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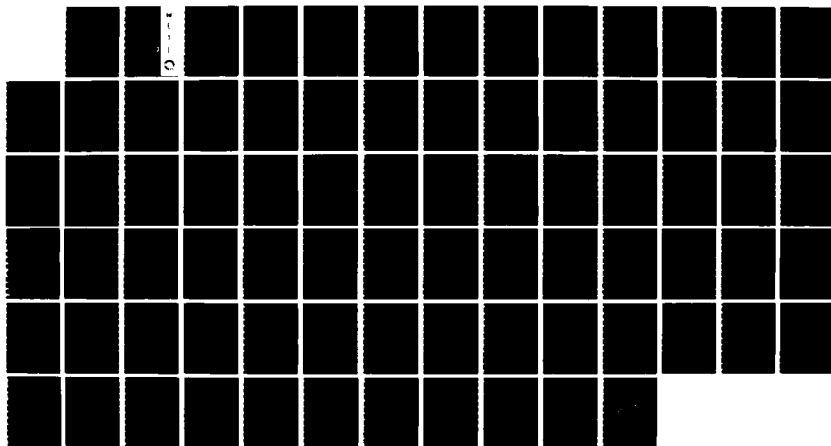
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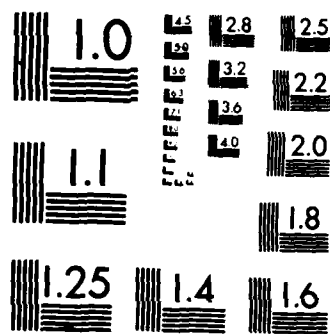
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XEROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

ETL - 0434

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Bibliography of in-house
and contract reports,
supplement 14

E. James Books
Margaret F. Fox
Alice L. Holmes

AD-A173 750

August 1986

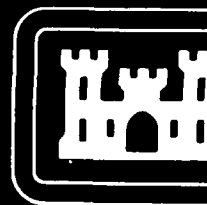


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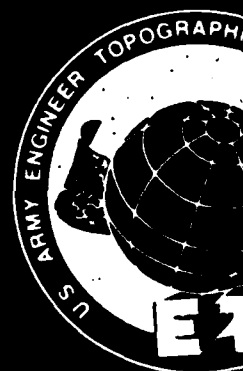
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Prepared for
U.S. ARMY CORPS OF ENGINEERS
ENGINEER TOPOGRAPHIC LABORATORIES
FORT BELVOIR, VIRGINIA 22060-5546

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ETL-0434	2. GOVT ACCESSION NO. AD-A173750	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) BIBLIOGRAPHY OF IN-HOUSE AND CONTRACT REPORTS, SUPPLEMENT 14		5. TYPE OF REPORT & PERIOD COVERED Bibliography, Supplement 14 1 Jan 85 - 31 Dec 85
7. AUTHOR(s) E. James Books Margaret F. Fox Alice L. Holmes		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer Topographic Laboratories Fort Belvoir, Virginia 22060-5546		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer Topographic Laboratories Fort Belvoir, Virginia 22060-5546		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE August 1986
		13. NUMBER OF PAGES 75
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for Public Release; Distribution Unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Author and title indexes are provided for the ETL "Bibliographies of In-House and Contract Reports." The indexes are designed to be used in conjunction with the 14 published bibliographies and refer to them by year and number.		

PREFACE

This is Supplement 14 to the report titled, "Bibliography of In-House and Contract Reports" AD-877 653L; Supplement 1, AD-890 066L; Supplement 2, AD-905 548L; Supplement 3, AD-B005 275L; Supplement 4, AD-B010 6421; Supplement 5, AD-B019 966L; Supplement 6, AD-A055 468; Supplement 7, AD-A068 744; Supplement 8, AD-A084 111; Supplement 9, AD-A099 803; Supplement 10, AD-A113 006; Supplement 11, AD-A128 400; Supplement 12, AD-A141 778; and Supplement 13, AD-A160 607. It is a continuing bibliography of reports prepared by and for the U.S. Army Engineer Topographic Laboratories (USAETL), Fort Belvoir, Virginia. This bibliography includes reports that were published from 1 January 1985 through 31 December 1985.

Reports with AD numbers can be purchased by Department of Defense agencies from the Defense Technical Information Center; other agencies and individuals can purchase copies from the National Technical Information Service, Springfield, Virginia 22161. Reports with a "B" in the AD number are limited in distribution to U.S. Government agencies unless permission for release is granted from the controlling office. Reports are available on an interlibrary loan from the Scientific and Technical Information Center (STINFO), U.S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia 22060-5546.

COL Alan L. Laubscher, CE was Commander and Director, and Mr. Walter E. Boge was Technical Director of the Engineer Topographic Laboratories during the report preparation.



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TEXTURE ANALYSIS AND CARTOGRAPHIC FEATURE EXTRACTION

January 1985

Rand, Robert S.

Keywords: Ad-Hoc Image Descriptor, Bayes Classifier, Bhattacharyya Distance, Clustering, Digital Image Analysis Laboratory (DIAL), Feature Extraction, Interactive Processing, Laws Texture Measure, Principal Components, Raster Processing, Relaxation

Investigations into using various image descriptors as well as developing interactive feature extraction software on the Digital Image Analysis Laboratory (DIAL) have culminated in a revised procedure to test statistical classification methods. An interactive experiment using this procedure was performed and showed that of the image descriptors tested, the most significant was a two-component vector derived from an average and a standard deviation measure of gray shades. The texture measures failed to deliver any increase in performance for the classifier. In general, this report shows that statistical classification methods are insufficient by themselves to deliver the performance needed in a semi-automated cartographic feature extraction system.

ETL-0371

AD-A156 735

ANALYSIS OF EDGE DETECTION ALGORITHMS ON DIAL

January 1985

Brown, Jane M.

Keywords: Feature Extraction, Edge Detection, Nonlinear Edge Masks, Directional Edge Masks, Relaxation, Zero-Crossing (2nd Order Differential) Operator, Sobel, Marr Edge Detector, Prewitt Edge Masks, Kirsch Edge Masks

A study was conducted to determine whether selected edge-finding algorithms could be used in a semiautomated feature extraction system to find lineal features such as roads and boundaries. This research note analyzes and compares selected edge-finding algorithms, and comments on their integration with other feature classification algorithms.

**CULTURAL DATA BASE IMPLEMENTATION STUDY AND
COMPUTER-AIDED SCENE MODELING SYSTEM USERS MANUAL**
October 1984

Panton, D.J.
Murphy, M.E.
Grosch, C.B.

Control Data Corporation

DAAK70-81-C-0063

Keywords: Cultural Data Base, Digital Imagery, Photogrammetry, Software, Structures, Workstation

This report describes the software developed for cultural features data base generation as implemented in the Remote Work Processing Facility at the Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC). Manmade structures such as buildings, smokestacks, or storage tanks that appear on stereo pictures are measured by an operator and the measurements are combined by the software system to create a data base. Concepts, commands, and operational procedures are discussed.

**EVIDENTIAL REASONING IN EXPERT SYSTEMS
FOR IMAGE ANALYSIS
February 1985**

Thompson, Terence R.

System Planning Corporation

DACA72-84-C-0006

Keywords: Image Analysis, Expert Systems, Evidential Reasoning

This report documents efforts to understand approaches to evidential reasoning of use in application of expert-system or knowledge-based-system techniques to image analysis (IA). There is a growing evidence that these techniques offer significant improvements in image analysis, particularly in the coordinated application of specialized algorithms.

This effort has four principal goals: (1) to clarify the basic issues in evidential reasoning (ER), (2) to provide a common framework for analysis, (3) to structure the ER process for major expert-system tasks in image analysis, and (4) to identify promising directions for further research.

This research was carried out in three major segments. The first segment structured the evidential-reasoning problem in a formal paradigm robust enough to be of practical use in design and construction of expert systems. It then formulated six important theoretical approaches in a parallel fashion in order to identify key assumptions, similarities, and differences.

The second segment applied each of the ER approaches to three important tasks for expert systems in the domain of image analysis. This segment concluded with an assessment of the strengths and weaknesses of each approach.

The third segment addressed promising directions for further research. It reviewed current results and identified important questions bearing on successful application of expert-system technology to image analysis.

ALTERNATIVE THEORIES OF INFERENCE IN EXPERT SYSTEMS FOR IMAGE ANALYSIS

February 1985

Cohen, Marvin S.
Watson, Stephen R.
Barrett, Eamon

Decision Science Consortium, Incorporated

DACA72-84-C-0005

Keywords: Expert Systems, Uncertainty, Belief Functions, Fuzzy Sets, Non-Monotonic Logic, Bayesian Statistics, Image Analysis

Reasoning with uncertainty is essential in most expert system applications to image understanding, both for bottom-up analysis of pixel data and for top-down utilization of general knowledge. A variety of alternative approaches have been proposed for inference in expert systems: Bayesian probabilities, belief functions, fuzzy sets, non-monotonic logic, and others. They differ in the concepts they seek to address, in their normative justification, in computational feasibility and input burden, and psychological aptness for the purposes of experts and expert system users.

The present report has two main objectives: (1) to clarify the strengths and weaknesses of various inference mechanisms for expert system applications, and (2) to develop alternative approaches which remedy shortcomings and retain strengths. We develop the top-level design of a new system, the Non-Monotonic Probabilist (NMP), which takes into account the actual practice of expert statisticians in probabilistic reasoning. Probabilistic analysis typically requires extensive judgments regarding interdependencies among hypotheses and data, and regarding the appropriateness of various alternative models. The application of such models to real problems is typically an iterative process, in which the plausibility of the results confirms or disconfirms the validity of judgments and assumptions made in building the model. All these features seem to conflict with the modularity of knowledge representations associated with current expert systems. The Non-Monotonic Probabilist, however, embeds a belief function calculus within a framework of non-monotonic reasoning. Probabilistic statements and rules are regarded as assumptions whose acceptance or use depends on their consistency with other beliefs. Non-monotonic reasoning is itself guided by measures of the credibility of belief function arguments. Fuzzyifying those measures provides for a simple, graded process of control over belief revision. To the extent that assumptions are explicitly tracked and reevaluated, conflict among different sources of evidence or lines of reasoning can lead to improved overall truth of a system of beliefs, and to better analytical results, instead of meaningless statistical compromise.

**DEFENSE MAPPING AGENCY (DMA)
RASTER-TO-VECTOR ANALYSIS
November 1984**

Selden, David D.
Went, Burton H., Jr.
Kleszczelski, Stan E.

Battelle-Columbus Laboratories

DAAHO1-83-D-A008

Keywords: Mapping, Cartography, Plotters, Graphics, Analog-to-Vector Conversion, Raster-to-Vector Conversion, Digital Systems, Benchmark Testing

In this study a comprehensive evaluation was conducted of the analog map to digital cartographic vector data (A/V) conversion process. The evaluation consists of six major subsections: (1) development of an analog-to-vector conversion model which defines an objective framework for evaluation of systems which implement this process; (2) a study of raster-to-vector conversion algorithms and software implementations; (3) a study of current and projected A/V conversion procedures requirements at DMA Hydrographic/Topographic and Aerospace Centers; (4) a study of state-of-the-art automated cartographic data capture systems; (5) development of a standard DMA A/V benchmark testing package and methodology; and (6) recommendations for future research and development.

ETL-0383A

AD-B091 534L

**DEFENSE MAPPING AGENCY (DMA)
RASTER-TO-VECTOR ANALYSIS-APPENDIX
November 1984**

Selden, David D.
Went, Burton H., Jr.
Kleszczelski, Stan E.

Battelle-Columbus Laboratories

DAAHO1-83-D-A008

This has been published as a special appendix to report number ETL-0383.

**DEFENSE MAPPING AGENCY
RASTER-TO-VECTOR BENCHMARK TESTING
December 1984**

Selden, David D.
Went, Burton H., Jr.

Battelle-Columbus Laboratories

DAAHO1-83-D-A008

Keywords: Mapping, Cartography, Benchmark Testing Materials, Benchmark Testing Methods, Scanners, Digitizing Systems, Graphics, Plotters

Battelle's Columbus Laboratories (BCL) conducted raster-to-vector benchmark testing on two cartographic data capture systems at the Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC). A cartographic benchmark testing package and testing methodology, developed during an earlier project, were validated during the testing on DMA production systems. This final report consists of six topical areas: (1) benchmark testing materials and testing methods, (2) benchmark testing results, (3) benchmark testing materials and testing methodology validation, (4) recommendations for benchmark testing of non-DMA cartographic data capture systems, (5) recommendations for future research and development, and (6) observations about in-house system characteristics and operating procedures.

ETL-0385

AD-A153 112

**FURTHER STUDY OF DIGITAL MATCHING
OF DISSIMILAR IMAGES
February 1985**

Berenstein, Carlos
Kanal, Laveen
Lambird, Barbara

Lavine, David
Leifker, Daniel
Olson, Eric

L.N.K. Corporation

DACA76-82-C-0003

Keywords: Edge Detection, Filtering, Match Accuracy, Point Feature Matching, Registration

This report reviews the L.N.K. registration algorithm and provides an example. The matching of radar and optical imagery was investigated. Special processing of the radar imagery was found to be required and an edge-preserving local filter was successfully applied. A foundation was begun for transformation reliability estimation through the concept of point pattern spaces, as an alternative preferable to least squares. Pattern spaces for translation, rotation, and point reordering were considered.

LANDSAT AND DMA ELEVATION STUDY
September 1984

Faust, N.L.

Georgia Institute of Technology

F-33657-82-G-2083

E-115

Keywords: DFAD, DTED, Landsat, MSS, TM, Visual

A study was undertaken to investigate the overlay of Landsat MSS and TM data over DMA elevation data. Two study regions in different physiographic regions were studied. Landsat data were geometrically corrected to overlay the DTED elevation. DFAD data for one study area were decoded and overlaid on Landsat data. Three dimensional perspective images of the integrated data set were developed.

ETL-0387

AD-A152 519

**APPLICATION OF ARTIFICIAL INTELLIGENCE TO
RADAR IMAGE UNDERSTANDING**
February 1985

Franks, D.T.
Musselman, J.A.
Sapp, J.W.

Software A&E, Incorporated

N00014-84-C-0463

Keywords: Radar Image Understanding, Image Processing, Artificial Intelligence

This report describes applied research into the application of artificial intelligence (AI) techniques to the problems associated with the extraction of terrain features from synthetic aperture radar (SAR) images. Specific AI techniques have been implemented and analyzed. They have given positive results. A conceptual model for an image-understanding system is described. The model provides the framework for a flexible experimental image-understanding research tool as well as potential for growth to an operational system.

**A NEW LARGE-SCALE, HIGH-RESOLUTION, MULTICOLOR
SOFTWARE DISPLAY CONCEPT**

March 1985

Logan, Joseph G.

Applied Energy Sciences, Incorporated

DACW72-84-C-0013

Keywords: Display Technology, Flat Screen Display, Large Screen Display, Multicolor Software Display

Progress in CRT display technology has been limited. Consequently, new technologies are being examined (e.g., solid-state, "flat-panel" displays) that might be applicable for a large-scale, high-resolution, multicolor software display.

In this proposal, a "new" approach to very large screen display technology is suggested, based on the unique piezoelectric properties of stretched polyvinylidene fluoride films. The objective of this Phase I program is to demonstrate that individual picture elements can be developed, yielding the necessary gray-scale range, to form the basis for large-screen display and that these elements can also easily be modified to incorporate full-color display.

This report provides a summary of the activities carried out during the six-month Phase I program to demonstrate that the use of simple bimorph elements to modulate light beams provides a very simple technique for the development of large, flat-screen display systems. The construction of simple prototype display elements to demonstrate the feasibility of the approach is also described. The potential for the development of inexpensive display systems is suggested.

In particular, it is shown that the U.S. Army Engineer Topographic Laboratories' requirement for a large-scale, high-resolution, multicolor software display to proof and display maps and charts can be satisfied using this approach.

**HIGH-SPEED, LARGE-FORMAT FILM WRITER
METHODOLOGIES AND DESIGN STUDY
May 1985**

Dunn, S. Thomas

Dunn Technology, Incorporated

DACA76-84-C-0009

Keywords: Color Proofing, Electronic Imaging, Electronic Prepress, Film Processing, Film Scanners, Film Writers, Graphic Arts

This report summarizes the results of an in-depth analysis of methodologies and technologies applicable to high-speed film imaging of digital cartographic data files on a large-format film base. It identifies and reports on candidate systems/technologies and recommends a course of action for successful development of a system in the 1985-1990 timeframe.

**HIGH-SPEED, LARGE-FORMAT FILM WRITER
METHODOLOGIES AND DESIGN STUDY-ANNEX A
May 1985**

Dunn, S. Thomas

Dunn Technology, Incorporated

DACA76-84-C-0009

Keywords: Color Proofing, Electronic Imaging, Electronic Prepress, Film Processing, Film Scanners, Film Writers, Graphic Arts

This annex to ETL-0389 contains proprietary information only.

**SYSTEM ANALYSIS OF THE ENTIRE
TOPOGRAPHIC SUPPORT SYSTEM
February 1985**

Gold, Arthur A.
Goldsmith, C. Thomas
Sellers, Val E.

DECILOG, Incorporated

DAAK70-82-C-0095

Keywords: Topographic Systems, Battlefield Systems, Simulation, System Throughput Efficiency

In 1978, Decilog completed a Computer Simulation Model of the Topographic Support System (TSS) under contract for the Engineer Topographic Laboratories (ETL). As a result of exercising that Model, it was possible to conclude that the TSS, as configured by an interagency Integrated Equipment Evaluation Team, was capable of producing the required Products and Services in a manner which was then considered timely.

With the passage of time, however, there were changes in the TSS design and environment. Furthermore, the 1978 model was restricted to a particular scenario. For these reasons, it was desirable to revise the 1978 model to both update it and remove the restrictions.

In addition, it was desirable to teach a group of government employees how to use the simulation. In this way it could be "handed over" to the Government, which would then have a System Analysis tool.

The major objectives of this effort, then, were to:

- Revise the Simulation Model to simplify input and add additional features to enhance flexibility.
- Install ETLSIM on the ETL Cyber 170 and train government personnel in its use and in the analysis of the simulations.
- Perform a continuing analysis of classified inputs to assure that ETLSIM could be utilized to assess their impact on field army topographic units.

These objectives have been met.

The following modifications to the 1978 model were completed:

- The model was modified to conform with changes made by MERADCOM for the fabrication contract.
- The Product Lists were revised.

As these changes were added to the code, the simulation program became more and more complicated. Since a prime objective was to have government personnel learn how to use the system, this complication was especially bad. Therefore, it was decided to scrap the 1978 simulation and completely rewrite the code. A product of this rewriting is a program in which the analyst specifies the characteristics of the system which is to be simulated. The program then "builds" the system, simulates its operation and produces a statistical report. This capability, ETLSIM, has the following features:

- The Direct Support vehicle was simulated rather than ignored.
- The product list is easily modified by the analyst.
- Alternate paths through production steps have been provided.
- It is now easy for the analyst to "install" new equipments in the field topographic units for analysis.
- The capability of having equipments "fail" and "be repaired" as a function of Mean Time Between Failures and Mean Time to Repair has been added.
- The time unit and duration of the simulated system are specified by the analyst.

ETLSIM has been delivered to the Government. It was installed on and tested at the MERADCOM Computing Center and at Cyber 170 at the ETL Computing Center. A four-week training course was given with extensive course materials provided. Those personnel who attended all, or nearly all, of the sessions were able to use all of the features of the model after the training.

A continuing analysis of classified inputs was conducted during the contract to ensure that ETLSIM could be utilized to assess their impact on field army topographic units.

**COMPUTER-ASSISTED LIKELY MINESITE PREDICTION
MODEL AND ESTIMATED ELECTROMAGNETIC
AND THERMAL SOIL PROPERTIES
May 1985**

Bidwell, Bernard L.
Armstrong, Mary

IIT Research Institute

DACA72-84-C-0007

Keywords: Computer-assisted, Minefield, Prediction, Synthesis, Terrain Factor

It is essential that a commander have as much accurate information as possible to plan and execute tactics. The location and the detection of the most likely minesites are most valuable in aiding the commander towards this goal. The "most likely minesites" are areas in which minefields will most probably be placed. These sites are determined by terrain, mine doctrine, and military objectives. Terrain features that affect the placement of mines are soil, slope, and vegetation as well as waterways, roads, bridges, etc. Some very important parameters of the soil feature are near-surface moisture content and such electromagnetic parameters as attenuation, permittivity, and thermal capacity. These parameters, which are dependent on soil type, climate, time of year, and location, are critical in selecting the proper sensors for minefield detection and identifying the most likely minefield areas. This model provides such information in both graphics and printed form.

ETL-0393

AD-A164 305

**DIGITAL TERRAIN ELEVATION MODEL ANALYSIS
July 1985**

Loon, Joseph C.
Patias, Petros G.

The Ohio State University Research Foundation

DAAG29-81-D-0100

Keywords: Cartography, Contour to Grid Algorithms, Digital Elevation Model, Digital Terrain Elevation Data, Fourier Series, Surface Interpolation, Synthetic Surface

An effort to develop techniques to evaluate contour-to-grid interpolation algorithms. The use of synthetic surfaces as a tool is explored. A set of synthetic surfaces is generated using Fourier Series to represent terrain with different degrees of ruggedness; each surface represented by an equation of the form: $Z=F(X,Y)$. The results of a contour-to-grid interpolation can then be evaluated by comparison with the "true elevations," the elevations calculated from the synthetic surfaces.

**SOFTWARE CONVERSION OF STANDARD LINEAR FORMAT (SLF)
TO STANDARD INTERCHANGE FORMAT (SIF)**

July 1985

Sands, Kathryn J.

Headlee, Kim D.

Measurement Concept Corporation

DAAK70-83-C-0174

Keywords: Defense Mapping Agency, Standard Linear Format, Intergraph Corporation, Standard Interface Format, Graphic Symbolization

Software accepts a digital cartographic data set in DMA Standard Linear Format as input and generates graphics and attribute data base information in Intergraph Corporation Standard Interchange Format. Cartographic feature information is examined to derive graphic symbolization characteristics. Validation of inputs ensures the quality of the output. Additional software provides the capability to convert from Intergraph Standard Interchange Format to DMA Standard Linear Format.

ETL-0395

AD-A160 607

**BIBLIOGRAPHY OF IN-HOUSE AND
CONTRACT REPORTS, SUPPLEMENT 13**

May 1985

Books, E. James

Fox, Margaret F.

Holmes, Alice L.

Author and title indexes are provided for the ETL "Bibliographies of In-House and Contract Reports." The indexes are designed to be used in conjunction with the 13 published bibliographies and refer to them by year and page: AD-877 653L(1970); AD-890 066L(1971); AD-905 548L(1972); AD-B005 275L(1975); AD-B010 642L(1976); AD-B019 966L(1977); AD-A055 468(1978); AD-A068 744(1979); AD-A084 111(1980); AD-A099 803(1981); AD-A113 006(1982); AD-A128 400(1983); AD-A141 778(1984).

The indexes were prepared by the staff of the Scientific and Technical Information Center.

**THIRD-ORDER CO-OCCURRENCE TEXTURE ANALYSIS
APPLIED TO SAMPLES OF HIGH RESOLUTION
SYNTHETIC APERTURE RADAR IMAGERY**
August 1985

Hevenor, Richard A.

Keywords: Texture Analysis, Pattern Recognition, Radar Imagery

A third-order co-occurrence texture analysis technique was applied to samples of synthetic aperture radar imagery. This technique was applied to four classes of terrain features on selected samples of radar imagery. The four classes considered were forests, cities, agricultural fields, and water. A feature vector was computed from samples of each class. A linear feature selection technique was applied for dimensionality reduction, and a pseudo-inverse classifier was developed. This classifier was applied to the original training samples as well as to other samples from the same imagery.

**DEVELOPMENT OF ELECTRONIC CONTROL OF A
SUPERCONDUCTING GRAVITY GRADIOMETER**
September 1985

Paik, Ho Jung
Richard, J.-P.

University of Maryland

DACA72-84-C-0004

Keywords: Feedback Control Network, Gravity Gradiometer, Magnetic Switch, Shielded Transformer, Spring-mass System, SQUID, Superconductivity, Three-axis Gradiometer, Vacuum Oven

This report discusses the development of a three-axis superconducting gravity gradiometer and a six-axis superconducting accelerometer for geological and navigational applications.

**ELECTRONIC FEEDBACK CONTROL OF
MASS-SPRING SYSTEMS**
September 1985

Kong, Qin

University of Maryland

DACA72-84-C-0004

Keywords: Ground Motion Isolation, Josephson Junction, Mass-spring System, SQUID Amplifier, Wide-band Accelerometer

This thesis develops an electronic system for the control of motion of different types of active springs, thus improving the performance of mass-spring systems. A mathematical analysis is carried out for various types of active springs. Also, this thesis discusses future design for improving the performance of these electronic circuits to achieve even better performance of mass-spring systems.

ETL-0399

AD-A159 364

EXTENDED AREA EXIT PUPIL VIEWER
August 1985

Radl, Bruce

EIKONIX Corporation

DACA76-83-C-0008

Keywords: Exit Pupil, Head Moving Parallax, Human Factors Engineering, Illumination, Image Diffuser, Image Quality, Lens Vignetting, Magnification, Resolution, Toroidal Field Mirror

This report describes the process of designing and building a prototype Extended Area Exit Pupil viewer. This system will enable comfortable viewing of a projected stereo image. It works by enlarging the microscope's exit pupil, thus allowing increased head movement while maintaining stereo separation of the images.

**NOISE REMOVAL ON RADAR IMAGERY
USING LOCAL GRADIENT AND STATISTICS**

September 1985

**Kim, Jungwhan
Haralick, Robert M.**

Mnemonics, Incorporated

DACA76-84-C-0003

Keywords: Directional Gradient Masks, Image Blurring, Multiplicative Noise, Noise-removal Filters, Noise Variance

This report shows that the noise-removal algorithm using local gradient and statistics is most favorable to filter a noisy radar image without contrast loss. This report includes the summary of this algorithm with a suggestion of a practical method of estimating a local noise variance. Various noise-removal algorithms are compared with this algorithm based on a visual examination of their filtering results on a set of radar images. The final results of noise removal of the images are displayed along with the originals in the last section. A set of twenty-eight SAR (synthetic aperture radar) images, of size 512x512 pixels, was used for experimentation.

ROAD DETECTION ON RADAR IMAGERY

September 1985

**Kim, Jungwhan J.
Haralick, Robert M.**

Mnemonics, Incorporated

DACA76-84-C-0003

Keywords: Linear Features, Radar Imagery, Remote Sensing, Road Network Detection

Detecting a road network on radar imagery is becoming a new area in remote sensing. This report is an attempt to build a facet-based road network detection procedure for radar imagery. This procedure includes the line detection part and the road detection and connection part. The first part analytically detects linear features using a facet valley-finding technique which looks for the first directional derivative zero-crossing of a bicubic facet model. The second part statistically screens the linear features on a component-by-component base and then optimally connects the screened linear features using a dynamic programming algorithm.

**DISCRIMINATION OF WATER FROM SHADOW REGIONS ON
RADAR IMAGERY USING COMPUTER VISION TECHNIQUES**

September 1985

Qian, Jianzhong
Haralick, Robert M.

Mnemonics, Incorporated

DACA76-84-C-0003

Keywords: MTA Filter, Noise Removal, Radar Interpretation, SAR Imagery, Scene Analysis, Texture Preserving

Unlike MSS LANDSAT imagery and other photography, the specific characteristics of the intensity of water and shadow in SAR imagery make the task of discriminating between them extremely difficult. In this report, we analyze the mechanism of reflectivity of water and shadow on radar imagery and describe a scene-analysis system which consists of a texture-preserving, noise-removal procedure as the preprocessing step, a probabilistic relaxation algorithm to do the low-level labeling, and a spatial reasoning procedure based on a relational model to perform the high-level interpretation. The experimental results obtained from the SAR images are presented to illustrate the performance of this system.

ETL-0405

AD-A161 154

LINEAR FEATURE EXTRACTION FROM RADAR IMAGERY

September 1985

Lawton, Daryl T.
Glicksman, Jay

Conner, Gary D.
Drazovich, Robert J.

Advanced Information & Decision Systems

DACW72-84-C-0014

Keywords: Artificial Intelligence, Image Understanding, Knowledge-based System, Expert System, SAR Aerial Image Interpretation

This report summarizes a feasibility study performed by AI&DS to determine the requirements for the extraction of linear features such as roads, rivers, and environmental region boundaries from SAR aerial imagery. The effort has involved determining effective processes for extracting such features by algorithm surveys, hand processing sample imagery, and algorithm implementation. This work has provided the necessary basis for the implementation of an intelligent, automated system in Phase II of this research. We have designed a general vision system for linear feature extraction which can be generalized to a wide range of SAR (and other sensor) objects, and begun developments of the components of such a system.

ETL-0406

AD-A160 586

**IMAGE PROCESSING FOR VISUAL NAVIGATION
OF ROADWAYS
September 1985**

LeMoigne, Jacqueline
Waxman, Allen M.

Srinivasan, Babu
Pietikainen, Matti

University of Maryland

DACA76-84-C-0004

Keywords: Image Processing, Computer Vision, Road Following, Linear Feature Extraction, Autonomous Navigation, Region-based Segmentation

The Computer Vision Laboratory at the University of Maryland has developed several image processing algorithms for use by an autonomous land vehicle in order to navigate roadways. This report describes one module of this system, the Image Processing module, which extracts 2-D symbolics from the imagery to be analyzed in the world domain.

ETL-0407

AD-A160 946

**ROAD BOUNDARY DETECTION FOR AUTONOMOUS
VEHICLE NAVIGATION
September 1985**

Davis, Larry S.
Kushner, Todd

University of Maryland

DACA76-84-C-0004

Keywords: Image Processing, Computer Vision, Road Following, Autonomous Navigation, Sobel Edge Detector

The Computer Vision Laboratory at the University of Maryland has been developing a computer vision system for autonomous ground navigation of roads and road networks. This report describes the image processing component of that vision system and its implementation on a VICOM image processing system.

**A VISUAL NAVIGATION SYSTEM FOR
AUTONOMOUS LAND VEHICLES**

October 1985

Waxman, Allen M.
LeMoigne, Jacqueline
Davis, Larry S.

Liang, Eli
Siddalingaiah, Tharakesh

University of Maryland

DACA76-84-C-0004

Keywords: Computer Vision, Image Processing, Autonomous Navigation, Road Following, Rule-based Reasoning

The Computer Vision Laboratory at the University of Maryland has developed a modular system architecture to support visual navigation by an autonomous land vehicle. The system consists of vision modules performing image processing, 3-D shape recovery, and rule-based reasoning, as well as modules for planning, navigating, and piloting.

ETL-0409

AD-B097 176L

**MECHANIZATION DESIGN, PERFORMANCE SIMULATIONS,
AND COST TRADE-OFFS OF HYBRID INS/GPS/PLRS
POSITIONING AND ORIENTATION SYSTEMS**

October 1985

Bose, Sam C.
Kouba, James T.
Sobek, David A.

Applied Science Analytics, Incorporated

DACW72-84-C-0005

Keywords: Navigation Error Modeling, Global Positioning System, Position Location Reporting System, Hybrid Inertial Systems, System Performance Simulations, Cost/Performance Trade-Offs, Kalman Filter Mechanizations, Positioning and Orientation Systems

This report documents detailed Kalman filter mechanization designs, computer simulations of system performance, and cost trade-off analyses of several hybrid ground-based positioning and orientation systems, employing externally referenced and dead-reckoning

systems. The externally referenced systems include the Global Positioning System (GPS), and the Position Location Reporting System (PLRS). The dead-reckoning systems considered consist of complete Inertial Navigation Systems (INS), comprising three gyros and three accelerometers, augmented with an odometer and a barometric altimeter. Both gimbaled and strapdown INS technology is investigated. The inertial sensors range in quality from high, to medium, to low, corresponding approximately to a CEP rate of 1, 10, and 100 nm/hr open loop (free-inertial) performance, respectively. The relative merits of the various hybrid systems were compared based on performance measures established on system velocity, azimuth, attitude, and position error. Performance degradation due to system jamming is also included. Results show that the most promising candidates for further analysis and fabrication appear to be low and medium accuracy strapdown inertial systems in combination with GPS.

ETL-0410

AD-A164 325

AUTOMATIC FEATURE EXTRACTION/ALGORITHM TESTING
November 1985

Ferris, Ned A.

Autometric, Incorporated

DACA72-84-C-0008

Keywords: Clustering, Digital Image Processing, Edge Operator, Feature Extraction, Segmentation, Target Detection, Texture

Feature extraction results using an Improved Texture Clustering Algorithm were compared to photo interpreters' manual segmentation/classification results. The clustering algorithm segments digital images via texture and edge attributes. The probability of detecting a target or feature is increased if the number of segments is reduced; therefore, the algorithm merges segments via edge thresholds. Evaluation showed general agreement, but the edge attributes would apply more to target detection than to feature classification.

ETL-0411

AD-A163 674

**APPLICATION OF HIERARCHICAL DATA STRUCTURES
TO GEOGRAPHICAL INFORMATION SYSTEMS
PHASE IV
December 1985**

Samet, Hanan
Rosenfeld, Azriel

University of Maryland

DAAK70-81-C-0059

Keywords: Quadtrees, Hierarchical Data Structures, Geographical Information Systems, Linear Edge Quadtree, PM Quadtree, PMR Quadtree, Edge Quadtree, MX Quadtree

This document is a report on Phase IV of an investigation of the application of hierarchical data structures to geographical information systems. It deals primarily with developing new structures for storing linear feature data. The attribute attachment package was extended to point and linear feature data.

ETL-0412

AD-A163 201

**BLUE LASER
December 1985**

Griffin, Gordon R.

Xerox Special Information Systems

DACW72-84-C-0016

Keywords: Hollow Cathode Laser, Blue Laser, Low Noise Laser, He-Cd Laser, Metal Vapor Laser, Gas Laser

This has been a development program to design a low noise, moderate power, blue, hollow cathode laser used for imaging on photoconductors for on-demand color printing. Descriptions of the construction, processing, and testing of experimental unit are presented with recommendations for design improvements.

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Charging Equipment, Mobile (CEM)	ETL-0089 1976
Chemical Array Studies	ETL-0130 1977
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Circularly Polarized Measurements of Radar Backscatter from Terrain and Snow Covered Terrain	ETL-0234 1980
Circumpolar Method for Determining Azimuth Classification and World Distribution of Vegetation Relative to V/STOL Aircraft Operations	ETL-0317 1983 ETL-SR-74-4 1973
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Color Contact Printer Mark III	ETL-ETR-70-9 1970
Color Ink-Jet Demonstration Program	ETL-0196 1979
Color Orthophotomaps	ETL-ETR-72-2 1972
Color Separation System Evaluation	AD-672 078 1968
Combination Map Reproduction Van Body	1536-TR 1958
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Comparative Study of Photography for Soils and Terrain Data	38-TR 1968
Comprehensive Summary of Project Trend	ETL-0041 1975
Computer for Army Artillery Inertial Survey System (GEISHA)	AD-814 052 1963
Computer Program to Simulate Scenario Functions	ETL-0025 1975
Computing a Line-of-Sight Using Digital Image Matching and Analytical Photogrammetry	ETL-0027 1975
Concept Development of Automated Image Analysis	ETL-0194 1979
Concept Development of Automatic Instrumentation for Monitoring Movement of Dams	ETL-0187 1979
Concept for an Ultraprecise Geodetic Baseline	RN-24 1967
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CONPLOT II-A Contour Generating Program	ETL-CR-71-1 1971
CONRAD-A Program to Contour Radar Data	ETL-CR-73-20 1973
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Corona Study Relevant to Electrostatic Printing Process	ETL-CR-71-22 1971
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Delta Pulse Code Modulation Compression Relative to Stereo Image Matching	ETL-0157 1978
Demonstration and Evaluation of the Utilization of Side-Looking Airborne Radar for Military Terrain Analysis	ETL-0023 1975
Derivation and Potential of New Filter Equations for Numerical Weather Prediction	ETL-RN-71-3 1971
Description of Instrumentation Data Analysis and Reduction for an Atmospheric Seeing Monitor	AD-701 124 1969
Design and Analysis of a High-Production Mini-Computer System for Regridding Digital Terrain Elevation Matrices	ETL-0240 1980
Design and Development of a Position and Azimuth Determining System (PADS)	ETL-CR-71-18 1971
Design and Development of an Advanced Electron Beam Control System	ETL-0032 1975
Design and Development of Power Package for Surveying Instrument: Azimuth, Gyro, Lightweight	ETL-CR-71-5A 1971
Design and Development of Surveying Instrument: Azimuth, Gyro, Lightweight (SIAGL)	ETL-CR-71-5 1971
Design and Fabrication of a 70 Millimeter Interference Imaging System	ETL-CR-71-8 1971
Design and Fabrication of an Experimental Multiband Camera	ETL-CR-71-28 1971
Design and Feasibility Study of an Off-Line Digital Orthoprinter for Field Use	ETL-0149 1978
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Design, Modification, Fabrication, and Test of a Prototype Miniaturized North Reference Unit (MINRU)	ETL-0276 1979

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Vol. 1	AD-270 216L 1961
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Design Studies and Prototype Model Development of a Small North Orienting Device (Miniaturized Gyrocompass)	ETL-CR-70-4 1970
Design Study of a Large Format Printer (LFP)	ETL-0368 1984
Desk Model Fotosetter Photo-Lettering Machine	1329-TR 1953
Detecting Line-Road and Road-Intersection Patterns at Various Angles	ETL-0274 1981
Determination of Height Differences from Gravity and Gravity Gradients	ETL-71-CR-10 1971
Determination of Level Sensitivity (Field Calibration with the Level on the Instrument)	ETL-RN-74-4 1974
Determination of the Anomalous Gravity Potential from Satellite and Terrestrial Data Under Utilization of Modern Gravimetric Theory	ETL-RN-73-2 1973
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Development of a Prototype Family of Military Geographic Intelligence Products to Support Airmobile Operations	ETL-ETR-70-7	1970
Development of a Small North Orienting Device		1970
Development of a Terrain Profile Recorder Image Point Transfer Instrument	AD-649 830	1967
Development of a Variscale Stereo Point Marking Instrument	AD-643 722	1966
Development of an Evaluation Model-Change Detector		1965
Development of an Experimental Family of Military Geographic Intelligence (MGI) Products to Support Battlefield Sensor Activities	ETL-TR-72-3	1972
Development of Descriptor Sets for the Unambiguous Characterization of Geographic Features on SAR Imagery	ETL-0369	1984
Development of Finite Element Models for the Earth's Gravity Field Phase I: Macro Gravity Model for Satellite Orbit Integration	ETL-0096	1977
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Development of Height Finder Oblique, Topographic	1383-TR	1954
Development of High Speed CRT Print Head Systems for Cartographic Applications	ETL-0213	1980
Development of Improved Area Correlation Techniques	ETL-CR-73-19	1973
Development of Lightweight Long-Range Survey System (LRSS)	AD-477 042	1965
Development of Spherical Map Sections and Transparent Conforming Overlays	1440-TR	1956
Development, Service Tests, and Production Model Tests, Autofocusing Rectifier	1307-TR	1953
Development, Test, Preparation, Delivery, and Installation of Algorithms for Optimal Adjustment of Inertial Survey Data	ETL-0307	1982
Developmental Optical Correlator	ETL-0033	1975
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Digital Planimetric Compiler	ETL-ETR-72-1 1972
Digital Pre-Press System Design Study	ETL-0339 1983
Digital Radar Restitution	AD-448 230L 1964
Digital Rectification of Side-Looking Radar (DRESLR)	ETL-CR-73-18 1973
Digital Simulation of a Radar Image of Pisgah Crater Test Site, California	ETL-0019 1975
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Dimensionally Stable Opaque Cartographic Bases	1469-TR 1956
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Doppler Translocation Test Program	41-TR	1968
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Electronic Pointing Device (Microwave) System (Electrotransit)	AD-471 726L	1965
Electronic Survey Equipment and Tests	AD-264 454	1960
Electro-Optical Image Processing with an Image Storage Tube	AD-A836 685	1968
Electrophotographic Imaging Materials Evaluation	ETL-0266	1981
Electrostatic Paper and Toner Development		1969
Elevation Data Compaction by Polynomial Modeling	ETL-0140	1978
Elevation Data Edit Terminal	ETL-0328	1983
Emergency Target Location Function	21-TR	1965
Engineer Design Test and Evaluation of a Planimetric Compiler	35-TR	1966
Engineer Design Tests and Evaluation of a Multipower Army Stereoscope	12-TR	1963
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Engineering Evaluation of Pulsed Xenon Light Sources for Graphic Arts Use	2-TR 1961
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Engineering Tests and Evaluation of a 9 by 18 inch Electronic Printer	1646-TR 1960
Engineering Tests and Evaluation of Multiplex Reduction Printer for Metrogon and Distortion-Free Photography	1431-TR 1955
Engineering Tests and Evaluation of Printers for the Preparation of 9 1/2- by 9 1/2-inch Diapositives for the Precision Stereoplotter	1538-TR 1958
Engineering Tests and Evaluation of the Photogrammetric Transforming Printer for 20° Convergent Photography	1497-TR 1957
Engineering Tests of a Temperature-controlled Processing Unit, Deep-tank, for Photomechanical Film	1599-TR 1959
Engineering Tests of Diapositive Processing Unit	1628-TR 1960
Engineering Tests of Interim Target Location Systems for Use in Controlled Areas	1498-TR 1957
Engineering Tests of Interim Target Location Systems for Use in Uncontrolled Areas	1612-TR 1960
Engineering Tests of Opaque Cartographic Bases	1290-TR 1953
Engineering Tests of Scanning Stereoscope	1491-TR 1957
Engineering Tests of the Cartographic Grid Ruler	1486-TR 1957
Engineering Tests of the Cartographic Van Section of the Motorized Photomapping Train	1373-TR 1954
Engineering Tests of the PPI Radar Presentation Restitutor	1629-TR 1960
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Equipment and Techniques for the Utilization of Convergent Photography in Mapping	1583-TR 1959
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Evaluation and Comparison of Terrain Classification Methods (Type III)	AD-845 338L 1968
Evaluation and Test of a Five-Color Electrostatic Printing Machine for the Reproduction of Topographic Maps and Charts	25-TR 1965
Evaluation and Test of a Modified Plate Process Section, a Proposed New Photomechanical Process and a Redesigned Brush-Surfacing Machine	1560-TR 1959
Evaluation and Test of a Self-Contained Vehicle Land Navigation System	ETL-0167 1979
Evaluation and Test of a Single-Color Electrostatic Printing Machine for the Reproduction of Topographic Maps and Charts	19-TR 1964
Evaluation of a New Electrostatic Recording Medium	ETL-0102 1977
Evaluation of a Xerographic Process for Preparing Zinc Oxide-Silicone, Binder-Type Lithographic Plates	1545-TR 1958
Evaluation of Automatic Mapping APQ as a Radar Mapping System	31-TR 1966

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Evaluation of Color Recognition Devices for Making Color-Separations from Multicolor Maps and Charts	1401-TR	1955
Evaluation of Color Test Photography for Military Geographic Analysis-A Literature Review	ETL-TR-70-6	1970
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Evaluation of Conventional Correlation Methods When Matching Infrared Imagery to Panchromatic Imagery	ETL-0195	1979
Evaluation of Experimental Xerographic Process for Lithographic Platemaking	1417-TR	1955
Evaluation of High Precision SHORAN-Controlled Photography	1484-TR	1957
Evaluation of Land Use Techniques for Processing MGI	AD-817 124L	1967
Evaluation of Multiband and Color Aerial Photography for Selected Military Geographic Intelligence in a Subtropical Desert Environment	54-TR	1970
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Evaluation of Single and Multicolor Map and Chart Reproduction Equipment	ETL-0080	1976
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Feasibility Study for Field Generation of Input for Radar Scene Generation from DLMS Terrain and Elevation Data	ETL-0203	1978
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Feasibility Test of a Proposed 3-D Radar System	AD-349 882L	1964
Feasibility Test Program for Measurement of Gravity Anomaly Changes Using 2 MICRO-g Accelerometer in the Inertial Platform	ETL-CR-74-16	1974
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Feature Extraction Assessment Study, Final Report	ETL-0377	1984
Feature Extraction of the Illiac IV	ETL-0191	1979
Feature Tagging	ETL-0227	1980
FEED Evaluation	ETL-0322	1983
FEED Software Documentation	ETL-0335	1983
Fictitious Data Generator for Analytical Aerotriangulation	AD-640 799	1965
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Formulas for Computing Atmospheric Refraction for Objects Inside or Outside the Atmosphere	RN-8 1963
Formulation of a Space Oblique Mercator Map Projection	ETL-0131 1977
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General Programming on a Parallel Processor	ETL-0062 1976
Geocentric Position and/or Orbital Parameters with Star Satellite Photography from a Single Camera Station	CR-102-1 1963
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Geodetic Control without Triangulation, Trilateration, or Gravity Data and Gravimetric Reduction of Levelling	
1st Interim Report	AD-447 994L 1964
2nd Interim Report	AD-461 100L 1965
3rd Interim Report	AD-477 474 1965
Geodetic SECOR	1962
Geodetic SECOR Ground Equipment	1964
Geodetic SECOR Satellite	ETL-TR-74-6 1974
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Geodetic SECOR Wide-Band RF Subsystem for SECOR Ground Equipment Sets	AD-804 780L	1967
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Geodimeter, Models I and II	1495-TR	1957
Geographic Modelling of Insurgency Resources, & Appendix	AD-848 723L	1969
	AD-851 896L	
Geoid Representation from Satellite-Determined Coefficients	AD-634 541	1966
Geologic Evaluation of Radar Imagery from Darien Province, Panama	AD-853 884	1969
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Geomorphic Evaluation of Radar Imagery of Southeastern Panama and Northwestern Columbia	ETL-CR-71-2	1971
Geopotential Determination from Satellite to Satellite Tracking and Satellite Altimetry	ETL-CR-74-21	1975
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Geo-Spin Precision Inertial Survey	ETL-0135	1978
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Graphic Data Handling Techniques	AD-659 807	1967
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High Resolution Orthophoto Output Table (HIROOT)	AD-856 731L 1969
High Resolution Orthophoto Output Table	ETL-ETR-72-3 1972
High Speed Disc Memory and a Color Image Display for a Small Computer	AD-878 975L 1970
High Speed Parallel Sensing Scheme	ETL-0119 1977
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Holographic Optical Elements With Low Q-Factors	ETL-0123 1977
Holographic Ray Tracing and Spot Diagrams	ETL-0052 1975
Holographic Stereogram Display Techniques for the Viewing and Mensuration of Stereo Photogrammetric Imagery	ETL-CR-74-2 1973
Holographic Terrain Displays	ETL-0083 1976
Holography and Stereoscopy	ETL-CR-72-2 1972
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Image-Based Approach to Mapping Charting and Geodesy	ETL-0366 1982
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Image Enhancement by Chemical Intensification	ETL-0014 1975
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Determinations: Part I, <i>Coleogyne ramossissima</i>		
Torr. (Black-Brush)		
Inferential Techniques for Soil Depth	ETL-0176	1979
Determinations, PART II: <i>Artemisia filifolia</i>		
Torr. (Sand Sagebrush)		
Influence of Atmospheric Refraction on Directions	RN-10	1963
Measured to and from a Satellite		
Instrument for Measuring Absolute Acceleration	RN-17	1966
of Gravity		
Instrument to Measure the Tilt of Large Structures, An	ETL-0313	1983
Instrumentation for Color Aerial Photography	ETL-RN-70-1	1970
Intelligent Advisors for Cross-Country	ETL-0365	1984
Route Planning		
Interactive Digital Correlation Techniques for	ETL-0272	1981
Automatic Compilation of Elevation Data		
Interactive Digital Image Processing for Terrain	ETL-0241	1980
Data Extraction		
Interactive Digital Image Processing for Terrain	ETL-0277	1981
Data Extraction, Phase 2		
Interactive Digital Image Processing for Terrain	ETL-0294	1982
Data Extraction, Phase 3		
Interactive Digital Image Processing for Terrain	ETL-0348	1983
Data Extraction, Phase 4		
Interactive Digital Image Processing for Terrain	ETL-0374	1984
Data Extraction, Phase 5		
Interactive Digital Image Processing	ETL-0172	1978
Investigation		
Interactive Digital Image Processing	ETL-0221	1980
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Interactive Image Analysis System Design	ETL-0312	1982
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Interpretation of Radar Imagery for Terrain Analysis in Tropical Environments	1968
Inverse Scattering Applications in Determining Terrain Feature Parameters	ETL-0279 1981
Investigation and Evaluation of Planigon Lens Distortion Characteristics	1472-TR 1957
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Investigation of Bjerhammar's New Gravity Reduction Method	AD-460 404 1964
Investigation of Cartographic Pressplate Recording from Digital Data	ETL-0043 1976
Investigation of Continuous Photoconductive Layer Arrays	ETL-0011 1975
Investigation of Discrete Function Technology for Topographic Sciences	ETL-0162 1978
Investigation of Electro-Acoustic Technology for Topographic Application	ETL-0160 1978
Investigation of Extrema in Digital Images for Texture Analysis	ETL-0210 1979
Investigation of Fusion and Fixation Disparity Limits for Photogrammetry	AD-625 217 1965
Investigation of Linear Transformations for Automatic Cartographic Analysis	ETL-0181 1979
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Investigation of Multiband Photographic Techniques, Vol. III	1965
Investigation of Photographic Mapping Detail and Data Encoding	AD-286 715 1962
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KANDIDATS	ETL-CR-71-3	1971
Knowledge-Based Images Analysis	ETL-0258	1981
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MATS Transponder	1966
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Multi-Image Pattern Recognition: Ideas and Results	AD-863 596
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New Analyses and Methods Leading to Improved Target Acquisition Requirements Involving Systems, Geodetic and Reentry Errors, and Increased Weapons Effectiveness for Conventional Weapons (Part II)	ETL-RN-70-3 1970
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New Formulas Useful When Changing Ellipsoidal Parameters or Orientation	RN-2 1962
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2nd Interim Report	AD-422 227 1963
3rd Interim Report	AD-432 243 1963
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Photogrammetric Flash Triangulation for Corps of Engineers Field Use	
1st Interim Report	1960
2nd Interim Report	AD-265 036 1961
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Plastic-Scribing Color Separation for Military Cartography	1485-TR 1957
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Point Light Source Contact Printer Photographic Technology Series	ETL-0084 1976
Position and Azimuth Determining System (PADS)	ETL-ETR-74-1 1974
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Position and Surveying System (PASS)	ETL-CR-73-11 1973
Possibility of Adapting a Land Navigation System to Perform Artillery Survey	ETL-0078 1976
Post-Mission Smoothing and Analysis of the Measurements of the Change in the Deflection of the Vertical Obtained by the Rapid Geodetic Survey System (RGSS) at the White Sands Test Range	ETL-0065 1976
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Precise Photogrammetric Orientation and Data Determination of HIRAN Mapping System AN/APQ 73	AD-238 857	1960
Precision Enlarging Printer (4X)	27-TR	1966
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Precision STARAN Correlator	ETL-0133	1977
Predesign Data for the Radar Stereo Equipment Program	AD-701-169	1969
Preliminary Image Data Extraction Experiments with the Phase I, Automated Image Data Extraction System - I	ETL-RN-74-7	1974
Preliminary Radar Feature Extraction and Recognition Using Texture Measurement	ETL-0315	1983
Preliminary Reliability Prediction - MATS		1965
Preliminary Study into the Principles of Continuous Tone Electrophotography	AD-401 863	1962
Preproduction Model Cartographic EBR System	ETL-0246	1980
Proceedings of the International Symposium Figure of the Earth and Refraction	AD-825 792	1967
Product Improvement Test Report of Astronomic Surveying Equipment	28-TR	1966
Program and Test Procedures to Determine the Geocentric Coordinates and Orbital Parameters of an Unidentified Satellite	AD-617 698	1965
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Quantitative Geography: Achievements and Prospects	ETL-CR-71-12	1971
RACOMS Cartographic Module	ETL-ETR-70-3	1970
RACOMS Compilation Module I	ETL-ETR-70-1	1970
RACOMS Data Processing Module	ETL-ETR-70-4	1970
RACOMS Image Processing Module I	47-TR	1969
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RACOMS Map Revision Module	ETL-ETR-70-5	1970
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Radar Network Adjustment		1962
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Radar Sketching Device	20-TR	1965
Radar Stereo Equipment Program	AD-732	875 1971
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Radiative Transfer in One-Dimensional Discretely Stratified Media	ETL-0236	1980
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Remote Sensor Image Capabilities for Acquisition of Terrain Information	ETL-0054 1976
Remote Sensor Imagery Analysis for Location of Construction Materials in the Mekong Delta-Project SAND (Phase II)	52-TR 1970
Replacement of Photographic Imagery Equipment (RPIE)	ETL-0038 1976
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Research and Design of a PROM Coherent Optical Processor	ETL-0219 1980
Research and Development Acceptance Test Report Surveying Instrument: Azimuth, Gyro, Lightweight (Lear Siegler Inc. Models)	23-TR 1965
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Research in Surveying, Mapping and Geodesy	AD-230 066 1959-1965
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RWPF Spatial Data Study	ETL-0367 1984
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Satellite Angulation	RN-16 1965
Satellite Geodesy Based on Stellar Orientation of Lines Between Unknown Stations	RN-32 1969
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Satellite, U.S. Army Type II, Geodetic	1963
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Scene Classification Results Using the Max-Min Texture Measure	ETL-0300 1982
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Spatial Light Modulators: Test and Evaluation	ETL-0192 1979
Spatial Sampling: A Technique for Acquisition of Geographic Data from Aerial Photographs and Maps	ETL-CR-71-11 1971
Spectral Reflectivity Data: A Practical Acquisition Procedure	AD-880 049L 1970
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Stable Platform Assembly for Army Artillery Inertial Survey System	AD-681 932 1962
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Structural Analysis from Radar Imagery, Eastern Panamanian Isthmus	AD-715 322 1970
Studies in Zinc Oxide Photoconductivity	AD-673 836 1968
Studies of Gravity in Space According to Bjerhammar	AD-485 687L 1966
Study and Analysis of the Position and Azimuth Determining System (PADS) Field Maintenance Concept	ETL-CR-74-22 1974
Study and Analysis of the Position and Azimuth Determining System (PADS) for Mapping, Charting, and Geodesy Applications	ETL-CR-73-12 1973
Study and Prototype Model Design of a Miniaturized Gyrocompass, Interim	AD-462 322 1964
Study and Prototype Model Design of a Miniaturized Gyrocompass, Final	AD-465 330 1965
Study of a Digital Interface Design for the Quick Response Multicolor Printer (QRMP)	ETL-0327 1983
Study of Classification and Nomenclature of Vegetation	ETL-0058 1976
Study of Digital Matching of Dissimilar Images	ETL-0248 1980
Study of Environmental Monitoring and Information Systems	ETL-CR-72-1 1972
Study of Knowledge-Based Systems for Photo Interpretation	ETL-0235 1980
Study of Lithographic Fountain Solutions	AD-830 674L 1967
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