 1991 Workshop, authored "Quantum Hall Effect and Setback Modulation Doping in HgTe-CdTe Heterostructures"

Contact Name:	Ray Larsen
Position:	Director
Organization:	Newport Industrial Glass Inc.
Component:	
Address:	2044-C Placentia Avenue Costa Mesa, CA 92627
Notes:	Manufacturer of CdTe, GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications.

Contact Name:	Gilbert Larson
Position:	Pres
Organization:	Omnidata International Inc.
Component:	
Address:	750 W 200 North, PO Box 3489 Logan, UT 84321
Notes:	Development of environmental and industrial sensors, hardware and software for data collection systems.

Contact Name:	D.N. Lazarovici
Position:	
Organization:	Institute for Atomic Physics
Component:	
Address:	ROMANIA
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Accurate Method for Neutron Fluence Control Used in Improving Neutron-Transmutation-Doped Silicon Detectors"

Contact Name:	AZ Lazzara
Position:	Pres
Organization:	Scisco Inc
Component:	
Address:	6020 Academy, NE PO Box 25446 Albuquerque, NM 87125)
Notes:	Optical sensor data reduction, including some IR work.

Contact Name:	M.B. Lee
Position:	
Organization:	Grumman Corporate Research Center
Component:	
Address:	MS A002-26 Bethpage, NY 11714
Notes:	Co-authored for 1992 MCT workshop "White Beam X-ray Synchroton Topography Analysis of CdTe (111)B Substrates and Epilayers"

Contact Name:	E.Y. Lee
Position:	
Organization:	Renssalaer Polytechnic Institute
Component:	Physics Department and Center for Integrated Electronics
Address:	110 Eight Street Troy, NY 12180
Notes:	Co-authored for 1992 meeting of SPIE on IRFPAs "Fundamental Studies of Schottky Barrier IR Detectors by Ballistic Electron Emission Microscopy"

Contact Name:	David Leech
Position:	
Organization:	TASC
Component:	
Address:	1101 Wilson Boulevard Arlington, VA 22209
Notes:	Complete study for Air Force on US industrial base for focal plane arrays.

Contact Name:	Dick Leftwich
Position:	Product Manager, Thermal Imaging Sensors
Organization:	Magnavox
Component:	Government and Industrial Electronics
Address:	46 Industrial Avenue Mahwah, NJ 07430-2206
Notes:	infrared materials and equipment for military use.

Contact Name:	Richard F. Leftwich
Position:	Product Manager, Thermal Imaging Sensors
Organization:	Magnavox Electronic Systems Company
Component:	Elecrto-Optical Systems
Address:	46 Industrial Avenue Mahwah, NJ 07430-2206
Notes:	

Contact Name:	Robert J. Leonard
Position:	Manager, Business Planning
Organization:	Eastman Kodak Co.
Component:	Government Systems Div.
Address:	1447 St. Paul Street Rochester, NY 14653
Notes:	IR Detectors work, mostly PtSi.

Contact Name:	B.F. Levine
Position:	
Organization:	AT&T Bell Laboratories
Component:	
Address:	600 Mountain Avenue Murray Hill, NJ 07974
Notes:	

Contact Name:	M. Levine
Position:	Marketing Manager
Organization:	Honeywell, Inc.
Component:	Solid State Sensors Group
Address:	830 E. Arapaho Road Richardson, TX 75081
Notes:	Manufactures IR optoelectronic components and assemblies, fiberoptic components, and modules.

Contact Name:	Jay Levy
Position:	Communications Director
Organization:	Agema IR Systems
Component:	
Address:	550 County Avenue Secaucus, NJ 07094
Notes:	Source of printed information about AGEMA

Contact Name:	Al Lewis
Position:	Mgr
Organization:	Raytheon Comp.
Component:	Special Microwave Devices Operation
Address:	55 Bearfoot Rd. Northboro, MA 01532
Notes:	Laser and infrared detectors.

Contact Name:	Al Lewis
Position:	Mgr
Organization:	Raytheon Comp.
Component:	Special Microwave Devices Operation
Address:	55 Bearfoot Rd. Northboro, MA 01532
Notes:	Laser and infrared detectors.

Contact Name:	Thomas Lewis
Position:	President
Organization:	Silicon Detector Corporation
Component:	
Address:	1240 Avenida Acaso Camarillo, CA 93012-8727
Notes:	Manufactures and distributes stock and custom NIR/IR LEDs, InGaAs, and silicvon photodetectors for a variety of commercial and military applications. Includes single element, bi-cell, quadrant, multi element arrays, filtered, position sensors, opti hybrids, custom hybrids, opto assmelbies, fiberoptics, etc.

Contact Name:	Sheng Li
Position:	Dr.
Organization:	University of Florida
Component:	
Address:	
Notes:	Working in DARPA Producibliity program, reported at Program Review Meeting in December 1992 on "Novel Grating Coupled III-V Quantum Well INfrared Photodetectors for FPA Applications"

Contact Name:	Sheng S. Li
Position:	
Organization:	University of Florida
Component:	Department of Electrical Engineering
Address:	Gainesville, FL 32611
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "A Noval Grating Coupled Step-Bound-to-Miniband Transition InGaAs/GaAs/AlGaAs Multiquantum Well Infrared Photodetector"

Contact Name:	Karl Lifschitz
Position:	Chief Executive
Organization:	GFI Advanced Technologies, Inc.
Component:	
Address:	112-41 69th Avenue Forest Hills, NY 113754
Notes:	Manufacture of GaAs, germanium, ZnS, and ZnSe for infrared applications, both commercial and military.

Contact Name:	T.T. Lin
Position:	
Organization:	Auburn University
Component:	
Address:	
Notes:	Co-authored 1988 "Adaptive Welding Using Infrared Sensing Techniques Manufacturing Processes, Machines and Systems"

Contact Name:	Jing-Hwa Lin
Position:	
Organization:	Chung-Shan Institute of Science and Technology
Component:	
Address:	P.O. Box 90008-8-7, Lung-tan, Tao-Yuan REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "A Novel CID Emulator for InSb Array"

Contact Name:	Hao-Hsiung Lin
Position:	
Organization:	National Taiwan University
Component:	Department of Electrical Engineering
Address:	1, Sec. 4, Roosevelt Road Taipei, TAIWAN, 10764, REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "A Novel CID Emulator for InSb Array"

Contact Name:	Wang Lingjie
Position:	
Organization:	Huazhong University of Science and Technology
Component:	
Address:	Wuhan, Hubei 430074 REPUBLIC OF CHINA
Notes:	Authored for 1992 SPIE IRFPA meeting "Optimum Design Model for the Injection of IRCCD"

Contact Name:	Benkt Linnander
Position:	Technical Support Director
Organization:	AGEMA Infrared Systems
Component:	
Address:	550 County Avenue Secaucus, N.J. 07094
Notes:	Develops specific new applications for individual companies using AGEMA's cameras

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Contact Name:	Roger Little
Position:	President
Organization:	Spire Corp
Component:	
Address:	One Patriots Park Bedford, MA 01730
Notes:	Photovoltaics, solar cells, compound, semiconductor thin films, and high temperature super conductors. Recently opened a new facility in Oman to produce solar cells. Manufacture of CdTe, GaAs, germanium, and silicon for infrared applications.

Contact Name:	Chris L. Littler
Position:	
Organization:	North Texas State University
Component:	Department of Physics
Address:	Denton, TX
Notes:	Authored July 1990 "Two-Photon Absorption Characterization of HgCdTe"

Contact Name:	C.L. Littler
Position:	
Organization:	University of Nort Texas
Component:	Department of Physics
Address:	Denton, TX 76203
Notes:	Co-Authored "Heavily Accumulated Surfaces of MCT Detectors: Theory and Experiment" for 1992 MCT Workshop. For 1991 Workshop, "Investigation of Mercury Interstititals in MCT alloys Using Resonant Impact-Ionization Spectroscopy"

Contact Name:	Jiy-Chen Liu
Position:	
Organization:	Chung-Shan Institute of Science and Technology
Component:	
Address:	P.O. Box 90008-8-7, Lung-tan, Tao-Yuan REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "A Novel CID Emulator for InSb Array"

Contact Name:	B. Liu
Position:	
Organization:	University of California, Los Angeles
Component:	Department of Chemical Engineering
Address:	Los Angeles, CA 90024-1592
Notes:	Co-authored for 1991 MCT Workshop "Photoassisted Organometallic VPE on CdTe"

Contact Name:	Art Lockwood
Position:	President
Organization:	Amber Engineering
Component:	
Address:	5756 Thornwood Drive Goleta, CA 93117
Notes:	

Contact Name:	Joseph Longo
Position:	VP
Organization:	Rockwell International Corporation
Component:	Science Center
Address:	1049 Camino Do Rios PO Box 1085 Thousand Oaks, CA 91358
Notes:	Basic applied research in electro-optics, including IR systems and equipment.

Contact Name:	D. Lorans
Position:	
Organization:	Societe Anonyme de Telecommunications
Component:	
Address:	41, rue Cantagrel 75631 Paris, Cedex 13 FRANCE
Notes:	Co-authored for 1992 MCT Workshop "Substrate Issues for Mercury Cadmium Telluride"

Contact Name:	Dr Paul Lovoi
Position:	Pres
Organization:	Inta
Component:	
Address:	2281 Calle De Luna Santa Clara, CA 95054
Notes:	3-D laser based machine vision systems, interest in IR guidance.

Contact Name:	J.R. Lowney
Position:	
Organization:	National Institute of Standards and Technology
Component:	Semiconductor Electronics Division
Address:	Gaithursburg, MD 20899
Notes:	Co-Authored "Heavily Accumulated Surfaces of MCT Detectors: Theory and Experiment" for 1992 MCT Workshop. For 1991 Workshop, "Investigation of Mercury Interstititals in MCT Alloys Using Resonant Impact-Ionization Spectroscopy"

Contact Name:	Ronald Lucier
Position:	
Organization:	American Risk Management Corp.
Component:	
Address:	4807 Rockside Road, Ste 500 Cleveland, OH 44131
Notes:	Active in predictive maintenance regimes, especially with nuclear power plants, as well as infrared non-destructive evaluation.

Contact Name:	Bjornar Lund
Position:	
Organization:	Virginia University
Component:	Department of Electrical Engineering
Address:	Charlottesville, VA
Notes:	Co-authored May 1992 report "Monte Carlo SImulation of Elecron Transport in HgCdTe"

Contact Name:	H. Luo
Position:	
Organization:	University of Notre Dame
Component:	Department of Physics
Address:	Notre Dame, IN 46556
Notes:	Co-Authored "Staes Confined in the Barriers of Type-III HgTe/CdTe Superlattices" for 1992 MCT Workshop

Contact Name:	J.D. Luttmer
Position:	
Organization:	Texas Instruments
Component:	Infrared Devices Laboratory
Address:	Dallas, TX 75265
Notes:	The Microelectronics Manufacturing Science and Technology Progarm at TI is developing a generaic semiconductor device manufacturing technology for the mid-1990's. Although the program goal is to develop and demonstrate low volume, fast cycle time, cost effective silicon microelectronic manufacturing the technology also is applicble to MCT, Ga As and other materials.

Contact Name:	Robert Lyle
Position:	Pres
Organization:	Exotech, Inc
Component:	
Address:	8502 Dakota Dr. Gaithersburg, MD 20877
Notes:	Electo-optical and electronic instrumentation

Contact Name:	Neal A. MacNamara
Position:	
Organization:	Southern Nuclear Operating Center
Component:	
Address:	40 Inverness Center Parkway Birmingham, AL 35242
Notes:	Active in infrared predictive maintenance, helped purchase their equipment.

Contact Name:	J. Mactaggart
Position:	VP Marketing
Organization:	Hughes Aircraft Company
Component:	
Address:	328 Ellen Street Midland, Ontari, L4R 2H2, CANADA
Notes:	

Contact Name:	Duncan MacVicar
Position:	Consultant, President
Organization:	MacVicar Associates
Component:	
Address:	1171 Buckingham Drive Los Altos, VA 94024
Notes:	Offers marketing and management consulting services for domestic and international high technology industry, including electro-optics. No direct IR experience, a one man operation.

Contact Name:	Bob Madding
Position:	
Organization:	McDonnel Douglas Tech Inc.
Component:	
Address:	11955 Bajada Road San Diego, CA 92128-2023
Notes:	Active in infrared remote sensing. He is a respected authority with an overview of the market.

Contact Name:	Robert P. Madding
Position:	
Organization:	McDonnell Douglas Technologies, Inc.
Component:	
Address:	11955 Bajada Road San Diego, CA 92128-2023
Notes:	Active in infrared predictive maintenance, a respected authority on predictive maintenance regimes.

Contact Name:	N.L. Madsen
Position:	
Organization:	Auburn University
Component:	
Address:	
Notes:	Co-authored 1984 "Automatic Welding: Infrared Sensors for Process Control Computer Based Factory Automation"

Contact Name:	Michael Magers
Position:	Dirtc
Organization:	Bobbit Laboratories
Component:	Viggo-Spectramed
Address:	1900 Williams Dr. Oxnard, CA 93030
Notes:	Instrumentation and precise measurement using advanced systems, including infrared sensors.

Contact Name:	DE Maguire
Position:	Pres
Organization:	Kemet Electronics Corporation
Component:	
Address:	2605 Laurens Hwy., PO Box 5928, Greenville, SC 29606
Notes:	Applied research and development on passive electronic components.

Contact Name:	H. Maier
Position:	
Organization:	AEG
Component:	
Address:	D-7100 Heilbronn GERMANY
Notes:	Co-authored for 1991 MCT Workshop "Influence of Resonant Defect States on Subband Structures in HgCdTe"

Contact Name:	E. Maldonado
Position:	
Organization:	University of Nort Texas
Component:	Department of Physics
Address:	Denton, TX 76203
Notes:	For 1991 Workshop, "Investigation of Mercury Interstititals in MCT alloys Using Resonant Impact-Ionization Spectroscopy"

Contact Name:	R.G. Mani
Position:	
Organization:	University of Maryland
Component:	
Address:	College Park, MD
Notes:	Co-authored 1987 study "Magnetophonon Effect in HgCdTe" Co-authored 1987 study "Phase Differences Between Quantum Oscillations of the Magnetoresistance and the Hall Effect in HgMnTe and HgCdTe"

Contact Name:	John Marchesano
Position:	President
Organization:	Decilog, Inc.
Component:	
Address:	555 Broad Hollow Rd Melville, NY 11747-5093
Notes:	Technical support to government and industry in infrared systems and components.

Contact Name:	Robert P. Marcus
Position:	President
Organization:	RGB Spectrum
Component:	
Address:	950 Marine Village Parkway Alameda, CA 94501
Notes:	Thermal imaging, predominantly for military applications.

Contact Name:	Y. Marfaing
Position:	
Organization:	CNRS
Component:	Laboratiore de Physique des SOlides de Bellevue
Address:	F-92195 Meudon-Cedex, FRANCE
Notes:	Authored for 1991 MCT Workshop "Point Defects and Defect-Purity Interaction of CdHgTe and Other II-Vi Semiconductors: Facts and Conjectures."

Contact Name:	David Marlow
Position:	International Marketing Manager
Organization:	Marlow Industries, Inc.
Component:	
Address:	10451 Vista Park Road Dallas, TX 75238
Notes:	Manufactures thermoelectric cooling devices, thermoelectric cooling assemblies, and related power supplies and temperature controllers

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Contact Name:	Philip D. Marlowe
Position:	Sales Manager
Organization:	Cleveland Crystals, Inc.
Component:	
Address:	19306 Redwood Avenue, P.O Box 17157 Cleveland, OH 44117
Notes:	Manufacturer and research into CdTe, ZnS, and ZnSe infrared materials, specialty in II-VI naterials. For both military and commercial markets.

Contact Name:	Stuart E. Marsh
Position:	
Organization:	University of Arizona
Component:	Arizona Remote Sensing Center
Address:	845 North Park Avenue Tucson, AZ 45719
Notes:	active in infrared remote sensing

Contact Name:	C. Martino
Position:	IR Marketing Manager
Organization:	Hughes Aircraft Co.
Component:	
Address:	2051 Palomar Airport Road Carlsbad, CA 92009
Notes:	

Contact Name:	K. Maruyama
Position:	
Organization:	Georgia Tech Research Institute
Component:	Physical Sciences Laboratory
Address:	225 North Avenue, NW Atlanta, GA 30332-0800
Notes:	Co-authored for 1991 MCT Workshop "Gas Source Iodine Doping and Characterization of MBE Epitaxially Grown CdTe"

Contact Name:	Lawrence Matteson
Position:	Manager
Organization:	Eastman Kodak Company
Component:	Kodak Apparatus Division
Address:	901 Elmgrove Rd. Rochester, NY 14653
Notes:	Applied research in physics and engineering to establish experimental and analystical foundations for new and improved processes in electro, photo-optical, and mechanical products. Additional research with PtSi under a contract from the Air Force Aeronautical Systems Division for use in adverse weather landing systems.

Contact Name:	EK Matthews
Position:	Pres
Organization:	The Pyrometer Instrument Company
Component:	
Address:	234 Industrial Pkwy. Northvale, NJ 07647
Notes:	Design and production of infrared temperature measurement systems.

Contact Name:	John-Paul Mattia
Position:	
Organization:	MIT
Component:	Lexington Lincoln Lab
Address:	244 Wood Street Lexington, MA 02173-9108
Notes:	Co-authored April 1990 study entitled "PtSi Schottky-Barrier Focal Plane Arrays for Multispectral Imaging in Ultraviolet, Visible, and Infrared Spectral Bands"

Contact Name:	R.B. Mattson
Position:	
Organization:	MIT
Component:	Lexington Lincoln Lab
Address:	244 Wood Street Lexington, AM 02173-9108
Notes:	Co-authored August 1989 study entitled "128 X 128 Element IrSi Schottky-Barrier Focal Plane Arrays for LWIR Imaging"

Contact Name:	Mario Maury
Position:	
Organization:	Maury Microwave Corp
Component:	
Address:	2900 Inland Empire Blv Ontario, CA 91764
Notes:	Cyrogenic equipment for military markets, some commercial.

Contact Name:	P.W. Mausel
Position:	
Organization:	Indiana State University
Component:	Department of Geography and Geology
Address:	Terre Haute, IN 47809
Notes:	Active in infrared remote sensing, has done studies which favored infrared videography over infrared photos; interested in developing the technology.

Contact Name:	T. Maxworthy
Position:	
Organization:	University of California in Los Angeles
Component:	
Address:	
Notes:	Authored February 1991 stud, "Laboratoty Modelling of the Dynamics of Coastal Upwelling" which studies the dynamics of the filamentary structured that have been repeatedly observed by satellite by IR imagery taken from the West Cost.

Contact Name:	George A. May
Position:	
Organization:	ITD - Space Remote Sensing Center
Component:	
Address:	Building 1103 Suite #118 Stennis Space Center, Mississippi 39529
Notes:	Active in infrared remote sensing, military and commercial.

Contact Name:	Alex McCallam
Position:	President
Organization:	McCallum & Associates, Inc.
Component:	
Address:	330 Pearl Street, Suite 3A New York, NY 10038
Notes:	Represents MediScience, Inc, which funded Alfano's work at CCNY on breast cancer detection. Interests in additional funding. Sees use in cancer pre-diagnosis and cardiology during operations.

Contact Name:	Donald E. McClure
Position:	
Organization:	Brown University
Component:	Center for Advanced Materials Research
Address:	182 Hope Street, P.O. Box D Providence, RI 02912
Notes:	Authored "Image Acquisition and Processing Equipment for Machine Vision" September 1990, distributed by Defense Technical Information Center

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Contact Name:	William P. McCracken
Position:	
Organization:	Texas Instruments, Inc.
Component:	Image Sensor Technology Center
Address:	P.O. Box 650311, Mail Stop 3966 Dallas, TX 75265
Notes:	Involved in electronics imaging, designing advanced video cameras at TI, specifically CCD cameras. Prefers CCDs to conventional IR detectors.

Contact Name:	Tom McGill
Position:	Dr.
Organization:	California Institute of Technology
Component:	
Address:	1201 East California Boulevard Pasadena, CA 91125
Notes:	Reported at the DARPA Program Review on Infrared Focal Plane Array Technology in December, 1992, on "InAs/GaInSb Superlattices: Growth Involving Anion Switching"

Contact Name:	T.C. McGill
Position:	
Organization:	California Institute of Technology
Component:	
Address:	1201 East California Boulevard Pasadena, CA 91125
Notes:	Co-Authoerd "Augur Lifetimes in Ideal InGaSb/InAs Superlattices" for 1992 MCT Workshop.

Contact Name:	Peter McGrath
Position:	General Manager
Organization:	Optoelectronics- Textron
Component:	
Address:	1309 Dynamics St. PO Box 750039 Petaluma, CA 94975-0039
Notes:	Manufactures lead salt infrared detectors and related components

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Contact Name:	Brian McLain
Position:	Sales Manager
Organization:	Eagle-Picher Industries, Inc.
Component:	
Address:	P.O.Box 737 Quapaw, OK 74363
Notes:	

Contact Name:	Gerard McLarhon
Position:	CEO
Organization:	Applied Solar Energy corporation
Component:	
Address:	15251 E Don Julian Rd. City of Industry, CA 91749
Notes:	Product oriented R&D of solar laser detector products, including CdTe

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Contact Name:	J.A. McLuckey
Position:	President
Organization:	Rockwell International Corporation
Component:	Defense Electronics
Address:	3370 Miraloma Ave. Anaheim, CA 92803
Notes:	Electro-optical products and systems, including IR equipment and components.

Contact Name:	Phillip C. McMullan
Position:	
Organization:	TSI Thermo-Scan Energy Management
Component:	
Address:	15658 North Gray Road, Box 705 Carmel, IN 46032
Notes:	active in infrared predictive maintenance

Contact Name:	Phillip C. McMullan
Position:	
Organization:	TSI Thermoscan Energy Management
Component:	
Address:	15658 North Gray Road, Box 705 Carmel, IN 46032
Notes:	infrared non-destructive evaluation

Contact Name:	Brett McNeil
Position:	Advanced Products Manager
Organization:	SBRC
Component:	
Address:	
Notes:	Knows diversification opportunities and Military work at SBRC.

Contact Name:	Michael J. McNutt
Position:	
Organization:	MIT
Component:	Lexington Lincoln Lab
Address:	244 Wood Street Lexington, AM 02173-9108
Notes:	Co-authored August 1989 study entitled "128 X 128 Element IrSi Schottky-Barrier Focal Plane Arrays for LWIR Imaging"

Contact Name:	DL McPherson
Position:	Gmgr
Organization:	General Dynamics Corporation
Component:	General Dynamics Air Defense Systems Division
Address:	PO Box 50800 Ontario, CA 91761-1085
Notes:	Exploration of new sensor concepts for electro-optical detection, guidance, and measurement applications for military markets.

Contact Name:	D.L. McPherson
Position:	General Manager
Organization:	General Dynamics Corporation
Component:	General Dynamics Air Defense Systems Division
Address:	PO Box 50800 Ontario, CA 91761-1085
Notes:	Exploration of new sensor concepts for electro-optical detection, guidance, and measurement applications for military markets.

Contact Name:	Thomas McRae
Position:	President and CEO
Organization:	Laser Imaging Systems, Inc.
Component:	
Address:	204A E. McKenzie Punta Gorda, FL 33950
Notes:	Has developed MCT-based gas detection cameras used for fugitive gas leaks as well as in factory testing for gas leaks. Marketed through Inframetrics.

Contact Name:	P. Meisen
Position:	
Organization:	Fraunhofer-Institut fur Angewandte Festkorperphysik
Component:	
Address:	D-7800 Freiburg, GERMANY
Notes:	Authored "XPD Investigation of Substrate Crystallinity at HgCdTe (111B) and CdTe(111)B Surfaces Upon Ag and Al Overlayer Formation."

Contact Name:	Jan Melles
Position:	CEO
Organization:	Melles Griot
Component:	
Address:	1770 Kettering St. Irvine, CA 92714
Notes:	Research into optical sciences and optical thin films.

Contact Name:	Arthur Mengel
Position:	Pres
Organization:	Teltron, Inc.
Component:	
Address:	2 Riga Ln. Birdsboro, PA 19508
Notes:	Development and production of UV, IR, and TV cameras.

Contact Name:	Heather Messenger
Position:	Senior Editor, Markets
Organization:	Laser Focus World
Component:	
Address:	One Technology Park Drive P.O. Box 989 Westford, MA 01886
Notes:	Wrote November 1992 article "Detector Makers Seek Dual-Use Technology for Survival." Friends with David Leech.

Contact Name:	Z.Y. Mi
Position:	
Organization:	Shanghai Institute of Technical Physics
Component:	National Laboratory for INfrared Physics
Address:	Academia Sinica Shanghai 200083 CHINA
Notes:	Co-authored for 1991 MCT Workshop "Influece of Resonant Defect States on Subband Structures in HgCdTe"

Contact Name:	Joel Milelli
Position:	Gmgr
Organization:	Loral Corporation
Component:	Loral-Fairchild Imaging Sensors
Address:	1801 McCarthy Blvd. Milpitas, CA 95035
Notes:	Development of IR sensing systems.

Contact Name:	David Miller
Position:	Gmgr
Organization:	Aritech
Component:	Aritech Corporation
Address:	1510 Tate Blvd., SE Hickory, NC 28603
Notes:	Sensor detector and alarm system equipment.

Contact Name:	Sol Mirelez
Position:	Marketing Communications Manager
Organization:	Rosemount Inc.
Component:	Aerospace Division
Address:	14300 Judicial Road Burnsville, MN 55337
Notes:	

Contact Name:	M.M. Miroshnikov
Position:	
Organization:	S.I. Vavilov State Optical Institute
Component:	
Address:	Moscow, RUSSIA
Notes:	Authored for 1991 SPIE meeting on Infrared Technology "Infrared in the USSR: Brief HIstorical Survey of Infrared Development in the Soviet Union"

Contact Name:	K.L. Moazed
Position:	
Organization:	North Carolina State University at Raleigh
Component:	Department of Materials Science and Engineering
Address:	Raleigh, NC
Notes:	Authored June 1980 paper "MBE Growth of HgCdTe"

Contact Name:	Jonathan H. Mohler
Position:	
Organization:	EG & Mound Applied Technology
Component:	
Address:	Box 3000 Manisburg, OH 45342
Notes:	active in infrared remote sensing

Contact Name:	S. Mohling
Position:	
Organization:	Dresden University of Technology
Component:	Institut fur Festkorperelektronik
Address:	Dresden, FEDERAL REPUBLIC OF GERMANY
Notes:	Co-authored for 1992 SPIE IRFPA meeting "Pyroelectric IR Single-Element Detectors and Arrays Based on LiNbO3 and LiTaO3"

Contact Name:	S.E. Mohr
Position:	
Organization:	EG&G Princeton Applied Research
Component:	
Address:	375 Phillips Boulevard Trenton, NJ 08618
Notes:	Co-authored for 1992 SPIE Workshop on IRFPAs "Popcorn Noise in Linear InGaAs Detector Arrays"

Contact Name:	Chrsitine Monestier
Position:	Advertising Manager
Organization:	Litton Electron Devices
Component:	
Address:	960 Industrial San Carlos, CA 94070
Notes:	Infrared systems and equipment, c/o sysetms, night vision for military markets.

Contact Name:	John Moore
Position:	Business and Marketing Manager
Organization:	BSA Technology, Inc.
Component:	
Address:	3812 Sepulveda Blvd, Ste 500 Torrance, CA 90505
Notes:	Infrared detectors in 1-14 micrometer range (MCT), HgMnTe, InSb, and others), infarred pyrometers, copper and molybdenum mirrors, laser power and energy measurement systems, crystals operitcal elements, solar energy collection mirrors, etc.

Contact Name:	James Morgan
Position:	President
Organization:	Applied Materials, Inc.
Component:	
Address:	3050 Bowers Ave. Santa Clara, CA 95054
Notes:	Research on chemical vapor deposition and plasma etching processes materials and equipment, with particular emphasis on semiconductor materials, metals and dielectrics for the electronics industry, ion implantation of dopants into silicon and process control equipment.

Contact Name:	William T. Morgan
Position:	
Organization:	Infrared Engineering Services
Component:	
Address:	110 Shadow Oaks Drive Easley, SC 29642
Notes:	Infrared non-destructive evaluation firm, doing mostly thermal building surveys.

Contact Name:	C.G. Morgan-Pond
Position:	
Organization:	Wayne State University
Component:	Department of Physics
Address:	Detroit MI
Notes:	Co-authored 1990 "FOrmation Mechanisms of Interstitial Defect States" And 1991 "Present Status and Future of Theoretical Work on Point Defects and Diffusion in Semiconductors" And 1990 "Structural Energies of Defects in CdTe and HgCdTe" and APril 1990 "Point Defects with Lattice Distortion in CdTe and HgCdTe"

Contact Name:	Walter Morrow
Position:	Deputy Director of Visionics lab
Organization:	Army Night Vision Labs
Component:	
Address:	Fort Belvoir, VA
Notes:	Secy: -1760. Wrote "Common Modules: A Success Story" in 1988.

Contact Name:	Charlie Morse
Position:	Pres
Organization:	Kistler-Morse Corporation
Component:	
Address:	10201 Willows Rd., NE, PO Box 3009, Redmond, WA 98073
Notes:	R&D of seminconductor displacement sensors.

Contact Name:	David Morton
Position:	CEO
Organization:	Alcan Aluminum Limited
Component:	ManLabs
Address:	21 Erie St. Cambridge, MA 02139
Notes:	Basic applied and product oriented research in metals, alloys, ceramics, and electro-optical materials.

Contact Name:	Asa Morton
Position:	Pres
Organization:	American Interplex Corporation Laboratories
Component:	
Address:	8600 Kanis Rd. Little Rock, AR 72204
Notes:	R&D on thermal properties of various metals and metal coatings; research in infrared spectroscopy and monitoring using infrared technologies.

Contact Name:	S. Motakef
Position:	
Organization:	MIT
Component:	
Address:	Cambridge, MA 01742
Notes:	Co-authored "Long Wavelength HgMnTe Avalanche Photodiodes" for 1991 MCT Workshop.

Contact Name:	Paul Mullen
Position:	Manager
Organization:	Laser Diode Inc.
Component:	
Address:	205 Forrest Street Metuchen, NJ 08840-1292
Notes:	Manufacturer of GaAs and germanium materials for infrared applications.

Contact Name:	Jimmy Murphy
Position:	Program Manager, Integrated Blade Inspection Systems
Organization:	General Electric Co.
Component:	General Electric Aircraft Engines
Address:	1 Neumann Way, P.O. Box 156301 Cincinnati, OH 45215-6301
Notes:	Helped design GEAE's thermographic inspection equipment for non-destructive evaluation of jet engine parts, orginally from Air Force funding

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Contact Name:	James C. Murphy
Position:	
Organization:	Johns Hopkins University
Component:	Center for NDE and Applied Physics Laboratory
Address:	Laurel, MD 20723
Notes:	Infrared non-destructive evaluation of advanced materials, leading researcher.

Contact Name:	Thomas H. Myers
Position:	Physics Department
Organization:	West Virginia University
Component:	
Address:	P.O. Box 6315 Morgantown, WV 26506-6315
Notes:	Attended 1992 MCT Workshop

Contact Name:	Charles W. Myles
Position:	
Organization:	Texas Tech University
Component:	Department of Physics and Engineering Physics
Address:	Lubbock, TX 79409-1051
Notes:	Co-authored for 1991 MCT workshop "Critical Stress of HgCdTe Solid Solutions." and "Microhardness of Hg-Containing II-VI Alloys"

Contact Name:	S. Nagarajan
Position:	
Organization:	Auburn University
Component:	
Address:	
Notes:	Co-authored 1991 "Weld Quailty Control in Gas Tungsten Arc Welding Process"

Contact Name:	Albert Narath
Position:	President
Organization:	American Telephone and Telegraph
Component:	Sandia National Laboratories
Address:	Albuquerque, NM 87185-5800
Notes:	Basic and applied research for US DoE in solid state materials, science, physics, opto-electronics, aerospace sciences, solar, geothermal, fossil, fission and fusion energy.

Contact Name:	Albert Narath
Position:	Pres
Organization:	American Telephone and Telegraph Co.,
Component:	Sandia National Laboratories
Address:	Albuquerque, NM 87185-5800
Notes:	Basic and applied research for US DoE in solid state materials, science, physics, opto-electronics, aerospace sciences, solar, geothermal, fossil, fission and fusion energy.

Contact Name:	Ram M. Narayanen
Position:	
Organization:	University of Nebraska
Component:	Center for Electro-Optics
Address:	Lincoln, NE 69588
Notes:	active in infrared remote sensing

Contact Name:	Donald Neamen
Position:	
Organization:	University of New Mexico
Component:	Department of Electrical and Computer Engineering
Address:	Albuquerque, NM 87131
Notes:	Co-authored with Eustace Dereniak for 1992 SPIE IRFPA meeting "Computer Simulation of a Switched FET Readout Multiplexer"

Contact Name:	J.G. Needham
Position:	General Manager
Organization:	MCP Wafer Technology
Component:	
Address:	Unit 34, Maryland Road, Tongwell, Milton Keynes, Bucks, MK158HJ UNITED KINGDOM
Notes:	Production of CdTe and GaAs for infrared applications.

Contact Name:	Jeannette Neff
Position:	Mgr. Marketing Communications
Organization:	Kollsman Division of Sequa Corp.
Component:	
Address:	220 Daniel Webster Highway Merrimack, NH 03054
Notes:	E/O Systems, infrared systems and equipment, night vision for military.

Contact Name:	Dr John Nelson
Position:	VP
Organization:	Baker Hughes, Inc.
Component:	TN Technology, Inc.
Address:	PO Box 800, Round Rock TX 78680-0800
Notes:	Applied R&D of radiation detectors and sources, acoustical transducers, and measurements and data processing methodolgy directed toward the development of instrumentation for the measurement of industrial process parameters.

Contact Name:	Craig R. Nelson
Position:	VP for New Business Development
Organization:	Emcore Corp.
Component:	
Address:	35 Elizabeth Avenue Somerset, NJ 08873
Notes:	Material production of GaAs, CdTe, silicon, ZnS, and ZnSe for infrared applications.

Contact Name:	John Nelson
Position:	Marketing Manager
Organization:	Marlow Industries, Inc.
Component:	
Address:	10451 Vista Park Road Dallas, TX 75238
Notes:	Manufactures thermoelectric cooling devices, thermoelectric cooling assemblies, and related power supplies and temperature controllers

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Contact Name:	Ralph Nelson
Position:	Dr.
Organization:	Univ of Illinois College of Medecine
Component:	Carle Foundation
Address:	611 West Park Street Urbanna, IL 61801
Notes:	active in infrared biomedical thermography

Contact Name:	D.A. Nelson
Position:	
Organization:	University of Maryland
Component:	
Address:	College Park, MD
Notes:	Co-authored 1987 study "Magnetophonon Effect in HgCdTe"

Contact Name:	Y. Nemirovsky
Position:	
Organization:	Kidron Microelectronics Research Center
Component:	Department of Electrical Engineering
Address:	Technion-Israel Institute of Technology Haifa 32000, ISRAEL
Notes:	"UV Photon Assisted Control of Interface Charge Between CdTe Substrates and Metal Organic Chemical Vapor Deposition CdTe Epilayers" for 1992 MCT Workshop. For 1991 Workshop, co-authored "Tunneling and 1/f Noise Curernts in HgCdTe Photodiodes"

Contact Name:	Yael Nemirovsky
Position:	IIT Department of Electrical Engineering
Organization:	Technion University
Component:	
Address:	Technion City Haifa, Israel 3200
Notes:	Attended 1992 MCT Workshop

Contact Name:	Brett Nener
Position:	
Organization:	University of Western Australia
Component:	Department of Electrical Engineering
Address:	Nedlands, Perth, Western Australia 6009
Notes:	Attended 1992 MCT Workshop

Contact Name:	N. Neumann
Position:	
Organization:	Dresden University of Technology
Component:	Institut fur Festkorperelektronik
Address:	Dresden, FEDERAL REPUBLIC OF GERMANY
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Pyroelectric Linear Array IR Detectors with CCD Multiplexer"

Contact Name:	Robert Ngyen
Position:	COO
Organization:	Entec
Component:	
Address:	Suite 100, 2817 Garden Hwy Sacramento, CA 95833
Notes:	Basic research in photovoltaics

Contact Name:	Yongping Ni
Position:	
Organization:	Luoyang Optic-Electronic Institute
Component:	
Address:	P.O. Box 030-12, 471009, Luoyang, Henan, P.R. CHINA
Notes:	Authored for 1992 SPIE meeting on IRFPAs "Auto-Gain-Control Characteristics of InSb P+/N Diode with High Sheet Resistance"

Contact Name:	Guy M. Nicoletti
Position:	
Organization:	University of Pittsburgh at Greensburg
Component:	
Address:	
Notes:	Authored 1988 "Optoelectronic Proximity Sensors for Automated Deburring"

Contact Name:	JA Noll
Position:	CEO
Organization:	JA Noll Co.,
Component:	
Address:	PO Box 312 Monroeville, PA 15146
Notes:	Research in optical metrology, some using IR detectors.

Contact Name:	P.W. Norton
Position:	
Organization:	Loral Infrared and Imaging
Component:	
Address:	2 Forbes Road MS/146 Lexington, MA 02173
Notes:	Their "guru" on IR detectors, senior scientist.

Contact Name:	Paul Norton
Position:	
Organization:	SBRC
Component:	
Address:	75 Coromar Drive Goleta, CA 93117
Notes:	A leading figure in MCT arrays, esp. IRFPAs.

Contact Name:	P.R. Norton
Position:	
Organization:	Virginia Polytechnic Institute
Component:	
Address:	
Notes:	On Program Committee of 1992 MCT Workshop. On Program Committee of 1991 MCT Workshop, as a representative of SBRC.

Contact Name:	Brian O'Donahue
Position:	President
Organization:	Inframetrics, Inc.
Component:	
Address:	16 Esquire Rd. North Billerica, MA 01862
Notes:	Infrared imaging radiometers and night vision devices.

Contact Name:	Tom O'Neill
Position:	CEO
Organization:	Pilkington Optronics
Component:	
Address:	Caxton Street Anniesland, Glasgow GL13 1HZ
Notes:	Thermal imaging and surveillance systems, laser rangefinders, etc. visible and IR optical systems. Producer of HgCdTe-based FPSs for a variety of military systems, including the IRST on the EFA.

Contact Name:	Jasen Ocho
Position:	Dr.
Organization:	Good Samaritan Hospital & Medical Center
Component:	Dept of Neurology
Address:	1015 NW 22nd Avenue Portland, OR 97210
Notes:	Cctive in infrared biomedical thermography for neurology.

Contact Name:	Greg Olsen
Position:	
Organization:	Sensors Unlimited, Inc.
Component:	
Address:	Princeton, NJ
Notes:	Start up company founded by former persident and CEO of EPITAXX, Inc., to advance recent developments in III-V compound device tech fro sensing and imaging applications in the 1000-3000 nm near-infrared spectrym. Ongoing development projects include a monolithic InGaAs detector for NASA Jet Propulsion Labs and 2000-5000 DFB lasers for Kirtland Air Force Base Phillips Lab.

Contact Name:	Dr MW Overhoof PhD
Position:	Pres
Organization:	Overhoff Technologies Corporation
Component:	
Address:	1160 US RT 50, PO Box 182 Millford, OH 45150
Notes:	Design and development and manufacture of electronic instrumentaiton and sensor systems for measurement and control, including infrared, other optical, ultraviolet and nuclear, gaging.

Contact Name:	Tofie Owen
Position:	V.P. Marketing
Organization:	Magnavox Electronic Systems, Inc.
Component:	
Address:	1313 Production Road Fort Wayne, IN 46808
Notes:	/o systems, infrared systems and equipment, night vision for military markets.

Contact Name:	James Owlswey
Position:	VP
Organization:	Northrop Corporation
Component:	Rolling Meadows Site
Address:	600 Hicks Rd. Rolling Meadows, IL 60008
Notes:	Development of electronic and infrared detection systems for military.

Contact Name:	Carol L. Oxley
Position:	President
Organization:	Target Corp.
Component:	
Address:	8400 Lakeview Parkway, Suite 200 Kenosha, WI 53142-7404
Notes:	infrared systems and equipment, passive and active c/o devices

Contact Name:	Paul Page
Position:	Mgr
Organization:	Sensor Control Corporation
Component:	Gentran
Address:	49050 Milmont Dr. Fremont, CA 94538
Notes:	Research on infrared temperature measurements.

Contact Name:	G.N. Pain
Position:	
Organization:	EPI Crystal Supplies Pty, Ltd.
Component:	
Address:	Monbulk, Victoria, 3793 Australia
Notes:	Authored for 1991 MCT Workshop "Effects of mixed-valence Mercury and Indium on the Electrical Properties of HgCdTe"

Contact Name:	H.D. Palfrey
Position:	
Organization:	University of Southampton
Component:	Engineering Materials
Address:	Southampton, SO9 5NH UNITED KINGDOM
Notes:	Authored "Growth Method, Composition, and Defect Structure Dependence of Mercury Diffusion in CdHgTe" for 1992 MCT Workshop.

Contact Name:	Yen-Ming Pann
Position:	
Organization:	Chung-Shan Institute of Science and Technology
Component:	
Address:	P.O. Box 90008-8-7, Lung-tan, Tao-Yuan REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "A Novel CID Emulator for InSb Array"

Contact Name:	Prauin Parekh
Position:	Director
Organization:	Honeywell, Inc,
Component:	Solid State Electronics Center
Address:	12001 State Hwy 55 Plymouth, MN 55441-2080
Notes:	Research, engineering and manufacturing of microunits, sensors, transducers and advanced packaging.

Contact Name:	Dr Prauin Parekh
Position:	Dir
Organization:	Honeywell, Inc,
Component:	Solid State Electronics Center
Address:	12001 State Hwy 55 Plymouth, MN 55441-2080
Notes:	Research, engineering and manufacturing of microunits, sensors, transducers and advanced packaging.

Contact Name:	Joseph A. Parini
Position:	President
Organization:	Elbit Systems, Inc.
Component:	
Address:	16 Esquire Road North Billerica, MA 01862
Notes:	EO systems, infrared systems and equipment, night vision for military markets

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Contact Name:	Camillo Pariset
Position:	P.R. Manager
Organization:	Elettronica S.p.A.
Component:	
Address:	via Tiburtina KM 13.7 1-00131 Rome, ITALY
Notes:	Infrared systems and equipment for European military market.

Contact Name:	Mann J. Park
Position:	
Organization:	Korea University
Component:	Sung-Buk-Ku
Address:	Cong-Am-Dong Seoul, KOREA 136-701
Notes:	Attended 1991 MCT Workshop, materials research.

Contact Name:	Nancy Parker
Position:	Business Communications
Organization:	Textron Defense Systems
Component:	
Address:	201 Lowell Street Wilmington, MA 01887
Notes:	Infrared systems and equipment, GaAs arrays, active and passive c/o systems, detectors and sensors

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Contact Name:	Ed Patton
Position:	COO
Organization:	Infrared Industries
Component:	
Address:	12151 Research Pkwy Orlando, FL 32826
Notes:	Lead sulphide, lead selenide, indium antimonide and silicon infrared detectors and thin film optical filters for government and industrial applications; hybrid preamplifier microcircuits.

Contact Name:	Alfred P. Pavot
Position:	Dr.
Organization:	Greater SE Community Hospital & Georgetown Univ School of Medecine
Component:	Dept of PMR
Address:	1310 Southern Avenue, SE Washigton, DC 20032
Notes:	Active in infrared biomedical thermography community as both user and former president of the American Academy of Thermology.

Contact Name:	M. Pepper
Position:	
Organization:	Cambridge University
Component:	Cavendish Lab
Address:	Cambridge, UNITED KINGDOM
Notes:	Co-authored October 1988 "MBE of HgCdTe"

Contact Name:	F.S. Perry
Position:	President
Organization:	Boston Electronics Corp.
Component:	
Address:	72 Kent Street Brookline, MA 02146
Notes:	Manufacture and use of germanium and silicon. Handles laser and optoelectronic detectors and accessories, fiberoptic components and equipment, optics, optoelectronic devices, materials and substrates, etc.

Contact Name:	Ron Perry
Position:	Dir. Sales and Marketing
Organization:	Pulse Instruments
Component:	
Address:	1234 Francisco Street Torrance, CA 90502
Notes:	E/o systems, infrared systems & equipment for military applications.

Contact Name:	David L. Perry
Position:	
Organization:	University of Arizona
Component:	Optical Sciences Center
Address:	Tucson, AZ 85721
Notes:	Author in 1992 SPIE meeting of "Measured Performance of the Hughes 256X256 Hybrid PtSi Imaging Device"

Contact Name:	R.E. Peterson
Position:	Vice President
Organization:	Honeywell, Inc.
Component:	Systems & Research Center
Address:	3660 Technology Dr. Minneapolis, MN 55418
Notes:	Development of electro-optical materials and sensors mainly for military; developing commercial opportunities.

Contact Name:	Thomas Petry
Position:	CEO
Organization:	Eagle-Picher Industries, Inc.
Component:	Eagle-Picher Research Laboratory
Address:	200 Ninth Ave., NE Miami OK 74354-3305
Notes:	Crystals for IR or UV detectors.

Contact Name:	Fletcher Phillips
Position:	President
Organization:	General Motors, Corporation
Component:	Santa Barbara Research Center
Address:	75 Coromar Dr. Goleta, CA 93117
Notes:	Manufacture of infrared photodetectors and associated components, packages and infrared focal plane arrays; electro-optical instrumentation for space; particularly multispectral earth observation sensors and weather sensors; specialized military equipment such as vehicle fire sensors and missle proximity fuses.

Contact Name:	F.R. Phillips
Position:	President
Organization:	Hughes
Component:	Santa Barbara Research Center
Address:	75 Coromar Drive Goleta, CA 93117
Notes:	Heavily involved in a broad array of US military programs using PtSi, HgCdTe, and InSb.

Contact Name:	Jim Phillips
Position:	Marketing Director
Organization:	SBRC
Component:	
Address:	75 Coromar Drive Goleta, CA 93117
Notes:	Their INFRARED PRODUCTS marketing director.

Contact Name:	J.A. Pickup
Position:	Sales Admin. Manager
Organization:	Oxley Developments Co., Ltd.
Component:	
Address:	Priory Park Ulverston Cumbria, UK LA12 9QG
Notes:	Detectors and sensors, infrared systems and equipment for military applications.

Contact Name:	Lars L. Pierce
Position:	
Organization:	University of Montana
Component:	School of Forestry
Address:	Missoula, MT 59812
Notes:	active in infrared remote sensing

Contact Name:	Michele Pimpinenelli
Position:	Marketing
Organization:	Officine Galileo
Component:	
Address:	V.A. Einstein 35 50013 Campi Bisenzio, Florence ITALY
Notes:	Night vision, thermal iamging, infrared systems & equipment for military applications.

Contact Name:	Joseph Plonski
Position:	V.P. Sales and Marketing
Organization:	Imagraph Corp.
Component:	
Address:	11 Elizabeth Drive Chelmsford, MA 01824
Notes:	Thermal imaging, primarily for military market.

Contact Name:	Maksymilian Pluta
Position:	
Organization:	Institute of Applied Optics
Component:	
Address:	ul. Kamionkowska 18 03-805 Warszawa, POLAND
Notes:	Will be editing the May 1994 edition of Optical Engineering, focusing on Semiconductor Infrared Detectors.

Contact Name:	Ruben Pochaczevsky
Position:	Dr.
Organization:	Albert Einstein College of Medecine
Component:	Dept of Radiology
Address:	1300 Morris Park Avenue New York, NY 10461
Notes:	Professor and doctor active in infrared biomedical thermography community

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Contact Name:	Leslie G. Polgar
Position:	Vice President
Organization:	Bertram Laboratories, Inc.
Component:	
Address:	72 Readington Road Somerville, NJ 08876
Notes:	Manufactures GaAs single and polycrystalline ingots and wafers. APplications for diode lasers, LED's, detectors, solar cells, source matkerl for liquid phase epitaxy, IR blanks and modulators.

Contact Name:	Fred H. Pollak
Position:	Dr.
Organization:	Brooklyn College
Component:	Semiconductor Institute
Address:	Brooklyn, NY
Notes:	Former director of the SPIE

Contact Name:	John Pomeroy
Position:	Pres
Organization:	Dover Corporation
Component:	Universal Instrument Corp.
Address:	PO Box 825 Binghamton, NY 13902
Notes:	Automation of electronics industry production.

Contact Name:	Gary Powell
Position:	Dreng
Organization:	Brunson Instrument Co, Inc
Component:	
Address:	800 E 23rd PO Box 7951 Kansas City, MO 64129
Notes:	Research, design, and development in the optical mechanical and electro-optical field, circular and linear developing.

Contact Name:	Mark Preis
Position:	
Organization:	Litton Electron Devices Division
Component:	
Address:	Tempe, AZ 85281
Notes:	Spent 22 years at SBRC, doing Lead Salts, InSb, IrSi, and MCT. At litton, doing Lead Salts for commercial applciatiosn, thinks will corner 3-5 micron range. Extensive contacts at SBRC, which he left in 1986.

Contact Name:	Nelson F. Principio
Position:	Manager of Business Development
Organization:	Eastman Kodak Co.
Component:	Government Systems Div.
Address:	1447 St. Paul Street Rochester, NY 14653
Notes:	IR Detectors work, mostly PtSi.

Contact Name:	Theodore Prophet
Position:	Gmgr
Organization:	Anacon Corp.
Component:	
Address:	117 S St. Hopkinton, MA 01748
Notes:	Applied research on refractometers; chlorine monitors; stack gas monitors; ultra-violet and infrared analyzers

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Contact Name:	N. Pundak
Position:	
Organization:	RICOR Ltd.
Component:	
Address:	En Haros (IHUD) 18960 Israel
Notes:	Authored for 1992 SPIE IRFPA workshop "Miniature Closed Cycle Cooler for FPA Detectors"

Contact Name:	Ernie Pusey
Position:	Mkt. Dir.
Organization:	Plessey Semiconductors Ltd.
Component:	
Address:	Unit 1, Crompton Road Groundwell Ind. Estate, Seindon, Wilts SN2 5AY UNITED KINGDOM
Notes:	Manufacture of a wide variety of HgCdTe-based infrared systems for military applications.

Contact Name:	Roger Putnam
Position:	Director of Marketing
Organization:	Aerodyne Research, Inc.
Component:	
Address:	45 Manning Rd. Billerica, MA 01821-3976
Notes:	Basic and applied product-oriented research in electro-optical and photo-optical systems, combustions, atmospheric, and environmental science; molecular physics; laser development; spectroscopy; product surface chemistry; optical signal processing; optical computing.

Contact Name:	Abdelrahman Rabie
Position:	
Organization:	SUNY College of Technology
Component:	
Address:	
Notes:	AUthored 1983 "The Use of Sensors in Part Handling" available from S.M.E.

Contact Name:	David Radford
Position:	Marketing Director
Organization:	Chemring, Ltd.
Component:	
Address:	Alchem Works Fratton Trading Estate Portsmouth, Hampshire, ENGLAND PO4 8SX
Notes:	Infrared Systems & Equipment, passive EO systems for military.

Contact Name:	D. Rajavel
Position:	
Organization:	Georgia Tech Research Institute
Component:	Physical Sciences Laboratory
Address:	225 North Avenue, NW Atlanta, GA 30332-0800
Notes:	Co-authored for 1991 MCT Workshop "Gas Source Iodine Doping and Characterization of MBE Grown CdTe"

Contact Name:	L.R. Ram-Mohan
Position:	
Organization:	MIT
Component:	Electronics Research Lab
Address:	77 Massachusetts Avenue Cambridge, MA 02139
Notes:	Co-authored January 1987 "Infrared Nonlinear Optics"

Contact Name:	L.R. Ram-Mohan
Position:	
Organization:	Worcester Polytechnic Institute
Component:	Department of Physics
Address:	Worcester, MA 01609
Notes:	Co-Authored "States Confined in the Barriers of Type-III HgTe/CdTe Superlattices" for 1992 MCT Workshop

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Contact Name:	A.C. Ramamurthy
Position:	
Organization:	BASF Corporation
Component:	Coatings Technical Center
Address:	26701 Telegraph Road Southfield, MI
Notes:	Designing IR inspeciton system to nondestructively inspect automotive paint for delaminations or rust

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Contact Name:	Tom Ramey
Position:	President
Organization:	Ramey Aerospace
Component:	
Address:	Box 39 Carmel, CA 93924
Notes:	Thermal Imaging, Infrared systems & equipment for military applications.

Contact Name:	Albert Rand
Position:	Pres
Organization:	Dynamics Research Corporation
Component:	
Address:	60 Concord St. Wilmington, MA 01887
Notes:	Design and fabrication of optical digital shaft angle encoders for aerospace and industrial applications.

Contact Name:	Roderick R. Randolph
Position:	Sales Manager
Organization:	Exotic Materials, Inc,
Component:	
Address:	2930 Bristol St. Costa Mesa, CA 92626
Notes:	Applied, product-oriented research as related to electro-optical materials, vacuum deposited coatings and devices for government, industrial and military systems applications.

Contact Name:	Vithal R. Rao
Position:	
Organization:	Rensselaer Polytechnic Institute
Component:	
Address:	JEC 6012 Troy, NY 12180
Notes:	Attended 1992 MCT meeting

Contact Name:	D. Rasmussen
Position:	Sales Manager
Organization:	Honeywell, Inc.
Component:	Solid State Sensors Group
Address:	830 E. Arapaho Road Richardson, TX 75081
Notes:	Manufactures IR optoelectronic components and assemblies, fiberoptic components, and modules.

Contact Name:	J.P. Rasquin
Position:	Directeur Departement de Defense
Organization:	Alcatel Bell-SDT S.A.
Component:	
Address:	101, rue Chapelle Beaussart 6032 Mont-Sur-Marchienne BELGIUM
Notes:	Infrared Systems and Equipment for military

Contact Name:	N.M. Ravindra
Position:	
Organization:	New Jersey Institute of Technology
Component:	
Address:	Newark, NJ 07102
Notes:	Authored for 1992 SPIE meeting on IRFPAs "HgCdTe Photovoltaic Detectors and Some Related Aspects"

Contact Name:	Rikki Razdan
Position:	Marketing Manager
Organization:	Iscan, Inc.
Component:	
Address:	125 Cambridgepark Drive Cambridge, MA 02140
Notes:	Infrared systems and equipment, e/o systems for military applications.

Contact Name:	Manijeh Razeghi
Position:	Dr.
Organization:	Northwestern University
Component:	
Address:	
Notes:	Presented at December 1992 DARPA IRFPA Technology Program Reviews on "Physics and Performance of GaInP/GaAs Quantum Wells and New Infrared III-V Compound InTiSb

Contact Name:	CZ Razi
Position:	Pres Dr CZ
Organization:	Litton Industries, Inc.
Component:	Integrated Automation Division
Address:	1301 Harbor Bay Pkwy Alameda, CA 94501
Notes:	Systems use advanced sensor techniques including vision, ultraviolet, infrared, and x-ray.

Contact Name:	JB Reagan
Position:	General Manager
Organization:	Lockheed Corporation
Component:	Lockheed Palo Alto Research Laboratories
Address:	3251 Hanover St., Orgn 90-01 Palo Alto, CA 94304
Notes:	Research and development of electro-optic systems, including HgCdTe under DARPA's Electronic Sciences program.

Contact Name:	Herman Reedy
Position:	Chief Engineer
Organization:	II-VI Inc.
Component:	
Address:	375 Saxonburg Blvd Saxonburg, PA 16056
Notes:	Manufacture of CdTe, GaAs, germanium, silicon, ZnS, ZnSe for infrared applications.

Contact Name:	Dr Leon Reibman
Position:	CEO
Organization:	American Electronic Laboratories, Inc.
Component:	
Address:	305 Richardson Rd., PO Box 552 Landsdale, PA 19446
Notes:	Diversivied R&D and manufacturing organization specializing in state-of-the-art equipment for military and industrial applications, electronic warfare and electronic warfare support measure systems, radar and fire control, antennas, supplies, technical service, system engineering services and manufacturing services.

Contact Name:	Kevin Reily
Position:	V.P. of IR Detector Group
Organization:	SBRC
Component:	
Address:	75 Coromar Drive Goleta, CA 93117
Notes:	

Contact Name:	M.B. Reine
Position:	
Organization:	Loral Corporation
Component:	Loral Infrared & Imaging Systems, Inc.
Address:	2 Forbes Rd. Lexington, MA 02173
Notes:	Leading figure in their producibility efforts, has represented LIIS at IRMP consortium.

Contact Name:	Paul Reising
Position:	
Organization:	Geonex Verde Technologies
Component:	
Address:	734 E. Lake Avenue Watsonville, CA 95076
Notes:	Active in infrared remote sensing as a consulting firm.

Contact Name:	J. Ren
Position:	
Organization:	North Carolina State University
Component:	Department of Physics
Address:	Raleigh, NC 27695-8202
Notes:	AUthored "Integrated Heterostructure Devices Based on II-VI Compound Semiconductors"

Contact Name:	Frank Renda
Position:	
Organization:	SBRC
Component:	
Address:	75 Coromar Drive Goleta, CA 93117
Notes:	

Contact Name:	Richard A. Reynolds
Position:	Dr.
Organization:	Hughes Research Laboratories
Component:	
Address:	3011 Malibu Canyon Road Malibu, CA 90265
Notes:	Former DARPA program officer who contributed extensively to II-VI semiconductor development while at the Defense Sciences office.

Contact Name:	Herbert Richardson
Position:	Dir
Organization:	Texas Engineering Experiment Station
Component:	
Address:	301 Wisenbaker Engineering Research Center, Texas A&M University, College Station, TX 77843-3126
Notes:	Research into all areas of engineering, including introduction of emerging technologies.

Contact Name:	H.J. Richter
Position:	
Organization:	Fraunhofer-Institut fur Angewandte Festkorperphysik
Component:	
Address:	D-7800 Freiburg, GERMANY
Notes:	Authored "XPD Investigation of Substrate Crystallinity at HgCdTe (111B) and CdTe(111)B Surfaces Upon Ag and Al Overlayer Formation."

Contact Name:	Max Riedl
Position:	CEO
Organization:	Contraves USA
Component:	Boston Electro Optic Division
Address:	170 Locke Dr. Marlborough, MA 01752
Notes:	Applied researach on electrical-optical systems, instruments and components utilizing infrared, visible and ultraviolet spectrums, including infrared detectors, optical elements, and optical interference and coatings filters, radiation sources, radiometers, combustion analyzers, navigation instruments for satellites and spacecraft and sensors for meteorological satellites; chemical and drug detection, instrumentation, target and scene simulation, models, gas detection, measurement insstrumentation.

Contact Name:	George A. Riggs
Position:	
Organization:	University of Montana
Component:	School of Forestry
Address:	Missoula, MT 59812
Notes:	active in infrared remote sensing

Contact Name:	Edward R.J. Ring
Position:	Dr.
Organization:	Royal National Hospital for Rheumatic Diseases
Component:	Dept of Clinical Measurement
Address:	Upper Borough Walls, Bath UNITED KINGDOM
Notes:	Active in infrared biomedical thermography, has written extensively on the widespread applications of IR thermography.

Contact Name:	Sherman Rinkel
Position:	Pres
Organization:	General Microwave Corp.
Component:	
Address:	5500 New Horizon Blvd Amityville, NY, 11701
Notes:	Applied sensor technology for industrial and automative applications.

Contact Name:	Dr. Malcom Roberts
Position:	Dirres
Organization:	Bethlehem Steel Corporation
Component:	Homer Research Laboratories
Address:	701 East Third Street Bethlehem, PA 18016-7699
Notes:	Investigation on new methods of measurement and instrumentation used in the control of steel processes and product quality. Thermal analysis of fatigue and fracture of steel.

Contact Name:	Elisanda Roca
Position:	
Organization:	Universitat de Barcelona
Component:	
Address:	Avd. Diagonal 647 E-08028 Barcelona, SPAIN
Notes:	Co-author at 1992 SPIE IRFPA meeting of "Comparative Study of SWIR and MWIR Schottky-barrier Imagers"

Contact Name:	Tom Rockwell
Position:	CEO
Organization:	Rockwell Engineering Co., Inc.
Component:	
Address:	2121 E. 45th St Indianapolis, IN, 46205
Notes:	Optical radiation research.

Contact Name:	Bill Rogatto
Position:	VP for FPA Development and Producibility
Organization:	SBRC
Component:	
Address:	75 Coromar Drive Goleta, CA 93117
Notes:	

Contact Name:	Michael Roitberg
Position:	
Organization:	Atomergic Chemetals Corporation
Component:	
Address:	222 Sherwood Avenue Farmingdale, NY 11735
Notes:	Material processing of CdTe, GaAs, Germanium, Silicon, ZnS, and ZnSe.

Contact Name:	Brett Rosner
Position:	Senior Engineer
Organization:	Santa Barbara Focalplane
Component:	
Address:	69 Santa Felicia Drive Goleta, CA 93117
Notes:	One of first firms marketing cameras based on focal plane arrays, InSb based.

Contact Name:	Richard Ross
Position:	CEO
Organization:	Diagnostic Retrieval Systems, Inc.
Component:	Photronics Corporation
Address:	270 Motor Pkwy. Hauppauge, NY 11788
Notes:	Develop and manufacture optical laser ultraviolet detection components, missile optical component and specialized coating, mostly for military applications.

Contact Name:	D.V. Rossi
Position:	
Organization:	Columbia University
Component:	
Address:	New York, NY
Notes:	Co-authored for 1990 SPIE workshop on IR Detectors "GaAs CCD Readout for Engineered Bandgap Detectors"

Contact Name:	Ralph Rotolante
Position:	
Organization:	Vicon Infrared
Component:	
Address:	Four Seneca Court Acton, MA 01720
Notes:	Former founder and president of the now defunct New England Research Center. Private consultant

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Contact Name:	Cathy Rude
Position:	Marketing Communications
Organization:	Alliant Techsystems
Component:	
Address:	5901 Lincoln Drive Edina, MN 55436
Notes:	Thermal Imaging, Night vision, detectors and sensors for military

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Contact Name:	Brian Rushton
Position:	VP R&D
Organization:	Air Products and Chemicals, Inc.
Component:	Gas Group
Address:	7201 Hamilton Blvd Allentown, PA 18195-1501
Notes:	Applications R&D for infrared spectroscopy.

Contact Name:	R.P. Ruth
Position:	
Organization:	SBRC
Component:	
Address:	75 Coromar Drive Goleta, CA 93117
Notes:	Research scientist doing their MCT IRFPA projects

Contact Name:	A. Ruzin
Position:	
Organization:	Kidron Microelectronics Research Center
Component:	Department of Electrical Engineering
Address:	Technion-Israel Institute of Technology Haifa 32000, ISRAEL
Notes:	"UV Photon Assisted Control of Interface Charge Between CdTe Substrates and Metal Organic Chemical Vapor Deposition CdTe Epilayers" for 1992 MCT Workshop.

Contact Name:	Morteza Safai
Position:	
Organization:	The Boeing Company
Component:	Boeing Defense and Space Group
Address:	Quality Assurance Research and Development P.O. Box 399, MS 85-08 Seattle, WA 98124-2499
Notes:	infrared non-destructive evaluation

Contact Name:	MS Sandhu
Position:	Pres
Organization:	SRS Technology
Component:	
Address:	Suite 402 3501 Jamboree Newport Beach, CA 92660
Notes:	Development of smart sensors, conformal-array antennas, image processing, field measurements, and process control systems.

Contact Name:	Ginette Sarrazin
Position:	Service Publicite
Organization:	Societe de Frabrication d'Instruments de Mesure
Component:	
Address:	13 avenue Ramolfo Garnier F91344 Massy Dedex FRANCE
Notes:	Thermal imaging, night vision equipment for European military market.

Contact Name:	T. Sasaki
Position:	
Organization:	NEC Corporation
Component:	
Address:	4-1-1 Miyazaki Miyamae, Kawasaki, 216 JAPAN
Notes:	Co-authored for 1991 MCT Workshop "Study of CdTe Epitaxial Growthn on (211)B GaAs by MBE"

Contact Name:	Thomas Scanlon
Position:	
Organization:	Inframetrics, Inc.
Component:	
Address:	16 Esquire Road North Billerica, MA 01862
Notes:	Active in setting up infrared predictive maintenance regimes for Inframetric's customers.

Contact Name:	S.E. Schacham
Position:	
Organization:	Kidron Microelectronics Research Center
Component:	Department of Electrical Engineering
Address:	Technion-Israel Institute of Technology Haifa 32000, ISRAEL
Notes:	For 1991 MCT Workshop Co-authored "Covered Electrode HgCdTe Photoconductor Under High Illumination Levels" and for 1992 SPIE meeting on MCT "P-Channel MIS Double-Metal Process InSb Monolithic Unit Cell for Infrared Imaging"

Contact Name:	Dr Eugene Scheide
Position:	Pres
Organization:	Environmetrics, Inc.
Component:	
Address:	2345 Millpark Dr. Maryland Heights, MO, 63043
Notes:	Development of "smart sensors," chemical sensors, development of gas sensing instruments

Contact Name:	J.F. Schetzina
Position:	
Organization:	North Carolina State University
Component:	Department of Physics
Address:	Raleigh, NC 27695-8202
Notes:	On Program Committe of 1991 & 1992 MCT Workshop, and Authored for 92 MCT workshop "Growth of HgSe and HgCdSe Thin Films by Molecular Beam Epitaxy," and "Integrated Heterostructure Devices Based on II-Vi Compound Semiconductors." For 1991 Workshop, co-authored "Properties of CdZnTe Crystals Grown by a High Pressure Bridgman Method" and "Quantum Hall Effect and Setback Modulation DOping HgTe-CdTe Heterostructures"

Contact Name:	J.T. Schick
Position:	
Organization:	Wayne State University
Component:	Department of Physics and Astronomy
Address:	Detroit, MI
Notes:	Co-authored 1990 article, 6 pages, "Structural Energies of Defects in CdTe and HgCdTe" And co-authored April 1990 "Point Defects in Lattice Distortion in CdTe and HgCdTe"

Contact Name:	J. Schieferdecker
Position:	
Organization:	Dresden University of Technology
Component:	Institut fur Festkorperelektronik
Address:	Dresden, FEDERAL REPUBLIC OF GERMANY
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Pyroelectric Linear Array IR Detectors with CCD Multiplexer"

Contact Name:	Frederick Schmid
Position:	CEO
Organization:	Crystal Systems Inc.
Component:	
Address:	Shetland Industrial Park 27 Congress St. Salem, MA 01970
Notes:	Growth of semiconductors using such materials as GaAs and CdTe, and use of silicon in infrared applications in both commercial and military markets.

Contact Name:	Frederick Schmid
Position:	CEO
Organization:	Crystal Systems Inc.
Component:	
Address:	Shetland Industrial Park 27 Congress St. Salem, MA 01970
Notes:	Growth of semiconductors using such materials as GaAs and CdTe, and use of silicon in infrared applications. Work for both military and commercial markets.

Contact Name:	Michael Schneider
Position:	
Organization:	Research Devices, Inc.
Component:	
Address:	121 Ethel Road West Piscataway, NJ 08854
Notes:	AUthored for 1992 SPIE Workshop on MCT "Hybridizing Focal Plane Arrays."

Contact Name:	Marija S. Scholl
Position:	
Organization:	California Institute of Technology
Component:	Jet Propulsion Laboratory
Address:	4800 Oak Grove Drive Pasadena, CA 91009-8099
Notes:	Editor of upcoming January 1994 edition of the SPIE's Optical Engineering journal, focusing on infrared technology.

Contact Name:	James R. Schott
Position:	
Organization:	Worchester Institute of Technology
Component:	Center for Imaging Science
Address:	One Lomb Memorial Drive Rochester, NY 14623
Notes:	active in infrared remote sensing

Contact Name:	L.J. Schowalter
Position:	
Organization:	Renssalaer Polytechnic Institute
Component:	Physics Department and Center for Integrated Electronics
Address:	110 Eight Street Troy, NY 12180
Notes:	Co-authored for 1992 meeting of SPIE on IRFPAs "Fundamental Studies of Schottky Barrier IR Detectors by Ballistic Electron Emission Microscopy"

Contact Name:	Frank Schrontz
Position:	CEO
Organization:	The Boeing Company
Component:	
Address:	7755 E Marginal Way S, PO Box 3707 Seattle, WA 98124
Notes:	Research in the field of aerospace including sensor systems.

Contact Name:	Mangred Schuck
Position:	Senior Manager
Organization:	Rodenstock Industrial Optics
Component:	
Address:	P.O. Box 14 04 40 Jsartalstrasse 43 D-8000 Munich 5, GERMANY
Notes:	Infrared systems & equipment, e/o systems, thermal imaging for military applications.

Contact Name:	Carl Schueler
Position:	Manager, Advanced Development Programs
Organization:	SBRC
Component:	
Address:	75 Coromar Drive Goleta, CA 93117
Notes:	

Contact Name:	M.J. Schulz
Position:	
Organization:	University of Erlangen
Component:	
Address:	Erlangen, GERMANY
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Electronic and Optical Properties of SIlicide/ SIlicon IR Detectprs"

Contact Name:	Norman Schumaker
Position:	CEO
Organization:	Emcore Corp.
Component:	
Address:	35 Elizabeth Avenue Somerset, NJ 08873
Notes:	Material production of GaAs, CdTe, silicon, ZnS, and ZnSe for infrared applications.

Contact Name:	WC Schwartz
Position:	President
Organization:	Schwartz Electro-Optics
Component:	
Address:	3404 N Orange Blossom Trail Orlando, FL 32804
Notes:	Manufactures near and mid-IR solid-state lasers for research, medical, industrial, and OEM applications. Knowledgeable in photofluoresence in IR, using IR detectors.

Contact Name:	Edward Scicchitano
Position:	CEO
Organization:	DTX Corporation
Component:	Dynatherm Corporation
Address:	One Beaver Ct. Cockeysville, MD 21030
Notes:	Thermal systems research oriented toward industrial process temperature control.

Contact Name:	M Seelmann-Eggebert
Position:	
Organization:	Fraunhofer-Institut fur Angewandte Festkorperphysik
Component:	
Address:	D-7800 Freiburg, GERMANY
Notes:	Authored "XPD Investigation of Substrate Crystallinity at HgCdTe (111B) and CdTe(111)B Surfaces Upon Ag and Al Overlayer Formation." For 1991 Workshop "Photoemission Spectrscopic Techniques to Assess Physical and Chemical Properties of Mercury Cadmium Telluride"

Contact Name:	Milton Seiler
Position:	
Organization:	Battelle Memorial Institute
Component:	
Address:	505 King Avenue Columbus, OH 43201-2693
Notes:	Designs infrared non-destructive evaluation applications.

Contact Name:	D.G. Seiler
Position:	
Organization:	National Institute of Standards and Technology
Component:	Semiconductor Electronics Division
Address:	Gaithursburg, MD 20899
Notes:	On Program Committee, and Co-Authored "Heavily Accumulated Surfaces of MCT Detectors: Theory and Experiment" for 1992 MCT Workshop. Co-Authored for 1991 Workshop "Investigation of Merury Interstitials in MCT alloys Using Resonant Impact-Ionization Spectroscopy"

Contact Name:	Sharon A. Semanovich
Position:	Ms.
Organization:	Allen Infrared Associates
Component:	
Address:	RR #1, Box 239K Coward, SC 29530
Notes:	Assistant to Allen, active in design of infrared predictive maintenance regimes

Contact Name:	Martin Sensiper
Position:	
Organization:	University of Central Florida
Component:	Electrical Engineering Department and Center for Research in Electro-Optics and Lasers
Address:	12424 Research Parkway, Suite 400 Orlando, FL 32828
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Use of Narrowband Laser Speckle for MTF Characterization of CCDs"

Contact Name:	Becky Setzler
Position:	Media Relations Program Manager
Organization:	Texas Instruments
Component:	
Address:	P.O. Box 660246 MS 3134 Dallas, TX 75266-0246
Notes:	INfrared systems & equipment, thermal imaging, detectors & sensors

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Contact Name:	Keith Seybald
Position:	Melec
Organization:	Angstrom Technologies, Inc.
Component:	
Address:	PO Box 607 Florence, KY 41042
Notes:	Basic and applied electro-optical vision for robotics and automated guided vehicles; applied and product-oriented research in packaging and material handling vision systems.

Contact Name:	Y. Shacham-Diamand
Position:	
Organization:	Cornell University
Component:	School of Electrical Engineering and the National Nanofabrication Facility
Address:	Ithaca, NY 14853
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "P-Channel MIS Double-Metal Process InSb Monolithic Unit Cell for Infrared Imaging"

Contact Name:	R.R. Shannon
Position:	
Organization:	Arizona University
Component:	Optical Sciences Center
Address:	Tucson, AZ
Notes:	Authored March 1990 "Research in the Optical Sciences" which reviews the progress of their optical sciences center, including growth of semiconductors through LPE and VPE. Some MCT and CZT research

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Contact Name:	Richard Shaps
Position:	Dvmgr
Organization:	Bio-Rad Laboratories
Component:	Digilab Division
Address:	237 Putnam Avenue Cambridge, MA 02139
Notes:	Manufactures fourier transform IR spectrometers.

Contact Name:	Dick Sharmam
Position:	General Manager
Organization:	Exotic Materials, Inc,
Component:	
Address:	2930 Bristol St. Costa Mesa, CA 92626
Notes:	Applied, product-oriented research as related to electro-optical materials, vacuum deposited coatings and devices for government, industrial and military systems applications.

Contact Name:	M.C. Shaw
Position:	
Organization:	Arizona State University
Component:	
Address:	Tempe, AZ 85287-5506
Notes:	Co-authored 1983 "Application of Infrared Radiation Measurements in Grinding Studies." MCT-based materials research

Contact Name:	Dr Manny Shaw
Position:	Pres
Organization:	Interscan Corporation
Component:	
Address:	21700 Nordhoff St. PO Box 2496 Chatworth, CA 91313-2496
Notes:	Gas analyzer and sensor developments.

Contact Name:	Diane R. Sheerar
Position:	Manager Marketing Services
Organization:	Brunswick Technical Group
Component:	
Address:	1 Brunswick Plaza Skokie, IL 60077
Notes:	Infrared Systems and Equipment predominantly for military markets

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Contact Name:	A. Sher
Position:	
Organization:	SRI International
Component:	
Address:	Menlo Park, CA 94025
Notes:	On Progam Committee, and Co-Authored "Native Defect Equilibria in HgZnTe and HgCdTe Alloys" for 1992 MCT Workshop. On 1991 MCT Workshop Progam Committee; co-authored "Defect Equilibrium in HgTe"

Contact Name:	K. Shigenaka
Position:	
Organization:	Toshiba Corporation
Component:	Research and Development Center
Address:	Komukai Works Kawasaki, Japan
Notes:	Co-authored for 1992 MCT Workshop "Effects of Growth Rate and Mercury Partial Pressure on Twin Formation in HgCdTe (111) Layers Grown by MOCVD"

Contact Name:	Lee Shiozawa
Position:	
Organization:	Cleveland Crystals, Inc.
Component:	
Address:	19306 Redwood Avenue, P.O Box 17157 Cleveland, OH 44117
Notes:	Manufacturer and research into CdTe, ZnS, and ZnSe infrared materials, specialty in II-VI, for both military and commercial markets.

Contact Name:	Michael Shur
Position:	
Organization:	Virginia University
Component:	Department of Electrical Engineering
Address:	Charlottesville, VA
Notes:	Co-authored May 1992 report "Monte Carlo SImulation of Elecron Transport in HgCdTe"

Contact Name:	Dr Joseph Siewick
Position:	CEO
Organization:	Science & Engineering Consultants, Inc.
Component:	
Address:	Suite 300, 1820 discovery St. Reston, VA 22090-5610
Notes:	Research in imaging and remote sensing.

Contact Name:	Orman Simpson
Position:	Pres
Organization:	MDA Scientific, Inc.
Component:	
Address:	Suite 185, 3000 Northwoods Pkwy Norcross, GA 30071
Notes:	Optical remote sensing techniques.

Contact Name:	J. Singh
Position:	
Organization:	University of Michigan
Component:	Department of Electrical Engineering and Computer Science
Address:	Ann Arbor, MI 48109
Notes:	Co-Authored "Recent Advances on HgCdTe Mid Infrared Diode Lasers" for 1992 MCT Workshop.

Contact Name:	Nicholas Sink
Position:	Gen. Mgr.
Organization:	Semiconductor Processing Co., Inc.
Component:	
Address:	409 East First Street Boston, MA 02127
Notes:	Manufacturer of GaAs, germanium, and silicon for infrared applications.

Contact Name:	S. Sivananthan
Position:	
Organization:	University of Illinois at Chicago
Component:	Microphysics Laboratory, Physics Department
Address:	P.O. Box 4348 Chicago, IL 60680
Notes:	Authored "Structure of CdTe(111)B grown by MBE on Misoriented Si(001)" and "Influence of CdZnTe(211)B Substrate on Electrical Properties of HgCdTe Grown by MBE" for 1992 MCT Workshop. For 1991 Workshop, "Current Status of Directo Growth of CdTe and HgCdTe on Silicon by MBE"

Contact Name:	R. Sizmann
Position:	
Organization:	Technische Universtat
Component:	Phsik-Department E-16
Address:	mUNCHEN, d-8046 GERMANY
Notes:	Co-authored for 1991 MCT Workshop "Influece of Resonant Defect States on Subband Structures in HgCdTe"

Contact Name:	John Skurla
Position:	Sales Manager
Organization:	EG&G Reticon Corp.
Component:	
Address:	345 Potrero Avenue Sunnyvale, CA 94086-4197
Notes:	Manufactures photodiode semiconductor detectors, detector arrays, CCPD image sensors, solid-state and line scan and area scan, and circular cameras

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Contact Name:	Joseph Slawek
Position:	Gmgr
Organization:	EG&G, Inc.
Component:	EG&G Judson
Address:	221 Commerce Dr. Montgomeryville, PA 18936
Notes:	Application of infrared materials including germanium and mercury cadmium telluride.

Contact Name:	Jon Slaybaugh
Position:	Gmgr
Organization:	Acme-Ceveland Corporation
Component:	Namco Controls Division
Address:	7567 Tyler Blvd. Mentor, OH 44060
Notes:	Product oriented R&D of electronic measurement and control devices including photoelectric sensors, laser guidance, identification and tracking devices.

Contact Name:	Lee Slizewski
Position:	
Organization:	American Risk Management Corp.
Component:	
Address:	P.O. Box 1042 West Brookfirld, MA 01585-1042
Notes:	Design infrared predictive maintenance regimes for factories, esp. nuclear power plants

Contact Name:	Mitchell R. Smigield
Position:	Dr.
Organization:	Scott-White Clinic
Component:	
Address:	Temple, TX 76501
Notes:	Active in infrared biomedical thermography research.

Contact Name:	Philip Smith
Position:	President
Organization:	Agema Infrared Systems
Component:	
Address:	550 County Avenue. Secaucus, N.J. 07094
Notes:	Manufactures infrared thermal imaging systems for condition monitoring, process monitoring and control, military/ defense research, surveillance and the nondestructive meeasurement and analysis of materials and components.

Contact Name:	Phillip A. Smith
Position:	National Sales Manager
Organization:	Amber Engineering
Component:	
Address:	5756 Stonewood Drive Goleta, CA 93117
Notes:	Participant in DARPA's IRFPA team and producer of InSb used in medium-wave infrared systems. Designs systems for both commercial and military markets. Amber's speciality is emissivity correction.

Contact Name:	L.M. Smith
Position:	
Organization:	GEC Hirst Research Centre
Component:	
Address:	Wembley, UNITED KINGDOM
Notes:	Co-authored May 1990 report "Integrated Technology in MCT/GaAs and MCT/Si for Medium and Long Wavelength Infrared"

Contact Name:	Carol Smith
Position:	Ms.
Organization:	Wahl Instruments, Inc.
Component:	
Address:	5750 Hunnum Ave., Culver City, CA 90231
Notes:	Production of non-contact IR thermometers for industrial processes.

Contact Name:	John R. Snell
Position:	
Organization:	John Snell & Associates
Component:	
Address:	17 First Avenue Montpelier, VT 05602
Notes:	Active in infrared predictive maintenance as inspector of plants and factories. Widely published author on predictive maintenance.

Contact Name:	Ed Snow
Position:	GrEx
Organization:	EG&G, Inc.
Component:	EG&G Optoelectronics
Address:	22001 Dumberry Vaudervil, PQ J7V 8P7
Notes:	R&D of optical emitters and detectors.

Contact Name:	Thomas Soderman
Position:	Pres
Organization:	Bath Electrical Systems
Component:	
Address:	5009 N Hwy 288 B, PO Box 198 Clute, TX 77531
Notes:	Design and development of systems for infrared scanning for energy losses problems.

Contact Name:	R Sommer
Position:	Pres
Organization:	IR Scientific Inc
Component:	
Address:	PO Box 110 Carlisle, MA 01741
Notes:	Product-oriented near infrared research and development manufacturing and infrared consulting services.

Contact Name:	J.L. Song
Position:	
Organization:	Columbia University
Component:	
Address:	New York, NY
Notes:	Co-authored for 1990 SPIE workshop on IR Detectors "GaAs CCD Readout for Engineered Bandgap Detectors"

Contact Name:	X.N. Song
Position:	
Organization:	University of Nort Texas
Component:	Department of Physics
Address:	Denton, TX 76203
Notes:	Co-Authored "Heavily Accumulated Surfaces of MCT Detectors: Theory and Experiment" for 1992 MCT Workshop. For 1991 Workshop, "Investigation of Mercury Interstititals in MCT alloys Using Resonant Impact-Ionization Spectroscopy"

Contact Name:	James Sorenson
Position:	General Manager
Organization:	Batelle Memorial Institute
Component:	Electronic Systems
Address:	505 King Ave. Columbus, OH 43201
Notes:	Advanced development and integration of complex electronic and optical systems; development of large laser materials for interaction studies; automated inspection systems and optical systems for tracking reentry vehicles.

Contact Name:	Robert A. Spangler
Position:	Dr.
Organization:	State University of NY at Buffalo
Component:	Dept of Biophysiacl Sciences
Address:	120 Cary Hall Buffalo, NY 14214
Notes:	Active in infrared biomedical thermography, helped develop multi-wavelength camera which measures temperature independent of emissivity.

Contact Name:	Robert Spangler
Position:	Professor
Organization:	SUNY Buffalo
Component:	Department of Biological Sciences
Address:	120 Cary Hall Buffalo, NY 14214
Notes:	An MD, with research interests in the application of classical and nonequilibrium thermodynamics in biological systems, membrane processes, stability properties, etc. as well as the development of novel medical diagnostic techniques. Advised Hejazi on OE article, Nov. 92, on IR detection of skin temperatures. Extremely knowledgeable on IR detectors biomedical. Interviewed 11-20-92.

Contact Name:	John Spelman
Position:	Pres
Organization:	Environmental Technology Group, Inc.
Component:	
Address:	1400 Taylor Ave., PO Box 9840 Baltimore, MD 21284-9840
Notes:	Applied research in microsensor systems for chemicals, design and development of environmental, meteorological, biological and chemical sensors, detectors for explosives, hazardous drugs and chemical warfare agents.

Contact Name:	Jane Spicer
Position:	Ms.
Organization:	Johns Hopkins University
Component:	Center for NDE and Applied Physics Laboratory
Address:	Laurel, MD 20723
Notes:	Infrared non-destructive evaluation specialist at leading center.

Contact Name:	R. Sporken
Position:	
Organization:	University of Illinois at Chicago
Component:	Microphysics Laboratory, Physics Department
Address:	P.O. Box 4348 Chicago, IL 60680
Notes:	For 1991 Workshop, "Current Status of Direct Growth of CdTe and HgCdTe on Silicon by MBE"

Contact Name:	Robert W. Spring
Position:	
Organization:	John Snell & Associates
Component:	
Address:	17 First Avenue Montpelier, VT 05602
Notes:	Active in infrared predictive maintenance as large New England consulting firm.

Contact Name:	K.K. Sreenivasan
Position:	
Organization:	Southern Methodist University
Component:	
Address:	
Notes:	Co-authored for 1992 SPIE meeting on Machine Vision "Automated Vision System for INspection of Wedge Bonds"

Contact Name:	M.D. Srinath
Position:	
Organization:	Southern Methodist University
Component:	
Address:	
Notes:	Co-authored for 1992 SPIE meeting on Machine Vision "Automated Vision System for INspection of Wedge Bonds"

Contact Name:	Charles G Stanich
Position:	Vice President
Organization:	Daedalus Enterprises, Inc.
Component:	
Address:	300 Parkland Plaza, PO Box 1869 Ann Arbor, MI 48106
Notes:	Infrared and multispectral analysis systems for remote sensing.

Contact Name:	Michael Stanton-Hicks
Position:	Dr.
Organization:	Cleveland Clinic Foundation
Component:	Pain Management Center, M-60
Address:	9500 Euclid Avenue Cleveland, OH 44195-5001
Notes:	User and innovator of infrared biomedical thermography

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Contact Name:	Charles Staples
Position:	Pres .
Organization:	Thorton Associates Inc
Component:	
Address:	1432 Main St. Waltham, MA 02154
Notes:	Production of electronic control devices.

Contact Name:	Herman Statz
Position:	General Manager
Organization:	Raytheon Comp.
Component:	Research Division
Address:	131 Spring St. Lexington, MA 02173
Notes:	Infrared window and detection materials and components, radar window materials, laser and electro-optics. Growth of CdTe on GAs/Si and Si substrates for HgCdTe.

Contact Name:	Bob Stauder
Position:	VP
Organization:	LaBarge Inc.
Component:	LaBarge Electronics
Address:	11616 E 51st St. Tulsa, OK 74146
Notes:	Intrusion detection systems and components, telemetry systems and components and other cletromechanical systems and components for airborne and space applications; atmospheric, weather and data measuring systems and components.

Contact Name:	Donald Sting
Position:	CEO
Organization:	Nicolet Instrument Corporation
Component:	Spectra Tech Inc.
Address:	652 Glenbrook Rd, PO Box 2190-G Stamford, CT 06906
Notes:	Infrared spectroscopy instruments and applications.

Contact Name:	Charles Stokes
Position:	Dir
Organization:	Arvin Industries, Inc
Component:	Franklin Research Center
Address:	2600 Monroe Blvd. Norristown, PA 19403
Notes:	Applied research, design, and development in electronic and electrical engineering, including electro-optics.

Contact Name:	JM Stone
Position:	Pres
Organization:	Dukane Corporation
Component:	Microbiotics Division
Address:	2900 Dukane Dr. Saint Charles, IL 60174
Notes:	Precision automated alignment and laser welding systems used to manufacture optoelectronic devices.

Contact Name:	Harry Stonecipher
Position:	Pres
Organization:	Sunstrand Corp.
Component:	Analytical Productions Division
Address:	820 Linden Ave. Rochester, NY 14625
Notes:	Image analysis equipment systems and color spectrometry.

Contact Name:	Arthur Stout
Position:	National Sales Manager
Organization:	Agema IR Systems
Component:	
Address:	550 County Avenue Secaucus, NJ 07094
Notes:	

Contact Name:	Arthur Stout
Position:	Marketing
Organization:	Inframetrics, Inc.
Component:	
Address:	16 Esquire Road Billerica, MA 01862
Notes:	Active in infrared remote sensing, predictive maintenance, nondestructive evaluation markets for Inframetrics.

Contact Name:	Terry Straetten
Position:	Vice President
Organization:	General Dynamics Corporation
Component:	Electronics Division
Address:	5011 Kearny Villa Rd. San Diego, CA 92123-1447
Notes:	Product oriented research in automatic test equipment and electronics, communications, electronic warfare, signal processing, and displays and imagery, lasers. For military markets.

Contact Name:	Dr Terry Straetten
Position:	VP
Organization:	General Dynamics Corporation
Component:	Electronics Division
Address:	5011 Kearny Villa Rd. San Diego, CA 92123-1447
Notes:	Product oriented research in automatic test equipment and electronics, communications, electronic warfare, signal processing, and displays and imagery, lasers for military markets.

Contact Name:	Robert Stratton
Position:	VP
Organization:	Texas Instruments Inc
Component:	Central Research Laboratories
Address:	PO Box 655936, MS 136 Dallas, TX 75265
Notes:	Production of HgCdTe-based infrared imagers.

Contact Name:	Joe Straub
Position:	Manager, Signal Processing Systems
Organization:	Pacer Systems, Inc.
Component:	
Address:	900 Technology Park Drive Billerica, MA 01803
Notes:	Infrared systems & equipment for military applications.

Contact Name:	Reggie Stroupe
Position:	Pres
Organization:	Andersen Instruments, Inc.
Component:	Nutech Corporation
Address:	2806 Cheek Rd Durham, NC 27704
Notes:	Applied and product-oriented research in the areas of air pollution sampling, filter systems, electronic sensors and controls, temperature control, chromatography, and laboratory research instruments, medical electronics and mass spectrometry.

Contact Name:	Gary Stutte
Position:	
Organization:	University of Maryland
Component:	Maryland Agricultural Experiment Station
Address:	College Park, MD 20742
Notes:	active in infrared remote sensing

Contact Name:	Miles Suer
Position:	Director of Marketing
Organization:	Irvine Sensors Corp.
Component:	
Address:	3001 Redhill Ave Bldg 3 Costa Mesa, CA 92626
Notes:	Applied research in military detection system (infrared sensing).

Contact Name:	C.J. Summers
Position:	
Organization:	Georgia Institute of Technology
Component:	
Address:	
Notes:	On Program Committee of 1991 & 1992 MCT Workshop For 1991 Workshop, "Selected-area Epitaxy on CdTe," and "Gas Source IOdine Doping and Characterization of MBE Grown CdTe"

Contact Name:	Tai-Ping Sun
Position:	
Organization:	Chung-Shan Institute of Science and Technology
Component:	
Address:	P.O. Box 90008-8-7, Lung-tan, Tao-Yuan REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "A Novel CID Emulator for InSb Array"

Contact Name:	John Sun
Position:	VP
Organization:	ITI Electro-Optics Corp.
Component:	
Address:	11500 W Olympic Blvd Los Angeles, CA 90064
Notes:	Manufacture of CdTe, GaAs, germanium, ZnS, and ZnSe for infrared technologies.

Contact Name:	James Swanson
Position:	President
Organization:	Ramtek Corporation
Component:	
Address:	1525 Atteberry Lane San Jose, CA
Notes:	Remote sensing systems, multispectral system design, for both military and commercial markets.

Contact Name:	M.L. Swanson
Position:	
Organization:	University of North Carolina at Chapel Hill
Component:	Department of Physics and Astronomy
Address:	Chapel Hill, NC 27599-3255
Notes:	Co-Authored "Observation of Indium-Vacancy and Indium Hydrogen Interactions in (HgCd)Te Using PAC

Contact Name:	Ron Swarbrick
Position:	Marketing Director
Organization:	EG&G, Inc.
Component:	EG&G Optoelectronics
Address:	22001 Dumberry Vaudervil, PQ J7V 8P7 CANADA
Notes:	R&D of optical emitters and detectors.

Contact Name:	Tony Sweet
Position:	Marketing Director
Organization:	EG&G Reticon Corp.
Component:	
Address:	345 Potrero Avenue Sunnyvale, CA 94086-4197
Notes:	Manufactures photodiode semiconductor detectors, detector arrays, CCPD image sensors, solid-state and line scan and area scan and circular cameras

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Contact Name:	H. Takigawa
Position:	
Organization:	Fujitsu Laboratories, Ltd.
Component:	Atsugi Infrared Devices Laboratory
Address:	10-1 Morinosato-Wakamiya Atsugi 243-01 JAPAN
Notes:	Authored for 1992 MCT Workshop "Mercury Cadmium Telluride in Japan"

Contact Name:	E.M. Talund
Position:	Defece Sales
Organization:	Scandinavian Avionics
Component:	
Address:	Billund Airport P.O. Box 59 7190 Billund, DENMARK
Notes:	Infrared systems and equipment, thermal imaging, night vision for military applications.

Contact Name:	A. Tanabe
Position:	
Organization:	NEC Corporation
Component:	Microelectronics Research Laboratories
Address:	1120, Shimokuzawa, Kanagawa 229, JAPAN
Notes:	Co-authored for 1992 SPIE workshop on IRFPAs "Optimum Barrier Height in Schottky-Barrier Infrared CCD Image Sensor"

Contact Name:	JD Tarbet
Position:	VPeng
Organization:	Crane Co
Component:	Hydro-Aire Division
Address:	3000 Winona Ave. Burbank, CA 91504
Notes:	Infrared tracking for wind shear detection and high response control synthesis for extra fast control systems.

Contact Name:	Bor-Yeu Tasur
Position:	
Organization:	MIT
Component:	Lexington Lincoln Lab
Address:	244 Wood Street Lexington, MA 02173-9108
Notes:	Co-authored April 1990 study entitled "PtSi Schottky-Barrier Focal Plane Arrays for Multispectral Imaging in Ultraviolet, Visible, and Infrared Spectral Bands" Co-authored August 1989 study entitled "128X128 Element IrSi Schottky-Barrier Focal Plane Arrays for LWIR Imaging"

Contact Name:	David Taylor
Position:	Sales Manager
Organization:	EEV Ltd.
Component:	
Address:	Waterhouse Lane Chelmsford, Essex ENGLAND CM1 2QU
Notes:	Active and passive eo systems, infrared systems and equipment, night vision for military.

Contact Name:	Gary Teagarden
Position:	Dir. Marketing Communications
Organization:	Paramax Systems Corp.
Component:	
Address:	8201 Greensboro Drove, Suite 1000 McLean, VA 22102
Notes:	Passive and active c/o systems, c/o systems, infrared systems and equipment for military applications.

Contact Name:	Peter Teets
Position:	Pres
Organization:	Martin Marietta Corporation
Component:	Martin Marietta Astronautics Group
Address:	Mail No S4400, PO Box 179 Denver, CO 80201
Notes:	Research into optical detection, optical control, electronic systems design, and thermal control systems.

Contact Name:	Jay Teich
Position:	VP for Commercial Products
Organization:	Inframetrics
Component:	
Address:	16 Esquire Road North Billerica, MA 01862-2598
Notes:	

Contact Name:	John Tengelsen
Position:	Pres.
Organization:	Lattice Materials Corp.
Component:	
Address:	516 E. Tamrack Bozeman, MT 59715
Notes:	Manufacturer of silicon for infrared applications.

Contact Name:	William Tennant
Position:	Dr.
Organization:	Rockwell International Science Center
Component:	
Address:	1049 Camino Dos Rios Thousand Oaks, CA 91360
Notes:	Chief scientist on IR producibility efforts, substrate issues.

Contact Name:	Dennis Thomas
Position:	
Organization:	Eagle-Picher Industries, Inc.
Component:	Electro-Optic Materials Department
Address:	P.O. Box 737 Quapaw, OK 74363
Notes:	Production of germanium and silicon systems for infrared applications.

Contact Name:	Robert L. Thomas
Position:	
Organization:	Wayne State University
Component:	Institute for Manufacturing Research
Address:	Detroit, MI 48202
Notes:	infrared non-destructive evaluation

Contact Name:	Earl Thompson
Position:	President
Organization:	Delta International, Inc.
Component:	
Address:	2111 Wilson Boulevard, Suite 700 Arlington, VA 22201
Notes:	Thermal imaging, detectors and sensors for military applications.

Contact Name:	W.R. Thurber
Position:	
Organization:	National Institute of Standards and Technology
Component:	Semiconductor Electronics Division
Address:	Gaithursburg, MD 20899
Notes:	Co-Authored "Heavily Accumulated Surfaces of MCT Detectors: Theory and Experiment" for 1992 MCT Workshop.

Contact Name:	Roger Titrone
Position:	Pres
Organization:	Titronics Inc
Component:	
Address:	RR 1, Box 53B Oxford, IA 52322
Notes:	Infrared terrain scanning.

Contact Name:	Glenn Todd
Position:	EW Requirements Manager
Organization:	Texas Instruments
Component:	Defense Systems and Electronics Group
Address:	2501 W. University McKinney, TX 95070
Notes:	infrared systems and equipment

Contact Name:	Glenn Tom
Position:	VPres Research
Organization:	Advanced Technology Materials
Component:	
Address:	520-B Danbury Road New Milford, CT 06776
Notes:	Recently awarded an SDIO contract to develop a new electronic thin-film material to improve IR detector technology. The company will focus on using barium strontium titanate to develop new sensors capable of operating at room temperature.

Contact Name:	Fei-Ming Tong
Position:	
Organization:	Shanghai Institute of Technical Physics
Component:	Chinese Academy of Sciences
Address:	Shanghai, 20092 CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "HgCdTe Photovoltaic Detectors and Some Related Aspects"

Contact Name:	Christopher Toth
Position:	President
Organization:	Superior Evaporants
Component:	
Address:	6965 Highway 9 Felton, CA 95018
Notes:	Manufacturer of germanium, silicon, ZnS, and ZnSe for infrared systems.

Contact Name:	John R. Tower
Position:	Manager, Visible and IR Imaging Business
Organization:	David Sarnoff Research Center
Component:	
Address:	CN5300 Washington Road Princeton, NJ 08543-5300
Notes:	Oversees their PtSi Schottky-barrier IR focal plane array technology work

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Contact Name:	Steven Towne
Position:	Public Relations
Organization:	Loral Infrared and Imaging Systems
Component:	
Address:	2 Forbes Road Lexington, MA 02173
Notes:	Detectors and sensors, night vision, thermal imaging, infrared systems & equipment, predominantly for military applications.

Contact Name:	Russell L. Travis
Position:	Dr.
Organization:	
Component:	
Address:	152 W. Zandale Drive Lexington, KY 40503
Notes:	Doctor in private practice, active in infrared biomedical thermography

Contact Name:	Roger B. Traycoff
Position:	Dr.
Organization:	Southern Illinois Univ School of Medecine
Component:	
Address:	P.O. Box 9230 Springfield, IL 62794-9230
Notes:	Active in use of infrared biomedical thermography, on board of directors of American Academy of Thermology.

Contact Name:	R. Triboulet
Position:	
Organization:	CNRS
Component:	Laboratoire de Physique des Solides de Bellevue
Address:	1, Place Aristide Briand F. 92125 Meudon Cedex FRANCE
Notes:	Co-authored for 1992 MCT Workshop "Substrate Issues for Mercury Cadmium Telluride"

Contact Name:	Charles T. Troy
Position:	
Organization:	Photonics Spectra Magazine
Component:	
Address:	Berkshire Common P.O. Box 4949 Pittsfield, MA 01202-4949
Notes:	Follows infrared remote sensing as journalist

Contact Name:	Martha Tulloch
Position:	Ms.
Organization:	Photonics Spectra Magazine
Component:	
Address:	Berkshire Common P.O. Box 4949 Pittsfield, MA 01202-4949
Notes:	Follows applications for infrared technologies as magazine's associate editor.

Contact Name:	Mike Turley
Position:	Marketing Director
Organization:	Computing Devices Co.
Component:	
Address:	Castleham Road St. Leonards on Sea East Sussex, UK TN389NJ
Notes:	Infrared systems and Equipment primarily for military markets.

Contact Name:	S. Kay Turner
Position:	VP Marketing
Organization:	Loral Corporation
Component:	Loral Infrared & Imaging Systems, Inc.
Address:	2 Forbes Rd. Lexington, MA 02173
Notes:	

Contact Name:	B.R. Turner
Position:	
Organization:	Renssalaer Polytechnic Institute
Component:	Physics Department and Center for Integrated Electronics
Address:	110 Eight Street Troy, NY 12180
Notes:	Co-authored for 1992 meeting of SPIE on IRFPAs "Fundamental Studies of Schottky Barrier IR Detectors by Ballistic Electron Emission Microscopy"

Contact Name:	Wilson Twohig
Position:	Pres
Organization:	Timeco Inc
Component:	
Address:	1035 26th St. Huntington, WV 25705
Notes:	Timing controls, photoelectric controls, and load sensors.

Contact Name:	Y.L. Tyan
Position:	
Organization:	LTV Aerospace and Defense Company
Component:	
Address:	Mail Stop PT-88 Dallas, TX 75265
Notes:	Co-authored for 1991 MCT Workshop "Analysis of Excess Carrier Lifetime in p-Type HgCdTe Using a Three-Level Shockley-Read Model"

Contact Name:	M.N. Udrea-Spenea
Position:	
Organization:	Enterprise for Semiconductor Devices
Component:	
Address:	ROMANIA
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Accurate Method for Neutron Fluence Control Used in Improving Neutron-Transmutation-Doped Silicon Detectors"

Contact Name:	Sumio Uematsu
Position:	Dr.
Organization:	Johns Hopkins Hospital
Component:	
Address:	Meyer 2-147 600 N. Wolfe Street Baltimore, MD 21205
Notes:	Active in infrared biomedical thermography, past President of American Academy of Thermology.

Contact Name:	A. Unikovsky
Position:	
Organization:	Kidron Microelectronics Research Center
Component:	Department of Electrical Engineering
Address:	Technion-Israel Institute of Technology Haifa 32000, ISRAEL
Notes:	For 1991 MCT Workshop co-authored "Tunneling and 1/f noise currents in HgCdTe Photodiodes"

Contact Name:	Malcom Unsworth
Position:	Gmgr
Organization:	Schlumberger Limited
Component:	Statham Transducers
Address:	2230 Statham Rd. Oxnard, CA 93033
Notes:	Micromachined silicone and thin film sensors.

Contact Name:	Frank J. Vallese
Position:	General Manager
Organization:	Electrophysics
Component:	
Address:	373 Route 46 West, Building E Fairfield, NJ 07004
Notes:	Night Vision, thermal imaging for military applications. Sells their line of Pyroviewer, phovidicon cameras.

Contact Name:	Hervert Van Denend
Position:	Pres
Organization:	Glenro, Inc.
Component:	
Address:	29 McBride Ave. Paterson, NJ 07501
Notes:	Research into infrared system production, infrared ovens

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Contact Name:	Will Van Dyke
Position:	Manager of Advanced Program Development
Organization:	SBRC
Component:	
Address:	75 Coromar Drive Goleta, CA 93117
Notes:	

Contact Name:	A.D. Van Rheenen
Position:	
Organization:	Minnesota University
Component:	Department of Electrical Engineering
Address:	Minneapolis, MN
Notes:	Co-authored August 1991 "Quantum Noise in Solid-State Devices in Particular HgCdTe Diodes"

Contact Name:	M. van Schilfgaarde
Position:	
Organization:	SRI International
Component:	
Address:	Menlo Park, CA 94025
Notes:	Author of "Comparison of InTiSb and HgCdTe as Infrared Material" and "Native Defect Equilibria in HgZnTe and HgCdTe Alloys" at 1992 MCT Workshop For 1991 Workshop, co-authored "Defect Equilibrium in HgTe"

Contact Name:	M. van Schlifgaarde
Position:	
Organization:	SRI International
Component:	
Address:	Menlo Park, CA 94025
Notes:	Co-authored for 1992 MCT Workshop "Comparison of InTiSb and HgCdTe as Infrared Material"

Contact Name:	Victor Vargo
Position:	Gmgr
Organization:	Qualitec-Technologies, Inc.
Component:	Optoelectronics Division
Address:	3400 Hillview Ave. Palo Alto, CA 94304
Notes:	Development of III-V optoelectronic materials and silicon detectors.

Contact Name:	V.P. Vavilov
Position:	
Organization:	Tomsk Polytechnic Institute
Component:	
Address:	Tomsk, RUSSIA
Notes:	Authored for 1991 SPIE meeting on IR Technology "Soviet IR IMagers and THeir Applications: Short State of the Art"

Contact Name:	Richard Veith
Position:	President
Organization:	Crystal Technology, Inc.
Component:	
Address:	1040 E Meadow Circle Palo Alto, CA 94303
Notes:	Preparation and characterization of single crystal materials for use in optical, acoustic, magnetic applications; device development using these materials in acousto-optics and surface acoustic waves (SAW).

Contact Name:	Tom Venable
Position:	Marketing Manager for IR Detectors
Organization:	Cincinatti Electronics
Component:	
Address:	7500 Innovation Way Mason, OH 45040-9699
Notes:	Manufactures and designs IR detectors including single-element, linear and two dimensional arrays, discrete channel amplified, multiplexed, in Ge, MCT, InSb and InAs, 1-12 um. CIncinnatti Electronics is owned by Canadian Marconi Company, which is, in turn, owned by the General Electric COmpany.

Contact Name:	Frank Verbeke
Position:	President
Organization:	Alturdyne
Component:	
Address:	8050 Armour San Diego, CA 92111
Notes:	Infrared systems and equipment for military

Contact Name:	Horacio R. Verdun
Position:	
Organization:	FIBERTEK, Inc.
Component:	
Address:	510 Herndon Parkway Herndon, VA 22070
Notes:	Co-authored for 1992 MCT Workshop "Tunnelling Current Probe for Contactless Electrical Performance Measurements of Infrared Focal Plane Detector Arrays." Firm manufactures high average power diode array pumped solid-state lasers, CW, Q-switched and frequency doubled, and highly advanced laser receiver for the military market, and laser crystals with new formulations for evaluation purposes.

Contact Name:	Jan Vermeiren
Position:	Ms.
Organization:	IMEC
Component:	
Address:	Jaockdreef 75 B-3001 Leuven, BELGIUM
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Comparative study of SWIR and MWIR Schottky-Barrier Imagers"

Contact Name:	Vincent Vidas
Position:	CEO
Organization:	Semcor Inc
Component:	
Address:	815 E Gate Dr. Mount Laurel,NJ 08054
Notes:	Product-oriented research on the ststems engineering and program management in support to the government in aeronautics, military science, missile technology, countermeasures, ordnance and fire control communications, radar, acoustic, optics, INFRARED and ultraviolet detection systems.

Contact Name:	C.R. Viswanathan
Position:	
Organization:	University of California, Los Angeles
Component:	Electrical Engineering Department
Address:	Los Angeles, CA 90024
Notes:	For 1991 MCT Workshop, wrote "Compositional Analysis of HgCdTe Epitaxial Layers Using Secondary Ion Mass Spectrometry"

Contact Name:	Jeffrey Voelker
Position:	
Organization:	General Electric Company
Component:	Electronics Laboratory
Address:	Syracuse, NY
Notes:	Authored Jan 92 piece evaluating LPE vs. MBE and MOCVD for radiometry. Source on cost differences between two methods.

Contact Name:	Randall Voight
Position:	CEO
Organization:	International Research and Evaluation
Component:	
Address:	21098 IRE Control Ctr. Eagan, MN 55121
Notes:	Product-oriented with emphasis on photovotaic cells.

Contact Name:	H. Vydyanath
Position:	
Organization:	Aerojet Corp.
Component:	Electronic Systems Division
Address:	Azuza, CA
Notes:	Co-authored for 1992 MCT Workshop "Photo-Induced Excess Low Frequency Noise in HgCdTe Photodiodes"

Contact Name:	B.K. Wagner
Position:	
Organization:	Georgia Institute of Technology
Component:	
Address:	
Notes:	Co-authored for 1991 MCT Workshop "Selected-area Epitaxy on CdTe" and "Gas Source Iodine Doping and Characterization of MBE Grown CdTe"

Contact Name:	Roger Waldock
Position:	Pres.
Organization:	MR Semicon, Inc.
Component:	
Address:	276 Route 59 Tall Pines Industrial Park Monsey, NY 10952-3407
Notes:	Manufacture of CdTe and GaAs for infrared applications.

Contact Name:	william Wallace
Position:	Pres
Organization:	Westmark Systems, Inc
Component:	Tracor-GIE
Address:	1652 W 820 North Provo, UT 84601
Notes:	Development of infared and far-infared systems.

Contact Name:	L. Walther
Position:	
Organization:	Dresden University of Technology
Component:	Institut fur Festkorperelektronik
Address:	Dresden, FEDERAL REPUBLIC OF GERMANY
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Pyroelectric Linear Array IR Detectors with CCD Multiplexer"

Contact Name:	M.W. Wang
Position:	Dr.
Organization:	California Institute of Technology
Component:	
Address:	1201 East California Boulevard Pasadena, CA 91125
Notes:	Reported at the DARPA Program Review on Infrared Focal Plane Array Technology in December, 1992, on "InAs/GaInSb Superlattices: Growth Involving Anion Switching"

Contact Name:	Peter Wang
Position:	CEO
Organization:	Fermionics
Component:	
Address:	4555 Runway St. Simi Valley, CA 93063
Notes:	Produces wholesale CdTe and participant in CECOMs night vision advanced research. Sells in both military and commercial markets.

Contact Name:	Peter C.C. Wang
Position:	Chief Executive
Organization:	Fermionics Corp.
Component:	
Address:	4555 Runway Street Simi Valley, CA 93063
Notes:	

Contact Name:	Wen Sang Wang
Position:	
Organization:	Rensselaer Polytechnic Institute
Component:	
Address:	110 Eight Street Troy, NY 12180
Notes:	Co-authored "Improved CdTe Layers on GaAs and Si Substrates, Grown by Atomic Layer Epitaxy" for 1992 MCT Workshop Co-authored for 1991 Workshop "Low Temperature Epitaxy of HgCd, CdTe, and HgCdTe Using Flow Modulation Techniques."

Contact Name:	Y.H. Wang
Position:	
Organization:	University of Florida
Component:	Department of Electrical Engineering
Address:	Gainesville, FL 32611
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "A Noval Grating Coupled Step-Bound-to-Miniband Transition InGaAs/GaAs/AlGaAs Multiquantum Well Infrared Photodetector"

Contact Name:	Raymond Wary
Position:	Sls Mgr
Organization:	PPM Pure Metals
Component:	
Address:	111 Richmond Street, West, Suite 418 Toronto, Ontario, CANADA M5H 2G4
Notes:	Manufacture of germanium for infrared technologies.

Contact Name:	John Wasylyk
Position:	Director of Research
Organization:	AGR International, Inc.
Component:	
Address:	PO Box 149 Butler, PA 16003-0149
Notes:	Development of optical inspection techniques for process control in glass container manufacturing.

Contact Name:	Tomoji Watanabe
Position:	
Organization:	Hitachi Koki Co.
Component:	Mechanical Engineering Laboratory
Address:	502 Kandatsu, Tsuchiura, Ibaraki, 300, JAPAN
Notes:	Proposed designs for IR detectors for radiation thermometry of silicon wafers in a diffusion furnace for fabrication of LSI.

Contact Name:	Gary J. Weil
Position:	
Organization:	EnTech Engineering, Inc.
Component:	
Address:	111 Marine Lane St. Louis, MO 63146-2235
Notes:	Active in infrared predictive maintenance. Using joint IR/GPR technique.

Contact Name:	Christopher S. Welch
Position:	
Organization:	College of William and Mary
Component:	Dept of Physics
Address:	Williamsburg, VA 23185
Notes:	Leader in infrared non-destructive evaluation.

Contact Name:	Gary Well
Position:	
Organization:	EnTech Engineering, Inc.
Component:	
Address:	111 Marine Lane St. Louis, MO 63146
Notes:	Active in infrared remote sensing, using joint IR/GPR technique.

Contact Name:	Song Wen-Zhen
Position:	
Organization:	Shandong University
Component:	Infrared and Remote Sensing Re.
Address:	Jinan, Shandong, CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "The Dependence of Fermi Level of HgCdTe on Impurity Concentration and Temperature"

Contact Name:	N. Wereley
Position:	
Organization:	BDM Inc.
Component:	
Address:	4001 North Fairfax Drive Arlington, VA 22203
Notes:	Authored for 1992 SPIE workshop on IRFPAs "Modeling the Cost and Producibility Impacts of IRFPA Operability"

Contact Name:	Greg Whaley
Position:	Business Manager
Organization:	Amorphous Materials Inc.
Component:	
Address:	3130 Benton Street Garland, TX 75042
Notes:	Infrared materials production of CdTe, GaAs, and silicon, mainly for military.

Contact Name:	Robert White
Position:	VP for Sales
Organization:	Galileo Electro-Optics Corp.
Component:	
Address:	Galileo Park, PO Box 550 Sturbridge, MA 01566
Notes:	Develops fiber-optic and electro-optic components which transmit, intensify or sense light images.

Contact Name:	Larry Whited
Position:	Pres
Organization:	Magna Industries, Inc
Component:	
Address:	2201 W 110th St., PO Box 734 Cleveland, OH 44107
Notes:	Produce oriented research in infrared products for gas saving devices.

Contact Name:	Warner Whitmer
Position:	Pres
Organization:	CVS Systems & Services, Inc,
Component:	CVD Systems & Services
Address:	Penn Centre Plaza Quakertown, PA 18951
Notes:	Production of solar cells and sensor prototyping.

Contact Name:	P.S. Wijewarnasuriha
Position:	
Organization:	EPIR, Ltd.
Component:	
Address:	Oak Brook, IL 60521
Notes:	Co-authored for 1992 MCT Workshop "Influence of CdZnTe (211)B Substrate on Electrical Properties of HgCdTe Grown by MBE"

Contact Name:	Ronald Willey
Position:	Pres
Organization:	Willey Corporation
Component:	
Address:	PO Box 670 Melbourne, FL 32902
Notes:	R&D of unique and sophisticated infrared reflectance spectrophotometry.

Contact Name:	Clifford Williams
Position:	Pres
Organization:	International Sensor Systems, Inc.
Component:	
Address:	Industrial Park, PO Box 345 Aurora, NE 68818
Notes:	Research in hybrid thick film technology and optical relays.

Contact Name:	Clayton Williams
Position:	Pres
Organization:	Litton Industries, Inc.
Component:	Applied Technology Division
Address:	4747 Hellyer Ave., PO Box 7012 San Jose, CA 95150-7012
Notes:	Electro-optic and acouto-optic systems, predominantly for military.

Contact Name:	Patricia Williamson
Position:	Assistant VP Corp. Comm.
Organization:	DRS Photronics Corp
Component:	
Address:	270 Motor Parkway Hauppauge, NY 11788
Notes:	Electro optical systems, night vision, infrared systems and equipment for military applications.

Contact Name:	Nick Willick
Position:	Senior Manager
Organization:	McDonnell Douglas Aerospace
Component:	
Address:	1801 E. St. Andrew Place Santa Ana, CA 92705
Notes:	Night Vision, thermal imaging, e/o systems for military markets.

Contact Name:	A.F.W. Willoughby
Position:	
Organization:	University of Southampton
Component:	Engineering Materials
Address:	Southampton, SO9 5NH UNITED KINGDOM
Notes:	Authored "Growth Method, Composition, and Defect Structure Dependence of Mercury Diffusion in CdHgTe" for 1992 MCT Workshop.

Contact Name:	Jeanine Wilson
Position:	Ms.
Organization:	Coors Brewing Company
Component:	
Address:	Golden, CO 80401
Notes:	Proposed technique used by Coors to determine the parameters necessary to improve glass distribution in the bottles used by Coors, and thuse achieve reductions in glass weight.

Contact Name:	Bill Wilson
Position:	Pres
Organization:	Microwave Technology Incorporated
Component:	
Address:	4268 Solar Way Fremont, CA 94538
Notes:	Research on GaAs and silicon for infrared applications.

Contact Name:	Robert Wilson
Position:	VP
Organization:	Textron Inc
Component:	Sensor Systems
Address:	201 Lowell St Wilmington, MA 01887
Notes:	Sensor systems for target discriminations, detections, and tracking.

Contact Name:	Kirk Winchester
Position:	Marketing Director
Organization:	Janos Technology, Inc.
Component:	
Address:	HCR #33, Box 25 Townshead, VT 05353-7702
Notes:	Manufacturer of CdTe, GaAs, germanium, silicon, ZnS, and ZnSe for infrared applications.

Contact Name:	William P. Winfree
Position:	
Organization:	NASA, Langley Research Center
Component:	
Address:	MS-231 Hampton, VA 23665
Notes:	Infrared non-destructive evaluation, aging aircraft skins.

Contact Name:	Debra Withrow
Position:	Advertising Manager
Organization:	Recognition Concepts, Inc.
Component:	
Address:	5200 Convair Drive Carson City, NV 89706
Notes:	Infrared systems & equipment, imaging software for military applications.

Contact Name:	Norman Witriol
Position:	
Organization:	Lousiana Tech University
Component:	
Address:	
Notes:	Co-authored 1990 "A Simplified Vision System WIth Robotic Assembly and Manufacturing Applications"

Contact Name:	A.F. Witt
Position:	
Organization:	MIT
Component:	
Address:	Cambridge, MA 02139
Notes:	Co-authoerd for 1991 MCT Workshop "Nonlinear Optical Effects in Rotationally Twinned CdTe and CdMnTe Crystals"

Contact Name:	Darold C. Wobschall
Position:	Dr.
Organization:	State Univ of NY at Buffalo
Component:	Dept of Elec & Computer Engineering
Address:	Bell Hall Buffalo, NY 14214
Notes:	Active in infrared biomedical thermography. Active in designing a multi-wavelength IR system which overcomes problems of emissivity differences in imaging the body.

Contact Name:	John Wohlgemuth
Position:	Head of R & D
Organization:	AMOCO Corporation
Component:	Solarex Corp
Address:	1335 Piccard Dr. Rockville, MD 20850
Notes:	Applied R&D including photovoltaic devices and power systems.

Contact Name:	T. Wojtowicz
Position:	
Organization:	University of Notre Dame
Component:	Department of Physics
Address:	Notre Dame, IN 46556
Notes:	Co-authored for 1991 MCT Workshop "Magnetic Generation of electrons and Holes in Semimetallic HgTe-CdTe Superlattices"

Contact Name:	Peter A. Wolff
Position:	
Organization:	MIT
Component:	Electronics Research Lab
Address:	77 Massachussets Avenue Cambridge, MA 02139
Notes:	Co-authored January 1987 "Infrared Nonlinear Optics"

Contact Name:	R. Wollrab
Position:	
Organization:	AEG
Component:	
Address:	D-7100 Heilbronn GERMANY
Notes:	Co-authored for 1991 MCT Workshop "Influence of Resonant Defect States on Subband Structures in HgCdTe"

Contact Name:	Edward Wood
Position:	President
Organization:	FJW Optical Systems, Inc
Component:	
Address:	629 S Vermont St. Palatine, IL 60067
Notes:	Electro-optical systems and infrared viewing devices for production industries. Manufactures IR viewers, IR thermal imagers, and IR non-contact thermometers.

Contact Name:	Richard Wood
Position:	Pres
Organization:	Optical Radiation Corp.
Component:	
Address:	1300 Optical Dr. Azusa, CA 91702
Notes:	Development of electro-optical systems.

Contact Name:	Thomas W. Woody
Position:	Manager of Product Engineering & Test Development
Organization:	Tektronix, Inc.
Component:	CCD Product Group
Address:	P.O. Box 500, MS 59-567 Microelectronics Product Line Beaverton, OR 97077
Notes:	Oversees high performance CCD development at CCD, and has strong knowledge of entire CCD industry, esp. compared with MCT-based detectors

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Contact Name:	Ronald Wright
Position:	President
Organization:	Sequa Corporation
Component:	Kollsman Military Systems
Address:	220 Daniel Webster Merrimack, NH 03054
Notes:	A variety of infrared research using primarily HgCdTe and InSb. Most HgCdTe is reportedly supplied by Sofradir.

Contact Name:	Harrison Wroton
Position:	Pres
Organization:	Solar Power Engineering Company
Component:	
Address:	PO Box 91 Morrison, CO 80465
Notes:	Tracking photovotaic tracking power systems.

Contact Name:	Wen-Jack Wu
Position:	
Organization:	National Taiwan University
Component:	Department of Electrical Engineering
Address:	1, Sec. 4, Roosevelt Road Taipei, TAIWAN, 10764, REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "A Novel CID Emulator for InSb Array"

Contact Name:	Chao-Wen Wu
Position:	
Organization:	National Taiwan University
Component:	Department of Electrical Engineering
Address:	1, Sec. 4, Roosevelt Road Taipei, TAIWAN, 10764, REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "A Novel CID Emulator for InSb Array"

Contact Name:	Larry S. Wu
Position:	
Organization:	University of Florida
Component:	Department of Electrical Engineering
Address:	Gainesville, FL 32611
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "A Noval Grating Coupled Step-Bound-to-Miniband Transition InGaAs/GaAs/AlGaAs Multiquantum Well Infrared Photodetector"

Contact Name:	Robert N. Wurzbach
Position:	
Organization:	Philadelphia Electric Company
Component:	Peach Bottom Atomic Power Station
Address:	Rd #1 Box 208 Delat, PA 17314
Notes:	Designed infrared predictive maintenance regime and purchased equipment for the Peach Bottom Atomic Power plant.

Contact Name:	Hu Xierong
Position:	
Organization:	Shandong University
Component:	Infrared and Remote Sensing
Address:	Jinan, Shandong, CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "Study of the Recombination Mechanisms and Carrier Lifetimes in HgCdTe Alloy"

Contact Name:	Hu Xierong
Position:	
Organization:	Shandong University
Component:	Infrared and Remote Sensing
Address:	Shandong University CHINA 250100
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "The Effect of Schockley-Read Recombination on Minority-Carrier LIfetime of HgCdTe"

Contact Name:	Yang Xiuzhen
Position:	
Organization:	Shanghai Institute of Technical Physics
Component:	Chinese Academy of Sciences
Address:	Shanghai, 20092 CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "HgCdTe Photovoltaic Detectors and Some Related Aspects"

Contact Name:	Hirofumi Yagi
Position:	
Organization:	Mitsubishi Electric Corporation
Component:	LSI Laboratory
Address:	4-1, Mizujara Itami, Hyogo, 664 JAPAN
Notes:	Co-authored for 1992 SPIE Workshop on IRFPAs "Improved 512X512 IRCSD with Large FIII Factor and High Saturation Level"

Contact Name:	Wenzhong Yang
Position:	
Organization:	Chongqing Optoelectronics Research Institute
Component:	
Address:	P.O. Box 1102, YongChuan, CHongqing CHINA
Notes:	Authored at 1992 SPIE meeting on IRFPAs "LWIR Monolithic HgCdTe Infrared Focal Plane Arrays."

Contact Name:	Sheng-Jenn Yang
Position:	
Organization:	Chung-Shan Institute of Science and Technology
Component:	
Address:	P.O. Box 90008-8-7, Lung-tan, Tao-Yuan REPUBLIC OF CHINA
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "A Novel CID Emulator for InSb Array"

Contact Name:	G.L. Yang
Position:	
Organization:	University of Notre Dame
Component:	Department of Physics
Address:	Notre Dame, IN 46556
Notes:	Co-Authored "Staes Confined in the Barriers of Type-III HgTe/CdTe Superlattices" for 1992 MCT Workshop

Contact Name:	Li Yanjin
Position:	
Organization:	Shanghai Institute of Technical Physics
Component:	Academia Sinica
Address:	Shanghai, China 200083
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "The Effect of Shockley-Read Recombination on Minority Carrier Lifetime of HgCdTe"

Contact Name:	Bob Yanka
Position:	
Organization:	GE Aerospace
Component:	Electronics Lab
Address:	Building 3, Electronic Park Syracuse, NY 13211
Notes:	Scientist working on MBE, past work on advanced iRFPA concepts for WRight Patterson AFB April 1987-December 1990. The electronics lab works on gas (gallium arsenide) monolithic microwave technology, infrared arrays, high speed digital electronics gas GaAs monolithic

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Contact Name:	Wan Yong
Position:	
Organization:	Shandong University
Component:	Infrared and Remote Sensing
Address:	Shandong University CHINA 250100
Notes:	Co-authored for 1992 SPIE meeting on IRFPAs "The Effect of Schockley-Read Recombination on Minority-Carrier Lifetime of HgCdTe"

Contact Name:	K.M. Yoo
Position:	Dr.
Organization:	Graduate Center for the City Univ of NY
Component:	Dept of Electrical Engineering and Physics
Address:	Institute for Ultrafast Spectroscopy & Lasers, Photonics Appl Lab New York, NY 10031
Notes:	Active in multi-wavelength biomedical thermography system development

Contact Name:	Larry Yost
Position:	SrVP
Organization:	Rockwell International Corporation
Component:	Industrial Control Group
Address:	1201 S Second St. Milwaukee, WI 53204
Notes:	Automation systems and industrial controls, including IR sensors.

Contact Name:	P.M. Young
Position:	
Organization:	Harvard University
Component:	Division of Applied Sciences
Address:	20 Oxford Street Cambridge, MA 92138
Notes:	Co-Authored "Augur Lifetimes in Ideal InGaSb/InAs Superlattices" for 1992 MCT Workshop.

Contact Name:	Michael F. Young
Position:	President
Organization:	Young Design
Component:	
Address:	7110 Sea Cliff Road McLean, VA 22101
Notes:	Infrared systems & equipment

Contact Name:	z. Yu
Position:	
Organization:	North Carolina State University
Component:	Department of Physics
Address:	Raleigh, NC 27695-8202
Notes:	AUthored "Integrated Heterostructure Devices Based on II-VI Compound Semiconductors"

Contact Name:	Z. Yu
Position:	
Organization:	University of Nort Texas
Component:	Department of Physics
Address:	Denton, TX 76203
Notes:	Co-Authored "Heavily Accumulated Surfaces of MCT Detectors: Theory and Experiment" for 1992 MCT Workshop. For 1991 Workshop, "Investigation of Mercury Interstititals in MCT alloys Using Resonant Impact-Ionization Spectroscopy"

Contact Name:	Sunny Y. Yuen
Position:	
Organization:	MIT
Component:	Electronics Research Lab
Address:	77 Massachussets Avenue Cambridge, MA 02139
Notes:	Co-authored January 1987 "Infrared Nonlinear Optics"

Contact Name:	Ken Zanio
Position:	Mr.
Organization:	MOSET Corporation
Component:	
Address:	El Toro, CA 92630
Notes:	Authored for 1992 SPIE Workshop on MCT "HgCdTe on Si for Monolithic Focal Plane Arrays" supported by NRL contract from Dean Scribner

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Contact Name:	Thomas Zappetti
Position:	Pres
Organization:	Unitron, Inc
Component:	
Address:	170 Wilbur Pl., PO Box 469 Bohemia NY 11716
Notes:	Development of advanced optical systems.

Contact Name:	Cindy Zeidler
Position:	Ms.
Organization:	Xedar Corp
Component:	
Address:	2500 Central Avenue Boulder, CO 80301
Notes:	infrared non-destructive evaluation

Contact Name:	D. Zenatti
Position:	Dr.
Organization:	Sofradir
Component:	
Address:	43/47 rue Camille Pelletan 92290 Chatenay-Malabry FRANCE
Notes:	Research scientist working on SOFRADIR's process for reduction of IRFPA costs, presented paper on analysis criteria selection for IRFPA detector production at 1992 SPIE Orlando meeting.

Contact Name:	Francis Ziemba
Position:	VP
Organization:	Applied Electron Corp.
Component:	
Address:	2360 Owen Street Santa Clara, CA 95054
Notes:	Product-oriented research in the field of radiation detection, both nuclear and optical, including alpha, gamma, x-ray and radon detection, also near IR to visible optical radiation detection.

Contact Name:	A. Zigelmann
Position:	Mr.
Organization:	Soreq Nuclear Research Center
Component:	
Address:	ISRAEL
Notes:	Co-authored for 1991 SPIE meeting on Growth of IR Materials "Anodic Oxides on HgZnTe"

Contact Name:	Steve Zimmerman
Position:	Pres
Organization:	KRS Electronics Corporation
Component:	
Address:	Suite 16, 11649 Chairman Dr. Dallas TX, 75243
Notes:	Optical electronic sensing of liquids gases and temperatures, interest in developing IR products.

Contact Name:	P.D. Zingen
Position:	Marketing Coordinator
Organization:	Astronautics Corporation of America
Component:	
Address:	4115 N. Teutonia Milwaukee, WI 53209
Notes:	Night vision, robotics, security systems, ASW equipment, infrared systems & equipment, for military

---

Contact Name:	U. Zinnegger
Position:	Marketing Manager
Organization:	Siemens AG
Component:	
Address:	SI SM MA Landsluter Strasse 26 8044 Unterschleissheim, GERMANY
Notes:	Infrared systems & equipment, night vision for military applications.

Contact Name:	David Zish
Position:	IR CCD Marketing Director
Organization:	David Sarnoff Research Center
Component:	
Address:	CN5300 Washington Road Princeton, NJ 08543-5300
Notes:	

Contact Name:	Nello Zucch
Position:	
Organization:	Vision Systems, Intl
Component:	
Address:	3 Milton Drive Yardley, PA 19067
Notes:	infrared non-destructive evaluation

Contact Name:	M. Zutterman
Position:	Mr.
Organization:	Sofradir
Component:	
Address:	43/47 rue Camille Pelletan 92290 Chatenay-Malabry FRANCE
Notes:	Marketing Director for their MCT commercialization projects

Appendix G

Questionnaire Sent to Industry Individuals

1742 Swann Street, NW
Washington, D.C. 20009

August 14, 1992

Mr./Mrs. First Name, Last Name
Title
Company
Address

Dear Mr./Mrs. Last Name:

I am carrying out a study of potential future applications of sensitive infrared materials in industrial processes and commercial products as a consultant to a US Government R&D organization.

Your company is listed in the 1992 edition of the Directory of American Research and Technology, compiled by the Department of Commerce, and is said to be carrying out research on IR technologies. It would be very helpful for our study if you could complete the attached questionnaire and return it to me in the envelope provided. It should require no more than 30 minutes of your time to answer the questions.

I am asking a structured sample of more than 300 companies like yours to respond. Based on these responses, I will prepare an analysis of the view from industry. In return for your time, I will be delighted to make available to you the aggregate results of the survey. Individual responses are considered confidential, however, and will not be distributed further.

If you would like to discuss this study or the questionnaire prior to completing it, please feel free to call me. I can be reached during the day at 202/785-9041.

It would be most helpful to have your response no later than September 8th, 1992.
Thanks very much for your cooperation.

Yours truly,

Barry M. Blechman

Future Applications of Sensitive IR Materials
in Industrial Processes and Commercial Applications

Which specific research questions related to IR materials or detectors is your organization now pursuing? What benefits will result from the successful solution of these problems?

(Please turn to back of page)

What types of materials/compounds are you working with for infrared applications?

What do you think are the most promising specific applications of the materials with which you work in industrial processes or in commercial end-products? In what time frame -- 1-2 years, 3-7 years, 8-12 years -- do you think that each of these applications will be feasible on a commercial basis?

What specific industrial or commercial applications of sensitive IR materials, like mercury cadmium telluride and cadmium zinc telluride, do you foresee in 1-2, 3-7, or 8-12 years? If you are doing work on other IR materials, like PtSi, GaAs, Si, etc., please answer for those as well.

(Please turn to back of page)

What are the one, two, or three most difficult technological hurdles that have to be overcome in order to see widespread use of each potential application listed above? In particular, what will have to be accomplished to see significant reductions in cost?

Name of individual completing questionnaire: _____

Company: _____

Questionnaire Sent To University Individuals

1742 Swann Street, NW
Washington, D.C. 20009

September 4, 1992

Mr./Mrs. First Name, Last Name
Title
University Research Center
Address

Dear Mr/Mrs. Last Name:

I am carrying out a study of potential future applications of sensitive infrared materials in industrial processes and commercial products as a consultant to a US Government R&D organization.

Your center is listed in the 1993 edition of the Research Centers Directory, compiled by Gale Research, and is said to be carrying out research on photoelectric sensors, IR technologies, or both. It would be very helpful for our study if you could complete the attached questionnaire and return it to me in the envelope provided. It should require no more than 30 minutes of your time to answer the questions.

I am asking a structured sample of more than 60 university- affiliated organizations like yours to respond. Based on these responses, I will prepare an analysis of the view from research institutions. In return for your time, I will be delighted to make available to you the aggregate results of the survey. Individual responses are considered confidential, however, and will not be distributed further.

If you would like to discuss this study or the questionnaire prior to completing it, please feel free to call me. I can be reached during the day at 202/785-9041.

It would be most helpful to have your response no later than September 30th, 1992. Thanks very much for your cooperation.

Yours truly,
Barry M. Blechman

QUESTIONNAIRE

Future Applications of Sensitive IR Materials
in Industrial Processes and Commercial Applications

Which specific research questions related to IR materials or detectors is your research organization now pursuing? What benefits will result from the successful solution of these problems?

(Please turn to back of page)

What types of materials/compounds are you working with for infrared applications?

What do you think are the most promising specific applications of the materials with which you work in industrial processes or in commercial end-products? In what time frame -- 1-2 years, 3-7 years, 8-12 years -- do you think that each of these applications will be feasible on a commercial basis?

What specific industrial or commercial applications of sensitive IR materials, like mercury cadmium telluride and cadmium zinc telluride, do you foresee in 1-2, 3-7, or 8-12 years? If you are doing work on other IR materials, like PtSi, GaAs, Si, etc., please answer for those as well.

(Please turn to back of page)

What are the one, two, or three most difficult technological hurdles that have to be overcome in order to see widespread use of each potential application listed above? In particular, what will have to be accomplished to see significant reductions in cost?

Name of individual completing questionnaire: _____

University Center: _____

Appendix H

Individuals Contacted for Section on Biomedical Thermography

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Georgetown University Medical Center
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Washington, DC 20007

Dr. R. R. Alfano
Inst for Ultrafast Spectroscopy and Lasers
Photonics Appl. Lab
Dpt of Electrical Engineering and Physics
Graduate Center of the City Univ of NY
New York, NY 10031

Dr. Kurt Ammer
Ludwig Boltzmann Forschungsstelle fue
Physikalische Diagnostik
Heinrick Collinstr. 30
A-1140 Wien AUSTRIA

Dr. Michael Anbar
State University of NY at Buffalo
Department of Biophysical Sciences
120 Cary Hall
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Dr. Ray P. Clark
Thermal Biology Research Unit
King's College
Campden Hill Road, Kensington
London, W8 7AH, UNITED KINGDOM

Dr. Paul D. Croissant
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Bloomfield, MI 48103

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Picker International, Ltd.
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Wembley, HA9 7PR, UNITED KINGDOM

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Dr. Jack Hubbard
Minneapolis Clinic of Neurology
Univ of Minnesota School of Medicine
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Division of Rheumatology
Clinical Research Centre
Watford Road, Harrow, UNITED KINGDOM

Dr. Leonard Klenerman
Department of Orthopaedics
Northwick Park Hospital
Watford Road
Harrow, UNITED KINGDOM

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Univ of Illinois College of Medicine
Carle Foundation
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Urbanna, IL 61801

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Department of Neurology
Good Samaritan Hospital & Medical Center
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Portland, OR 97210

Dr. Alfred P. Pavot
Greater S.E. Community Hospital
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Department of PMR
1310 Southern Avenue, SE
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Department of Radiology
Albert Einstein College of Medicine
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Dr. Edward R.J. Ring
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Royal Natl Hospital for Rheumatic Diseases
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Dr. Robert A. Spangler
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Dr. Sumio Uematsu
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Dr. Darold C. Wobschall
State University of NY at Buffalo
Elec. and Computer Engineering Dpt
Bell Hall
Buffalo, NY 14214

Dr. K.M. Yoo
Institute for Ultrafast Spectroscopy and Lasers
Photonics Application Laboratory
Department of Electrical Engineering and Physics
Graduate Center of the City University of NY
New York, NY 10031

Appendix I

Individuals Interviewed for Section on Non-Destructive Evaluation

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Robert Bruno
Inframetrics
16 Esquire Road
North Billerica, MA 01862

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Doug Burleigh
General Dynamics Space Systems Div.
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NASA, Langley Research Center
Hampton, VA 23665

B. Scott Crews
MS 231
Analytical Services and Materials, Inc.
NASA Langley Research Center
Hampton, VA 23665

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UTI Instruments

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Mary Fallon
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Compaq Computer

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Appendix J

Individuals Contacted for Section on Predictive Maintenance

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Paul Grover
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Mr. Robert G. Hammaker
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Agema Infrared Systems
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Mr. Paul Hughett
Hughett Research
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Appendix K

Individuals Interviewed for Section on Process Control

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Imaging Technology
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Robotic Vision Systems, Inc.
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Appendix L

Individuals Interviewed for Section on Remote Sensing

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Remote Sensing Research Unit
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