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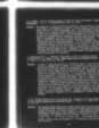
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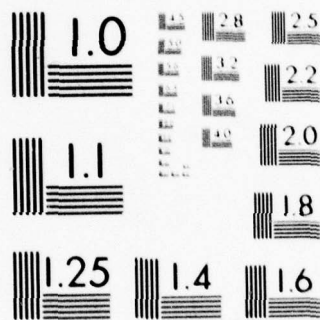
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JOINT SERVICES ELECTRONICS PROGRAM
FINAL REPORT (CONTRACT F44620-76-C-0100)

1 May 1976 - 30 April 1979

by

D. J. Angelakos and J. R. Whinnery

Report No. UCB/ERL 79/1

30 June 1979

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I. INTRODUCTION

During the period May 1, 1976, through April 30, 1979, the Electronics Research Laboratory (ERL), University of California, Berkeley, conducted research under the Joint Services Electronics Program (JSEP), sponsored by the Department of Air Force (Office of Scientific Research), Army (Army Research Office), and Navy (Office of Naval Research), under Contract F44620-76-C-0100. JSEP supports research projects by one of the following: complete support of a project from inception to completion; assumption of sponsorship after initial support by another agency; or initial support by the JSEP with subsequent spinoff to another sponsoring agency.

The research conducted for the contract period May 1, 1976, through April 30, 1979 is summarized in the following Interim Reports:

Report No. ERL-76-2	30 Sept. 1976	Joint Services Electronics Program Interim Report (Contract F44620-76-C-0100)
Report No. UCB/ERL 77/1	30 Sept. 1977	Joint Services Electronics Program Interim Report (Contract F44620-76-C-0100)
Report No. UCB/ERL 78/1	30 Sept. 1978	Joint Services Electronics Program Interim Report (Contract F44620-76-C-0100)

This report constitutes a summary (for the entire three-year period) of the salient parts of the research, as represented by the following: Section II contains information on research personnel affiliated with the JSEP. Section III lists journal articles and conference talks sponsored either in whole or in part by the JSEP.

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II. RESEARCH PERSONNEL

A. Faculty

Because of the nature of core support, 69 faculty members associated with ERL during the 3 year contract period received either direct or indirect support from, and therefore contributed either directly or indirectly to, the JSEP. Of these faculty, 34 received direct JSEP monetary support either during the summer recesses or the academic years.

B. Students

During the 3 year contract period 109 graduate students received direct support from the JSEP. During the same period, 42 Ph.D. and 26 M.S. degrees were awarded to students who received direct monetary JSEP support.

III. PUBLICATIONS

(1 May 1976 - 30 April 1979)

Journal Articles Published:

Y-K Lee and S. Wang, "Electrooptic guided-to-unguided mode converter," IEEE Journal of Quantum Electronics, v. QE-12, n. 5, May 1976, pp. 273-281.

Abstract: Experimental demonstration of electrooptic polarization conversion from a guided TE wave to an unguided TM wave in a thin-film light guide is reported. In the specific device we fabricated utilizing Ta₂O₅ film and LiTaO₃ substrate, we have observed a 40-percent modulation when 500 V were applied across two electrodes spaced 50μm apart. We present here a ray-optics analysis of the conversion process. With the inclusion of the Goos-Haenchen shifts, the analysis agrees well with the experiment.

P. Varaiya, "N-player stochastic differential games," SIAM Journal on Control and Optimization, v. 14, n. 3, May 1976, pp. 538-545.

Abstract: The paper presents conditions which guarantee that the control strategies adopted by N players constitute an efficient solution, an equilibrium, or a core solution. The system dynamics are described by an Ito equation, and all players have perfect information. When the set of instantaneous joint costs and velocity vectors is convex, the conditions are necessary.

C. L. Huang and T. Van Duzer, "Schottky diodes and other devices on thin silicon membranes," IEEE Transactions on Electron Devices, v. ED-23, n. 6, June 1976, pp. 579-583.

Abstract: The fabrication of ultra-thin silicon membranes of micron or submicron sizes with thicker supporting frames makes possible improvements in several kinds of electronic devices. We show that the series resistances of some devices can be reduced significantly, thus effecting increases in the cutoff frequencies. The resistance swing of Schottky diodes can also be raised. Initial experimentation relating to some of these applications is presented.

Y-K Lee and S. Wang, "Electrooptic Bragg-deflection modulators: theoretical and experimental studies," Applied Optics, v. 15, June 1976, pp. 1565-1572.

Abstract: We have studied the mechanism of Bragg diffraction in electrooptic thin-film lightguides and examined in detail the effectiveness of interaction between the electric field and optical field. Expressions for the full deflection voltage and the power per bandwidth are obtained and applied to various modulator structures using out-diffused, metal-diffused, epitaxial, and sputtered-film (electrooptic substrate) waveguides. An expression for minimum interaction length to ensure better than 30-dB extinction ratio is derived. The theoretical results are checked with experimental observations from an electrooptic substrate modulator we fabricated, and good agreement is obtained.

O. Teschke, A. Dienes and J. R. Whinnery, "Theory and operation of high-power CW and long-pulse dye lasers," IEEE Journal of Quantum Electronics, v. QE-12, n. 7, July 1976, pp. 383-395.

Abstract: A complete theoretical model for CW and long-pulse dye lasers is developed. The effects of excited singlet-state absorption of pump and laser light and triplet absorption of pump and laser light are included. Expressions are derived for gain, actual dye transmission, and output power. Experimental work is presented to verify the theory and to obtain values of excited-state absorption cross sections for rhodamine 6G by matching experimental to theoretical curves.

B. D. O. Anderson and E. I. Jury, "Generalized Bezoutian and Sylvester matrices in multivariable linear control," IEEE Transactions on Automatic Control, August 1976, pp. 551-556.

Abstract: Generalized Bezoutian and Sylvester matrices are defined and discussed in this short paper. The relationship between these two forms of matrices is established. It is shown that the McMillan degree of a real rational function can be ascertained by checking the rank of either one of these generalized matrices formed using a polynomial matrix fraction decomposition of the prescribed transfer function matrix. Earlier established results by Rowe and Munro are obtained as a special case. Several theorems related to the rank testing and other properties of the generalized matrices are discussed and various research problems are listed in the conclusion.

R. A. Heald and D. A. Hodges, "Multilevel random-access memory using one transistor per cell," IEEE Journal of Solid-State Circuits, v. SC-11, n. 4, August 1976, pp. 519-528.

Abstract: A memory cell capable of storing multilevel or analog information and providing random-access operation with nondestructive readout has been studied. It uses a single junction field-effect transistor (JFET) as the storage cell. Experimental and analytical studies suggest that eight or sixteen level operation should be feasible with refresh operations every 0.1 to 1 s; cell area can be under 2 mil². Tracking voltage and current reference circuitry is used to accommodate variations in fabrication processing and operating temperature.

R. K. Jain and T. K. Gustafson, "Efficient generation of continuously tunable coherent radiation in the 2460-2650-Å spectral range," IEEE Journal of Quantum Electronics, September 1976, pp. 555-556.

Abstract: Continuously tunable coherent radiation in the 2460-2650-Å spectral range has been achieved by second harmonic generation (SHG) of a dye laser in a 90° phase-matched ADP crystal, temperature tuned between -116°C and 52°C. The 8.4-percent conversion efficiency obtained at a fundamental power of 9.6 kW is approximately 5 times larger than that reported earlier for SHG at these wavelengths.

M. Stonebraker, E. Wong and P. Kreps, "The design and implementation of INGRES," ACM Transactions on Database Systems, v. 1, n. 3, September 1976, pp. 189-222.

Abstract: The currently operational (March 1976) version of the INGRES database management system is described. This multiuser system gives a relational view of data, supports two high level nonprocedural data sublanguages, and runs as a collection of user processes on top of the UNIX operating system for Digital Equipment Corporation PDP 11/40, 11/45, and 11/70 computers. Emphasis is on the design decisions and tradeoffs related to (1) structuring the system into processes, (2) embedding one command language in a general purpose programming language, (3) the algorithms implemented to process interactions, (4) the access methods implemented, (5) the concurrency and recovery control currently provided, and (6) the data structures used for system catalogs and the role of the database administrator.

Also discussed are (1) support for integrity constraints (which is only operational), (2) the not yet supported features concerning views and protection, and (3) future plans concerning the system.

C-C Tseng, D. Botez and S. Wang, "Optically pumped epitaxial GaAs waveguide lasers with distributed Bragg reflectors," IEEE Journal of Quantum Electronics, September 1976, pp. 549-551.

Abstract: Fabrication and characteristics of epitaxial waveguide lasers with distributed Bragg reflectors are described. GaAs-(GaAl)As double-layered structures were grown by conventional liquid-phase-epitaxy (LPE) technique. Periodic corrugations were made by chemical etching through a photoresist grating mask. Laser action with clearly defined longitudinal modes was observed under optical pumping at liquid-nitrogen temperature.

E. Wong and K. Youssefi, "Decomposition - A strategy for query processing," ACM Transactions on Database Systems, v. 1, n. 3, September 1976, pp. 223-241.

Abstract: Strategy for processing multivariable queries in the database management system INGRES is considered. The general procedure is to decompose the query into a sequence of one-variable queries by alternating between (a) reduction: breaking off components of the query which are joined to it by a single variable, and (b) tuple substitution: substituting for one of the variables a tuple at a time. Algorithms for reduction and for choosing the variable to be substituted are given. In most cases the latter decision depends on estimation of costs; heuristic procedures for making such estimates are outlined.

D. Botez, L. Figueroa and S. Wang, "Optically pumped GaAs-Ga_{1-x}Al_xAs half-ring laser fabricated by liquid-phase epitaxy over chemically etched channels," Applied Physics Letters, v. 29, n. 8, October 1976, pp. 502-504.

Abstract: Half-ring waveguides (5 μ m width, 185 μ m radius) fabricated by liquid-phase epitaxial growth of Ga_{1-x}Al_xAs and GaAs layers over preferentially

etched channels in GaAs substrates were made to lase by optical pumping with a N_2 laser ($\lambda=3371 \text{ \AA}$) at 77°K . The half-ring lasers had a threshold of about $2 \times 10^4 \text{ W/cm}^2$; a bending loss per radian $\alpha_c < 1.5 \text{ cm}^{-1}$; strong TE polarization; and a well-defined circumferential mode structure $\Delta\lambda=1.07 \text{ \AA}$ at $\lambda=8280 \text{ \AA}$ for a $580\text{-}\mu\text{m}$ long cavity. Straight guides of similar profile to the circular guides were made to lase for comparison. A calculated $0.5\text{-}\text{\AA}$ mode broadening due to transient heating during the pump laser pulse accounts for the observed lasing spectra.

D. Goodman, "An alternate proof of Huang's stability theorem," IEEE Transactions on Acoustics, Speech, and Signal Processing, October 1976, pp. 426-427.

Abstract: In this correspondence a complete proof of Huang's stability theorem for two-dimensional discrete filters is presented. The proof is based on certain properties of algebraic functions. It appears that Huang's original proof is not complete and it is hoped that this proof will fill the gap.

J. F. Albarrán and D. A. Hodges, "A charge-transfer multiplying digital-to-analog converter," IEEE Journal of Solid-State Circuits, v. SC-11, n. 6, December 1976, pp. 772-779.

Abstract: A new charge-transfer multiplying digital-to-analog converter employs an array of binary-weighted MOS capacitors and MOS transistors as its only elements. It can be fabricated on the same chip and by the same process as most charge-coupled devices and bucket-brigade devices, and provides two- or four-quadrant multiplication. An experimental n-channel metal-gate MOS realization demonstrated accuracy to 7 bits plus sign, total harmonic distortion 60 dB below fundamental, 70 dB dynamic range, and 200 kHz bandwidth.

F. M. Callier, W. S. Chan and C. A. Desoer, "Input-output stability theory of interconnected systems using decomposition techniques," IEEE Transactions on Circuits and Systems, v. CAS-23, n. 12, December 1976, pp. 714-729.

Abstract: We study the input-output stability of arbitrary interconnections of nonlinear, time-varying, multivariable subsystems which may be either continuous-time or discrete-time. All subsystems are specified by their input-output description. We use an algorithmic decomposition of the overall system into a hierarchy of strongly connected subsystems (SCS) interacting through inter-connection subsystems (IS). Theorem I establishes that the overall system is stable once the SCS's and the IS's are stable. Theorem II shows that, under very reasonable assumptions, these sufficient conditions are actually necessary. Using the concept of minimum essential set, we partition each SCS into two parts; one part corresponds to the "forward subsystem" whose only feedbacks are self-loops; the other part corresponds to the vertices of the minimum essential set; together they form the overall feedback

system. Simplified stability conditions for the SCS are obtained by exploiting this structural decomposition. Theorem III gives sufficient condition for stability of nonlinear time-varying SCS's. The other three theorems consider linear time-invariant continuous-time, lumped as well as distributed SCS's. We provide translation rules for reformulating these three theorems for the discrete-time case. We also show how to reduce the amount of calculation involved in finding the SCS characteristic polynomial.

B. S. Ting, E. S. Kuh and I. Shirakawa, "The multilayer routing problem: algorithms and necessary and sufficient conditions for the single-row single-layer case," IEEE Transactions on Circuits and Systems, v. CAS-23, n. 12, December 1976, pp. 768-778.

Abstract: The multilayer routing problem is introduced and its relation to the single-row single-layer routing problem is illustrated [1], [2]. An easily implementable sufficient condition on the routability of a net list over a single row of nodes is presented. The solution is given by a constructive forward marching procedure and the result is an improvement over the worst-case prediction of So [1]. The implementation algorithm is programmed on CDC 6400 computer. The nature of the optimum criterion relating to single-row routability is investigated and a necessary and sufficient condition is given to characterize the nature of optimality. Some necessary conditions are also presented which can be used to evaluate the sufficient condition and served as a lower bound for the channel capacity in the routing problem. The more general routing problem is illustrated and possible future research directions are discussed.

B. D. O. Anderson and E. I. Jury, "A "simplest possible" property of the generalized Routh-Hurwitz conditions," SIAM Journal on Control and Optimization, v. 15, n. 1, January 1977, pp. 177-184.

Abstract: To decide whether a prescribed complex polynomial has all its zeros with negative real parts, there are available many tests involving the checking of rational or polynomial inequalities in the coefficients. It is shown that the generalized Routh-Hurwitz conditions are from a certain point of view not replaceable by simpler conditions.

R. Boel and P. Varaiya, "Optimal control of jump processes," SIAM Journal on Control and Optimization, v. 15, n. 1, January 1977, pp. 92-119.

Abstract: The paper proposes an abstract model for the problem of optimal control of systems subject to random perturbations, for which the principle of optimality takes on an appealing form. This model is specialized to the case where the state of the controlled system is realized as a jump process. The additional structure permits operationally useful optimality conditions. Some illustrative examples are solved.

A. J. Smith, "Two methods for the efficient analysis of memory address trace data," IEEE Transactions on Software Engineering, v. SE-3, n. 1, January 1977, pp. 94-101.

Abstract: The high cost of analyzing long memory address traces has limited most researchers to short traces and analysis algorithms that are linear in the length of the trace. We suggest two methods that permit a trace to be shortened in length by one to two orders of magnitude (or more) for later further analysis. The Stack Deletion Method eliminates all references in the trace to the top k levels of the LRU stack. The Snapshot Method records the reference bits of the pages in the original tape at discrete intervals and uses these bits to generate a new trace. Extensive measurements are presented, from which we conclude that there is little or no loss in accuracy using reduced traces for many purposes for a wide range of memory sizes and degrees of reduction.

P. I. Suci and D. A. Hodges, "Image contour extraction with analog MOS circuit techniques," IEEE Journal of Solid-State Circuits, v. SC-12, n. 1, February 1977, pp. 65-72.

Abstract: Simple analog MOS circuits provide real-time contour extraction for video signals from CCD imagers. Variations in ambient lighting and image complexity can be accommodated using novel MOS analog counters. Applications include industrial controls and prosthetics. The possibility of automatic picture focusing is demonstrated with the contour extraction technique developed in this project.

J. F. Hunka, R. E. Stovall and D. J. Angelakos, "A technique for the rapid measurement of bistatic radar cross sections," IEEE Transactions on Antennas and Propagation, v. AP-25, n. 2, March 1977, pp. 243-248.

Abstract: Numerous techniques for measuring monostatic (backscatter) radar cross sections (RCS) are well known, but bistatic RCS measurements are inherently more difficult. In this paper we describe a bistatic RCS measurement technique which circumvents the major obstacles. It uses a variation of the CW "null-balance" approach resulting in rapid measurement times. A network analyzer and process computer were incorporated into an existing image ground plane system to improve the bistatic capability and add flexibility. Several objects were measured and compared with their known bistatic RCS to demonstrate the validity and utility of the technique.

D. Goodman, "Some stability properties of two-dimensional linear shift-invariant digital filters," IEEE Transactions on Circuits and Systems, v. CAS-24, n. 4, April 1977, pp. 201-208.

Abstract: This paper presents a detailed discussion of stability of two-dimensional linear digital filters, and the subtle differences between the one-dimensional and two-dimensional cases. In particular, it is shown that the fact that the impulse response trails off to zero, or more stringently is square summable does not guarantee BIBO (bounded-input bounded-output) stability.

Necessary conditions for the impulse response to be bounded and sufficient conditions for it to be square summable and to approach zero geometrically along any fixed column (or row) are stated.

W. Y. Lum and T. Van Duzer, "Switching measurements on semiconductor-barrier Josephson junctions, isolated and in memory loops," Journal of Applied Physics, v. 48, n. 4, April 1977, pp. 1693-1696.

Abstract: We report here the use of the semiconductor-barrier Josephson junction as the switching component in high-speed digital circuits. We have measured the switching time of a single Pb-Te-Pb junction and the current-transfer time of a memory cell using such a device as the logic switch. The fastest switching time of a rather large junction ($0.175 \times 0.175 \text{ mm}^2$) is 67 ps and the current-transfer time of a memory cell with loop inductance of $1.05 \times 10^{-10} \text{ H}$ is 350 ps. These measured values are comparable with those obtained for oxide tunnel junctions with similar dimensions.

M. S. Chung and T. E. Everhart, "Role of plasmon decay in secondary electron emission in the nearly-free-electron metals. Application to aluminum," Physical Review B, v. 15, n. 10, May 1977, 4699-4715.

Abstract: In this paper, a theoretical analysis of secondary electron emission in the nearly-free-electron (NFE) metals is presented. Restricting ourselves to excitation of secondary electrons (SE's) from the valence (or conduction) band only, we investigate the roles played by screened electron-electron scattering and by volume- and surface-plasmon decay in the excitation of SE's. Using the complex dielectric constant in the random-phase approximation we demonstrate that an important source of low-energy SE's may arise from the decay of long-wavelength surface and volume plasmons via near vertical interband transitions. A simple transport theory based on the work of Berglund and Spicer is developed to treat the SE escape problem approximately assuming an idealized model of the solid-vacuum surface barrier. Model calculations of the external SE energy distribution curve (EDC) and its derivative are presented for aluminum. The results are in reasonable agreement with some recent experimental EDC's obtained by a number of authors on clean Al samples. We tentatively conclude that an appreciable contribution to the total number of low-energy SE's emitted from NFE metals under kilovolt electron bombardment may come from the decay of surface and volume plasmons into single-electron excitations.

L. Figueroa, D. Botez and S. Wang, "Broadening of the longitudinal modes due to transient heating in optically pumped semiconductor lasers," Journal of Applied Physics, v. 48, n. 5, May 1977, pp. 1995-1997.

Abstract: We have found that the output spectra of cleaved GaAs lasers are broadened when they are optically pumped with a high-energy pulsed laser. We believe the effect is due to transient heating. A one-dimensional heat-flow equation is solved and the results predict the observed broadening. Ways of improving the mode spectra by reducing the broadening are discussed.

M. A. Morgan, S-K Chang and K. K. Mei, "Coupled azimuthal potentials for electromagnetic field problems in inhomogeneous axially symmetric media," IEEE Transactions on Antennas and Propagation, May 1977, pp. 413-417.

Abstract: Classical electromagnetic potential formulations are, with the exceptions of a few special cases of one-dimensional stratification, restricted to use in uniform media. A recently developed potential formulation that provides a flexible basis for numerical computation of time-harmonic field problems involving continuously and discretely inhomogeneous axially symmetric media is the topic of this paper. The formulation manifests itself in both a differential equation system and, alternately, a variational criterion. Typical numerical applications include solutions of scattering by arbitrarily shaped material bodies of revolution and radiation from inhomogeneously loaded rotationally symmetric antenna structures. Current numerical investigations by the authors, using Mei's unimoment in conjunction with both finite-difference and finite-element techniques, have shown the formulation to be highly feasible for computation of field problems having dimensions as large as several wavelengths.

M-J Chien and E. S. Kuh, "Solving nonlinear resistive networks using piecewise-linear analysis and simplicial subdivision," IEEE Transactions on Circuits and Systems, v. CAS-24, n. 6, June 1977, pp. 305-317.

Abstract: In recent years numerous results of piecewise-linear analysis of nonlinear resistive networks have been derived. The applicability of the method relies on the fact that every nonlinear device is modeled by a piecewise-linear continuous function. In order to extend the applicability of piecewise-linear analysis to treat more general nonlinear networks, three steps need to be carried out.

- i) the subdivision of the domain of the multi-dimensional nonlinear network function;
- ii) the interpolation of a piecewise-linear continuous function on the subdivided domain; and
- iii) the application of piecewise-linear analysis.

It turns out that the above three steps can be accomplished effectively by using simplicial subdivision. In addition, the difficulties encountered in the conventional piecewise-linear analysis are simplified. The memory space needed for the analysis is also greatly reduced. The complete analysis has been implemented in a program on CDC 6400.

R. E. Jewett, P. I. Hagouel, A. R. Neureuther and T. Van Duzer, "Line-profile resist development simulation techniques," Polymer Engineering and Science, v. 17, n. 6, June 1977, pp. 381-384.

Abstract: The relative advantages and disadvantages of three different algorithms are compared for simulating the time evolution of two-dimensional line-edge profiles produced by a locally rate dependent surface etching phenomenon. Simulated profiles typical of optical projection printing and electron-beam and X-ray lithography of micron-sized lines in resist and etching of ion-implanted SiO_2 are used as a basis of comparison. One of the algorithms is a cell-by-cell removal model used earlier by Neureuther and Dill. One of the newly developed algorithms employs ray tracing; it can be shown that the path followed by a point on a front between the developed and undeveloped regions can be calculated using ray-optic equations. The other new algorithm uses a string of points initially on the surface of the exposed resist. The

points on the string advance perpendicular to the local direction of the string; with time the string of points moves down into the resist, replicating the action of a developer. We compare the computing cost, convenience, and accuracy of the algorithms.

E. I. Jury, V. R. Kolavennu and B. D. O. Anderson, "Stabilization of certain two-dimensional recursive digital filters," Proceedings of the IEEE, v. 65, n. 6, June 1977, pp. 887-892.

Abstract: A possible extension of a well-known stabilization technique for one-dimensional recursive digital filters to the two-dimensional case was proposed by Shanks via a conjecture, stating that the planar least squares inverse of a two-dimensional filter polynomial is minimum phase and hence stable. In the present work, the conjecture has been verified first for a class of polynomials which are linear in one variable and quadratic in the other and then extended to a class of polynomials of higher degrees in the same variables. Though the conjecture is known to be false, in general, some conditions under which the conjecture is valid are explored.

C. A. Desoer, F. M. Callier and W. S. Chan, "Robustness of stability conditions for linear time-invariant feedback systems," IEEE Transactions on Automatic Control, v. AC-22, n. 4, August 1977, pp. 586-590.

Abstract: The robustness of stability conditions for linear time-invariant feedback systems is examined, assuming three different types of representations; state space representation, coprime matrix fraction representation, and transfer function representation. We stress the importance of certain details of the representation used and, even more, the importance of making sure that the allowed perturbations be relevant to the physical situation under study.

L. Figueroa, D. Botez and S. Wang, "Analysis of mode broadening due to transient heating of optically pumped semiconductor lasers," IEEE Journal of Quantum Electronics, v. QE-13, n. 8, August 1977, pp. 612-615.

Abstract: We have found that the output spectra of cleaved semiconductor lasers are broadened when they are optically excited with a high-energy pulsed laser. We believe the effect is due to transient heating. A one-dimensional heat-flow equation has been solved, and the results are applied to two representative cases, GaAs and PbTe. Good agreement is obtained between the calculated broadening and the experimentally observed values.

J. K. Yan and D. J. Sakrison, "Encoding of images based on a two-component source model," IEEE Transactions on Communications, v. COM-25, n. 11, November 1977, pp. 1315-1322.

Abstract: In this paper we describe a code for grey-scale still images which separates the intensity function into two components: a discontinuous one representing intensity variations due to distinct objects and a continuous component due to such effects as texture. Each component is encoded separately and the two decoded components combined at the receiver. The code produces images with notably sharper detail and more pleasing appearance than a whole raster Fourier Transform code operating at the same rate.

B. J. Hosticka, R. W. Brodersen and P. R. Gray, "MOS sampled data recursive filters using switched capacitor integrators," IEEE Journal of Solid-State Circuits, v. SC-12, n. 6, December 1977, pp. 600-608.

Abstract: A new technique to analog sampled data filtering is presented which can be fully integrated using MOS technology. Advantages of this new approach are reduced circuit complexity, low sensitivity to coefficient variations, and efficient utilization of silicon area. Performance of monolithic low $Q(Q=1)$ and high $Q(Q=73)$ filters are presented which were implemented using NMOS technology. In implementing the high Q filter a new operational amplifier design was used which had a 14-V output range, rms noise voltage of 45 μ V, an open-loop gain of 6000, and a unity-gain bandwidth of 2 MHz.

A. Sangiovanni-Vincentelli, L-K Chen and L. O. Chua, "An efficient heuristic cluster algorithm for tearing large-scale networks," IEEE Transactions on Circuits and Systems, v. CAS-24, n. 12, December 1977, pp. 709-717.

Abstract: An efficient heuristic algorithm for solving a cluster problem associated with the tearing of an undirected graph is presented via the concept of a contour tableau. The required computation time is shown to be bounded by $O(nb)$, where n and b are the number of nodes and branches of the input graph, respectively.

Experimental results show that our algorithm is highly efficient and yields near optimal solutions.

C. Hu and C. Drowley, "Determination of diffusion length and surface recombination velocity by light excitation," Solid-State Electronics, v. 21, 1978, pp. 965-968.

Abstract: The current induced by a monochromatic light source in a Schottky barrier or p-n junction perpendicular to the sample surface is analyzed. Expressions for the induced current are derived for a scanning light spot and for uniform illumination with part of the sample shadowed. A uniform illumination induces a current that is more nearly an exponential function of the distance between the junction and the illuminated area than a moving spot. When the effect of surface recombination is strong, an alternative method of deducing the diffusion length from the measured current is suggested. The surface recombination velocity may be determined from the dependence of the collected current on the optical penetration depth in a simple manner.

G. J. Korsh and R. S. Muller, "Conduction properties of lightly doped, polycrystalline silicon," Solid-State Electronics, v. 21, 1978, pp. 1045-1051.

Abstract: A hyperbolic-sine relationship describing the current-voltage characteristics of lightly-doped, n-type polycrystalline silicon films is derived. The derivation is based on a previous model which assumes that electron-trapping states exist at the grain boundaries of the polycrystalline film. The trapped electrons cause a surface-depletion zone and a

potential barrier at each grain boundary. Electrons are transported over the barriers by thermionic emission. Conduction measurements carried out on commercially prepared samples are in good agreement with the theory developed both in voltage and temperature dependence. The model parameters obtained from conduction measurements correspond reasonably well with values inferred from scanning electron micrographs.

C. A. Desoer and Y. T. Wang, "On the minimum order of a robust servocompensator," IEEE Transactions on Automatic Control, v. AC-23, n. 1, February 1978, pp. 70-73.

Abstract: In recent papers [1]-[4], Davison et al. have given the characterization of a minimal-order robust error-driven servocompensator which achieves asymptotic tracking and disturbance rejection. In this note, we establish this minimality property by frequency domain methods. We show that any right coprime factorization of the controller, say $N_r(s)D_r(s)^{-1}$, must have all the elements of $D_r(s)$ divisible by $\phi(s)$, the minimal polynomial of the tracking and disturbance signal generator. Hence, its order must be at least $n_0 \cdot \partial(\phi)$ (n_0 =number of outputs, $\partial(\phi)$ =degree of ϕ).

M. P. Guedes, T. K. Gustafson, M. Heiblum, D. P. Siu, C. W. Slayman, J. R. Whinnery and Y. Yasuoka, "Photoinduced currents in metal-barrier-metal junctions," Radiation Energy Conversion in Space, v. 61, February 1978, pp. 524-548.

Abstract: The fabrication and application of metal-barrier-metal tunneling junctions for radiative interactions are discussed. In particular we describe the photolithographic fabrication of small area devices ($\leq 10^{-9}$ cm²). We also consider the coupling to such devices via surface plasmon waves which play an important role at infrared and optical frequencies. It has been shown that the junction electron tunneling currents can be strongly coupled to surface plasmon junction modes, and spontaneous and stimulated emission of the latter are possible as well as nonlinear interactions. Finally, results demonstrating the photo-excitation of electrons with subsequent tunneling induced by ultraviolet radiation will be presented. It is estimated that quantum efficiencies of the order of 5% and higher are possible in the ultraviolet region.

M. Heiblum, S. Wang, J. R. Whinnery and T. K. Gustafson, "Characteristics of integrated MOM junctions at dc and at optical frequencies," IEEE Journal of Quantum Electronics, v. QE-14, n. 3, March 1978, pp. 159-169.

Abstract: We present a new metal-oxide-metal device (Ni-NiO-Ni, "Edge MOM") which is stable, reproducibly fabricated, and with a 10^{-10} -cm² tunneling area. Performing detection experiments, the device's nonlinear I-V characteristic is shown to be invariant at audio frequencies, 10.6, 3.39, and 0.6328 μ m. Similar devices with 10^{-8} -cm² tunneling areas perform as well as the Edge MOM's in the visible and the near-infrared range, but deteriorate in performance at the 10- μ m range. A dominant competing effect is a thermal-induced signal, which increases with frequency and temperature. Coupling mechanisms at the various regimes are investigated.

The device can serve as a broad-band detector and mixer, and might in the future be a basic element of broad-band amplifiers and oscillators.

A. L. Sangiovanni-Vincentelli and Y. T. Wang, "On equivalent dynamic networks: elimination of capacitor loops and inductor cutsets," IEEE Transactions on Circuits and Systems, v. CAS-25, n. 3, March 1978, pp. 174-177.

Abstract: Equivalence of two $(n+1)$ -terminal dynamic networks is defined. An algorithm is presented which shows how networks with loops of capacitors and/or cutsets of inductors can be transformed into equivalent networks without such loops and cutsets. Implications of this result are discussed.

F. M. Callier, W. S. Chan and C. A. Desoer, "Input-output stability of interconnected systems using decompositions: an improved formulation," IEEE Transactions on Automatic Control, v. AC-23, n. 2, April 1978, pp. 150-163.

Abstract: We study the input-output stability of an arbitrary interconnection of multi-input, multi-output subsystems which may be either continuous-time or discrete-time. We consider, throughout, three types of dynamics: nonlinear time-varying, linear time-invariant distributed, and linear time-invariant lumped. First, we use the strongly connected component decomposition to aggregate the subsystems into strongly-connected-subsystems (SCS's) and interconnection-subsystems (IS's). These SCS's and IS's are then aggregated into column-subsystems (CS's) so that the overall system becomes a hierarchy of CS's. The basic structural result states that the overall system is stable if and only if every CS is stable. We then use the minimum-essential-set decomposition on each SCS so that it can be viewed as a feedback interconnection of aggregated subsystems where one of them is itself a hierarchy of subsystems. Based on this decomposition, we present results which lead to sufficient conditions for the stability of an SCS. For linear time-invariant (transfer function) dynamics, we obtain a characteristic function which gives the necessary and sufficient condition for the overall system stability. We point out the computational saving due to the decompositions in calculating this characteristic function. We believe that decomposition techniques, coupled with other techniques such as model reduction, aggregation, singular, and nonsingular perturbations, will play key roles in large scale system design.

S. Goto and E. S. Kuh, "An approach to the two-dimensional placement problem in circuit layout," IEEE Transactions on Circuits and Systems, v. CAS-25, n. 4, April 1978, pp. 208-214.

Abstract: In this paper a new approach to the placement problem is introduced. The main idea is to take advantage of what one can do in linear placement in tackling the two-dimensional placement problem. The method consists of three distinct phases, namely: decomposition, linear placement, and iterative improvement. Each is clearly spelled out. Both constructive and iterative algorithms are developed. The complexity of computation is analyzed and the method has been tried with practical examples. Although no general conclusion can be made on the effectiveness of the method, it appears that the method is at least comparable to that described in a recent paper [1].

N. R. Sandell, Jr., P. Varaiya, M. Athans and M. G. Safonov, "Survey of decentralized control methods for large scale systems," IEEE Transactions on Automatic Control, v. AC-23, n. 2, April 1978, pp. 108-128.

Abstract: This paper surveys the control theoretic literature on decentralized and hierarchical control, and methods of analysis of large scale systems.

C. Hu, "LED charge-control model and speed at high currents," Proceedings of the IEEE, v. 66, n. 5, May 1978, pp. 599-601.

Abstract: A simple charge-control model for light-emitting diodes exists. The equation may be applied to both waveform analysis and synthesis (current preshaping). At high current levels, the cutoff frequencies are higher than predicted from the static high-injection lifetimes alone. The harmonic contents in the output may be frequency dependent at high current levels and cannot be completely determined from the static intensity-current curve.

C. Hu, "Determination of nonuniform diffusion length and electric field in semiconductors," IEEE Transactions on Electron Devices, v. ED-25, n. 7, July 1978, pp. 822-825.

Abstract: A method is proposed that purports to measure the nonuniform diffusion length $L(x)$ in the presence of an arbitrary electric field $E_x(x)$. A point source of carrier generation (as a model for an electron beam) scans across the sample in the thickness direction x while the induced currents are measured at two reverse-biased junctions sandwiching the sample. $L(x)$ and $(E_x \mu_p + D_p)/D_p$ can be deduced from the currents. If only one collecting junction is present, one of the two functions may be deduced provided that the other is known; in addition, the surface recombination velocity at the other boundary may be determined in the presence of arbitrary $L(x)$ and $E_x(x)$. With additional scanning in the y and z directions, quasi three-dimensional mapping is possible.

W. Y. Lum, H. W. K. Chan and T. Van Duzer, "Switching measurements on Josephson memory loops," Journal of Applied Physics, v. 49, n. 7, July 1978, pp. 4302-4303.

Abstract: This paper corrects and clarifies a previously reported dependence of current-transfer time on loop and junction parameters for Josephson-junction memory cells.

D. J. Allstot, S. K. Lui, T. S-T Wei, P. R. Gray and R. G. Meyer, "A new high-voltage analog-compatible I^2L process," IEEE Journal of Solid-State Circuits, v. SC-13, n. 4, August 1978, pp. 479-482.

Abstract: A new technique for realizing high-performance I^2L circuits simultaneously with high-voltage analog circuits is described. The method is flexible and may be used with any standard linear bipolar process. Only one additional noncritical masking step and one phosphorous implant are required to form the I^2L n-wells.

Experimental results are presented which show I^2L betas of greater than 8 per collector with the I^2L BV_{CEO} exceeding 3 volts. The measured minimum average propagation delay is 40 ns using a 14 micron thick, 5 ohm-cm epitaxial layer, while the analog BV_{CEO} exceeds 50 volts.

W. S. Chan and Y. T. Wang, "A basis for the controllable canonical form of linear time-invariant multiinput systems," IEEE Transactions on Automatic Control, v. AC-23, n. 4, August 1978, pp. 742-745.

Abstract: The controllable canonical form of linear time-invariant multiinput systems is directly derived by first exhibiting an explicit basis. The well-known result for the single-input case can be viewed as a special case of our result.

W. Y. Lum and T. Van Duzer, "Resonances in semiconductor-barrier Josephson junctions," Journal of Applied Physics, v. 49, August 1978, pp. 4560-4563.

Abstract: An analysis is made of the cavity resonances in Josephson junctions with semiconductor barriers. The quality factor Q is evaluated for Pb-Te-Pb junctions and it is found to be typically on the order of unity. Agreement with experiment is shown. The lower Q constitutes an advantage over oxide-barrier junctions for digital applications where cavity resonances can lead to unpredictable switching behavior.

H. Mukai and E. Polak, "On the use of approximations in algorithms for optimization problems with equality and inequality constraints," SIAM Journal of Numerical Analysis, v. 15, n. 4, August 1978, pp. 674-693.

Abstract: This paper presents an efficient implementation scheme for optimization algorithms in the family of gradient projection, reduced gradient, and gradient restoration methods.

C. A. Desoer, "Perturbation in the I/O map of a non-linear feedback system caused by large plant perturbation," Journal of the Franklin Institute, v. 306, n. 3, September 1978.

Abstract: This paper studies the perturbation in the input-output (I/O) map of a multi-input multi-output non-linear feedback system caused by large plant perturbations. It compares the effect of these perturbations on the given feedback system and on the nominally equivalent open-loop system. First the unity feedback system is considered, then a more general configuration—which includes the usual summing node as a special case—is analyzed. In both cases it is shown that the degree of desensitization provided by feedback is controlled by the linearized return difference operator.

S. A. J. Druet, B. Attal, T. K. Gustafson and J. P. Taran, "Electronic resonance enhancement of coherent anti-stokes Raman scattering," Physical Review, v. 18, n. 4, October 1978, pp. 1529-1557.

Abstract: We analyze the enhancement of the CARS susceptibility when the frequencies of the waves involved are tuned into resonance with discrete and continuum one-photon absorptions, and discuss the applications. We first derive the expression for the susceptibility by means of the usual iterative treatment of density matrix perturbations. We then show that this derivation can be done in a straightforward manner by means of a time-ordered diagrammatic representation, which brings novel physical insight into CARS mechanisms. This representation can also be used to analyze the transient behaviour of CARS as the pump fields are turned on and off. In addition, we discuss resonant CARS spectroscopy in the gas phase. The spectrum is composed of the expected enhanced Raman lines and also of double-electronic-resonance lines. All these lines are Doppler-free and occur as doublets. We derive their relative intensities based on detunings, collisional broadening, Franck-Condon overlap integrals and rotational transition moments. The line contours are predicted by representing the susceptibility in the complex plane. The problems arising from saturation and optical Stark effect are also considered; all should be small below pump densities of 100 MW/cm^2 in gas mixtures near STP. Fluorescence interference is negligible, except at power densities high enough for the Stark effect to be large. Beam absorption is also negligible at STP if the resonant species' concentration is less than 1000 ppm; phase matching is then satisfied. Finally, an experimental resonant CARS spectrum of I_2 at 1 mb in air near STP is presented and interpreted; the susceptibility is about 400 times larger than that of O_2 off resonance and under the same thermodynamic conditions.

C. L. McMaster, "An analysis of algorithms for the Dutch National Flag problem," Communications of the ACM, v. 21, n. 10, October 1978, pp. 842-846.

Abstract: Solutions to the Dutch National Flag Problem have been given by Dijkstra [1] and Meyer [3]. Dijkstra starts with a simple program and arrives at an improved program by refinement. Both of the algorithms given by Dijkstra are shown to have an expected number of swaps which is $2/3 N + O(1)$ and that these values differ at most by $1/3$ of a swap and asymptotically by $1/4$ of a swap. The algorithm of Meyer is shown to have expected swap complexity $5/9 N$.

T. K. Yee and T. K. Gustafson, "Diagrammatic analysis of the density operator for nonlinear optical calculations: pulsed and cw responses," Physical Review A, v. 18, n. 4, October 1978, pp. 1597-1617.

Abstract: In the present paper a diagrammatic analysis of the density operator for the evaluation of nonlinear optical quantities is considered. The present approach extends earlier diagrammatic analysis by treating the time evolution of both the wave function and its complex conjugate. Time-ordered graphs result, each of which corresponds to a term in the density matrix. Examples involving the third-order susceptibility are discussed for both monochromatic and pulse excitation. In

particular coherent rotational transient birefringence is discussed. The diagrams provide a convenient means by which nonlinear optical processes can be precisely defined and the susceptibility readily evaluated.

B. Zee, "Broadening mechanism in semiconductor (GaAs) lasers: limitations to single mode power emission," IEEE Journal of Quantum Electronics, v. QE-14, n. 10, October 1978, pp. 727-736.

Abstract: A nonlinear steady state theory of the emission spectrum of semiconductor (GaAs) lasers above threshold is developed, and limitation to power in a single longitudinal mode studied. The nonlinear steady state rate equations describing the power and the gain are solved iteratively. The model is based on the well known idea that the gain always saturates somewhere below the loss, and power sharing among the modes is dependent on the relative gain of the modes with respect to the loss level. The limitation to single mode power is essentially due to the uneven rate of saturation of the gain of the different modes as they approach the loss level asymptotically, with the dominant mode having the fastest saturation. The rate of saturation of the gain of different modes depends on the power emission spectrum and the intraband relaxation rate of the carriers. In this work, the relaxation is accounted for by using the generalized spectral weight function to describe the carriers. The dependence of maximum single mode power on intraband relaxation time is obtained. It ranges from a few milliwatts for relaxation time of the order of 10^{-12} to hundreds of milliwatts for relaxation time of 10^{-13} sec. The predictions of the model on gain saturation spectra, and carrier lifetime spectra agree well with experimental observations. The gain is seen to saturate near the lasing energy but continues to increase at a reduced rate at higher energy levels. The carrier radiative lifetime is found to decrease sharply in the vicinity of the lasing mode energies.

D. J. Allstot, R. W. Brodersen and P. R. Gray, "MOS switched capacitor ladder filters," IEEE Journal of Solid-State Circuits, v. SC-13, n. 6, December 1978, pp. 806-814.

Abstract: A new technique for designing precision, fully integrated, high-order filters using standard MOS technology is described. Switched capacitor integrators have been used to realize long time constants in small areas, and by interconnecting these integrators in a "leapfrog" configuration, monolithic high-order filters have been implemented with transfer functions that are very insensitive to component variations. Experimental results are presented for an NMOS fifth-order Chebyshev low-pass ladder filter with 0.1-dB passband ripple, a cutoff frequency of 3.4 kHz when clocked at 128 kHz, and a dynamic range of 83 dB. An efficient method for implementing transmission zeros is also presented, along with a complete design example, and additional experimental results for a third-order elliptic low-pass ladder filter which achieved 90-dB dynamic range, with a total power dissipation of 18 mW in a die area of 4400 mil^2 .

G. M. Jacobs, D. J. Allstot, R. W. Brodersen and P. R. Gray, "Design techniques for MOS switched capacitor ladder filters," IEEE Transactions on Circuits and Systems, v. CAS-25, n. 12, December 1978, pp. 1014-1021.

Abstract: Design techniques for monolithic, high-precision, MOS sampled-data active-ladder filters are described. Switched capacitor integrators are used to implement the "leapfrog" configuration for simulating doubly terminated LC ladder networks. Techniques are presented for designing all-pole low-pass filters, as well as methods for including transmission zeros. An approach for implementing bandpass filters is described which is derived from the conventional low-pass-to-bandpass transformation. Monolithic realizations for two different low-pass filters are briefly described which show excellent agreement with theory.

H. Mukai and E. Polak, "A second-order method for the general nonlinear programming problem," Journal of Optimization Theory and Applications, v. 26, n. 4, December 1978, pp. 515-532.

Abstract: This paper presents a multiplier-type method for nonlinear programming problems with both equality and inequality constraints. Slack variables are used for the inequalities. The penalty coefficient is adjusted automatically, and the method converges quadratically to points satisfying second-order conditions.

H. Mukai and E. Polak, "A second-order method for unconstrained optimization," Journal of Optimization Theory and Applications, v. 26, n. 4, December 1978, pp. 501-513.

Abstract: This paper presents a quadratically converging algorithm for unconstrained minimization. All the accumulation points that it constructs satisfy second-order necessary conditions of optimality. Thus, it avoids second-order saddle and inflection points, an essential feature for a method to be used in minimizing the modified Lagrangians in multiplier methods.

A. J. Smith, "An analytic and experimental study of multiple channel controllers," IEEE Transactions on Computers, v. C-27, n. 1, January 1979, pp. 38-49.

Abstract: A multiple channel controller (MCC) is a controller which switches a given number of channels among a larger number of input/output devices and permits simultaneous access to as many devices as there are channels available. A simple queuing model for multiple channel controllers is created, and an approximate solution for this model is generated. The approximate solution is found, using simulation, to be very close for those cases examined to the actual behavior of the model. Further simulations indicate that the approximate solution of the model appears to be robust with respect to changes in some of the assumptions used in making the approximation. Trace data from a real system are analyzed and they confirm the predicted utility of MCC's. The problem of optimal scheduling of MCC's is briefly discussed. Alternative system configurations are compared with the objective of minimizing queuing delays.

W. G. Oldham, "In Situ characterization of positive resist development," Optical Engineering, v. 18, n. 1, January-February 1979, pp. 59-62.

Abstract: The exposure of certain positive photoresists has been shown by Dill and co-workers to be modelable in terms of a local inhibitor concentration which results in a local development rate. The development process is assumed to be a surface etching reaction in which the surface velocity is the local development rate. The characterization of resists for the purpose of line-edge profile simulation therefore involves the measurement of development rate for controlled exposure dose profiles. In this paper a technique is described in which the resist thickness is continuously plotted during development. The low frequency capacitance is measured using a conducting substrate as one plate, and the highly conductive developer as the other plate of the capacitor. The inverse capacitance, proportional to the composite resist-oxide thickness, is obtained using an analog divider. Examples of standing wave effects in Shipley AZ 1350 resists, and resist development rate modification using chlorobenzene are presented.

D. Anastassiou and D. J. Sakrison, "New bounds to $R(D)$ for additive sources and applications to image encoding," IEEE Transactions on Information Theory, v. IT-25, n. 2, March 1979, pp. 145-155.

Abstract: In order to apply the results of information theory to the efficient storage or transmission of images, it is necessary to model the image source distribution and specify an appropriate fidelity criterion. One useful source model results from separating the log intensity random field of a typical image into the sum of two nearly independent random fields with a simpler description. It has also been found that under certain conditions a frequency-weighted squared-error fidelity criterion is satisfactory for evaluating the images. Thus it is important to consider the situation in which the source output is the sum of two independent random entities with known rate-distortion functions with respect to a (perhaps frequency-weighted) squared-error criterion. These rate-distortion functions are used to provide new bounds to the rate-distortion function of the additive source with respect to the same criterion. In one example considered, the new bounds are the tightest known in certain distortion regions. Examples from image coding are given, including a comparison of the performances of various encoding schemes.

C. Hu, "Optimum doping profile for minimum ohmic resistance and high-breakdown voltage," IEEE Transactions on Electron Devices, v. ED-26, n. 3, March 1979, pp. 243-244.

Abstract: The optimum doping profile of a lightly doped layer that introduces the minimum series resistance and sustains a given junction breakdown voltage is derived. The theory applies to a one-dimensional Schottky diode and qualitatively to the collector or drain doping profiles of transistors. The minimum series resistance is found to be about $3.7 \times 10^{-9} V_B^{2.6} \Omega \cdot \text{cm}^2$ for an n silicon layer. The optimum doping profile can be closely approximated by a conventional uniformly doped n-n⁺ structure.

B. Zee, "Models and method of calculation of doping and injection-dependent impurity density of states in GaAs," Physical Review B, v. 19, n. 6, March 1979, pp. 3167-3180.

Abstract: Using the solution to the problem of screened Coulomb potential for the low-doping regime, the theories of Morgan and of Halperin and Lax, respectively, for the medium- and high-doping regimes, the conduction- and valence-band impurity density of states of GaAs are expressed in explicit analytic forms and calculated self-consistently. The effects of injection and doping on the density of states are studied. To avoid the self-consistent iterative process but still take into account the effects of screening, a method of calculation for the density of states is obtained. It is shown that in many cases, the screening length can be determined using the Boltzmann approximation or the parabolic-band approximation. The region of validity for each approximation in the injection-doping space is found. Density of states calculated using these approximations are compared with density of states calculated self-consistently.

Accepted for Publication:

C. A. Desoer and Y. T. Wang, "The robust nonlinear servomechanism problem," International Journal on Control.

Abstract: We study the asymptotic tracking and disturbance rejection property of a general nonlinear multi-input multi-output distributed servomechanism which consists of input as well as output channel nonlinearity. We also explore the robustness of this property of such nonlinear servomechanism. Our result shows that the design principle of the robust linear servomechanism (i.e. replicating the dynamics of the reference and disturbance signals) works well for a large class of nonlinear servos provided that certain stability conditions are satisfied.

C. Gonzaga and E. Polak, "On constraint dropping schemes and optimality functions for a class of outer approximations algorithms," SIAM Journal on Control and Optimization.

Abstract: This paper presents a new class of outer approximations algorithms which incorporate constraint dropping schemes. The algorithms are based on the use of certain types of optimality functions, which are commonly used in minimization algorithms, for defining stationary points. The algorithms are implementable in that all the inner minimizations and maximizations need to be carried out only approximately. It is shown that any accumulation point constructed by these algorithms is both feasible and stationary.

C. D. Hartgring, W. G. Oldham and T-Y Chiu, "A MESFET model for circuit analysis," Solid-State Electronics.

Abstract: A model for silicon Schottky barrier field-effect transistors (Si MESFETs) with micron and submicron dimensions has been implemented in the integrated circuit simulation program SPICE2. A description of the model and its implementation is given, together with a discussion of the physical effects that are important in submicron channel length Si MESFETs. The model is compared with experimental data (DC) with emphasis on temperature dependence.

T-L Hwang, S. E. Schwarz and D. B. Rutledge, "Microbolometers for infrared detection," Applied Physics Letters.

Abstract: We describe a novel room-temperature detector for the wavelength range 10-1000 microns. This detector consists of a thin bismuth bolometer film with dimensions much smaller than a wavelength. The small size of the detector results in reduced NEP and faster response. A video NEP of $1.6 \times 10^{-10} \text{ W/Hz}^{1/2}$ is obtained at 119 μm , remaining within a factor of ten of this value for modulation frequencies up to 25 MHz. When used as a mixer, the device is predicted to have an NEP of $3.5 \times 10^{-18} \text{ W/Hz}$. It is easily fabricated with conventional planar processing techniques and can be replicated in arrays. The device is expected to be most useful when the radiation to be detected is spatially coherent.

E. I. Jury and L. F. Chaparro, "Remark on an equivalent relation in least square approximation," Proceedings of the IEEE.

Abstract: In this note it is shown that the least square inverse of the 2-D polynomial $B(z_1, z_2) = b_{00} + b_{mt} z_1^m z_2^t + b_{ns} z_1^n z_2^s + b_{m+n, s+t} z_1^{m+n} z_2^{s+t}$ with $(nt-ms) \neq 0$ is stable. This extends the Shanks' conjecture for a larger class of 2-D polynomials.

S. H. Kwan, C. T. Chuang, R. S. Muller and R. M. White, "Dual-gate depletion-mode D-MOS transistor for linear gain-control application," IEEE Transactions on Electron Devices.

Abstract: A conveniently implemented means is described for obtaining linear voltage control over the gain of dual-gate D-MOS transistor amplifiers. This approach is applicable to surface acoustic wave (SAW) transversal filters and signal-processing modules. The system makes use of dual-gated, depletion-mode, n-channel, D-MOS transistors. When two dual-gate DMOSTs with their associated transducers are connected in a suitable differencing circuit, the gain (tap weight) depends linearly upon an applied control voltage to a deviation of only ± 1 dB over a dynamic range of more than 50 dB. This linear property greatly simplifies the setting of tap weights in a transversal filter and provides versatility for acoustic-wave signal processing. A simple four-transistor model is proposed for the dual-gate D-MOST. Theoretical analysis agrees well with experimental results and justifies the validity of the differencing scheme. An analytical solution for the device transconductance as a function of the control voltage is

derived. Analysis based on this model gives insight into the operation of the dual-gate D-MOST, and the design and optimization of the sensor and amplifying devices.

E. Polak and A. Sangiovanni-Vincentelli, "Theoretical and computational aspects of the optimal design centering, tolerancing and tuning problem," IEEE Transactions on Circuits and Systems.

Abstract: The optimal design centering, tolerancing and tuning problem is transcribed into a mathematical programming problem of the form

$$P_g : \min(f(x) | \max_{\omega \in \Omega} \min_{\tau \in T} \max_{j \in J} \zeta^j(x, \omega, \tau) \leq 0, x \geq 0), x, \omega, \tau \in \mathbb{R}^n,$$

$f: \mathbb{R}^n \rightarrow \mathbb{R}^1$, $\zeta: \mathbb{R}^n \times \mathbb{R}^n \rightarrow \mathbb{R}^1$, continuously differentiable, Ω and T compact subsets of $\mathbb{R}^n$, $J = \{1, \dots, p\}$. A simplified form of P_g , $P: \min(f(x) | \psi(x) \triangleq \max_{\omega \in \Omega} \min_{\tau \in T} \zeta(x, \omega, \tau) \leq 0)$ is discussed. It is shown

that $\psi(\cdot)$ is locally Lipschitz continuous but not continuously differentiable. Optimality conditions for P based on the concept of generalized gradients are derived. An algorithm, consisting of a master outer approximations algorithm proposed by Gonzaga and Polak and of a new subalgorithm for nondifferentiable problems of the form $P_1: \min(f(x) | \max_{\omega \in \Omega_1} \min_{\tau \in T} \zeta(x, \omega, \tau) \leq 0)$, where Ω_1 is a discrete set, is

presented. The subalgorithm, an extension of Polak's method of feasible directions to nondifferentiable problems is shown to converge under suitable assumptions. Moreover, the optimality function used in the subalgorithm is proven to satisfy a condition which guarantees that the overall algorithm converges.

N. B. Guy Rabbat, A. L. Sangiovanni-Vincentelli and H. Y. Hsieh, "A multi-level Newton algorithm with macromodeling and latency for the analysis of large-scale nonlinear circuits in the time-domain," IEEE Transactions on Circuits and Systems.

Abstract: Analysis techniques which take advantage of the structural properties of large scale electrical networks are discussed. Exact macromodels of a subnetwork are defined and a sufficient condition on the sub-network equations for the existence of a macromodel is given. A multi-level Newton algorithm based on macromodels is presented. The algorithm is shown to have local quadratic convergence provided that suitable conditions on the continuity and nonsingularity of the Jacobian of the network equations are satisfied. The concept of latency for the analysis of large scale networks in the time domain is discussed. The relationship between latency and numerical integration methods is investigated. Some examples of application of the multi-level Newton algorithm with latency are presented.

Y. Yasuoka, M. Heiblum and T. K. Gustafson, "Coupling to an 'Edge-Metal-Oxide-Metal' junction via an evaporated long antenna," Applied Physics Letters.

Abstract: The observation of planar, long antenna coupling to a metal-oxide-metal (edge configuration) has been demonstrated at $\lambda = 118 \mu\text{m}$. The two major lobes of an eleven wavelength antenna are coupled to via a superstrate prism.

Insufficient data is presently available to identify with certainty the mechanism of detection.

Conference Talks:

R. W. Brodersen, "Introduction to charge transfer device discrete time processing," WESCON/76, Los Angeles, California, September 1976.

A. R. Neureuther, R. E. Jewett, P. I. Hagcuel and T. Van Duzer, "Surface etching simulation and applications in IC processing," Kodak Microelectronics Seminar, Monterey, California, October 1976.

E. I. Jury, "An overview of Shanks' conjecture and comments on its validity," 10th Annual Asilomar Conference on Circuits, Systems and Computers, Monterey, California, November 1976.

W. C. Black, Jr., R. H. McCharles and D. A. Hodges, "CMOS process for high-performance analog LSI," 1976 International Electron Device Meeting, Washington, D.C., December 1976. Also appeared in Technical Digest.

B. J. Hosticka, R. W. Brodersen and P. R. Gray, "MOS sampled data recursive filters using switched capacitor integrators," IEEE International Symposium on Circuits and Systems, Phoenix, Arizona, April 1977.

A. Sanviovanni-Vincentelli, L-K Chen and L. O. Chua, "A new tearing-approach -- node-tearing nodal analysis," International Symposium on Circuits and Systems, Phoenix, Arizona, April 1977.

C. A. Desoer, F. M. Callier and W. S. Chan, "Robustness of stability conditions for linear time-invariant feedback systems," Joint Automatic Control Conference, San Francisco, California, June 1977.

S. H. Kwan, R. S. Muller and R. M. White, "High frequency strain transducer for acoustic wave signal processing," 1977 Device Research Conference, Cornell University, Ithaca, New York, June 1977.

J. K. Yan and D. J. Sakrison, "Encoding of images based on a two-component source model," IEEE International Symposium on Information Theory, Cornell University, Ithaca, New York, October 1977.

D. J. Allstot, T. S-T Wei, S. K. Lui, P. R. Gray and R. G. Meyer, "A high-voltage analog-compatible I^2L process," International Electron Devices Meeting, Washington, D.C., December 1977.

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