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Jean R. Diaz

October 1992

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U.S. Army Corps of Engineers
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Fort Belvoir, Virginia 22060-5546

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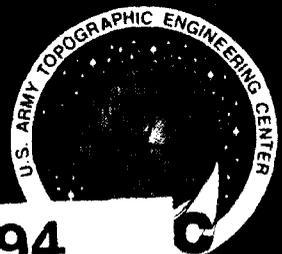


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This is Supplement 18 to the TEC Bibliography of In-House and Contract Reports. This supplement provides author and title indexes, abstracts, and AD numbers for the 1991 and 1992 additions to the continuing bibliography. It also contains a complete title index designed to be used in conjunction with the 18 published bibliographies and refers to them by year and number.

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PREFACE

This is Supplement 18 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 642L; Supplement 5, AD-B019 966L; Supplement 6, AD-055 468; 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; Supplement 13, AD-A160 607; Supplement 14, AD-A173 750; Supplement 15, AD-A195 953; Supplement 16, AD-A215 154 and Supplement 17, AD-A252 543. It is a continuing bibliography of reports prepared by and for the U.S. Army Topographic Engineering Center, Fort Belvoir, Virginia. This bibliography includes reports that were published from 1 October 1991 through 1 October 1992.

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 22161-2171. 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, U.S. Army Topographic Engineering Center, Fort Belvoir, Virginia 22060-5546.

Mr. Walter E. Boge was Director, and Colonel Kenneth C. Kessler was Commander and Deputy Director of the Topographic Engineering Center at the time of publication of this report.

**USE OF INTERIM TERRAIN DATA TO POPULATE PROJECT 2851's
DATABASE IN SUPPORT OF GROUND FORCES SIMULATION**

January 1991

Kevin Backe

Keywords: Project 2851, Interim Terrain Data, ITD, Simulation

Project 2851 is a Department of Defense (DoD) program to develop a standard DoD simulator database and associated transformation software necessary to support a wide range of simulator applications. Project 2851 is currently capable of directly inputting two standard Defense Mapping Agency (DMA) Digital Topographic Data (DTD) products, Digital Terrain Elevation Data (DTED) and Digital Feature Analysis Data (DFAD), to populate its simulator database. This report presents the findings from a study on the potential use of a third DMA DTD product, Interim Terrain Data (ITD), to populate Project 2851's database. ITD is compared to Project's 2851's Standard Simulator database (SSDB) to determine the necessary transformation required to incorporate ITD into the SSDB. ITD is a high resolution standard terrain feature database product currently available to the Army; therefore, ITD should prove very useful to the simulation community, especially for ground forces simulation applications.

**COMPARISON OF AIR PHOTO LANDFORM UNITS TO STATISTICALLY
DEFINED GROUPS OF TORS IN DARTMOOR, SOUTHWEST ENGLAND**

February 1992

Judy Ehlen

Keywords: Air Photo Analysis, Landforms, Granite, Multivariate Statistics

Landform mapping units delineated using manual photo analysis procedures on two air photo mosaics, one at a scale of 1:24,000 and the other at 1:50,000, were compared to groups of tors defined using multivariate statistical analysis of field and laboratory data. Correspondence between the results of the two procedures was quite good: (1) members of most tor groups occur in the same landform mapping unit; (2) most landform mapping units contain far greater proportions of one, or not more than two, tor groups; and (3) the tor types defined statistically as typical of a given landform mapping unit tend to agree with the actual distribution of tor types in that mapping unit. The landform mapping units can thus be defined in terms of statistically significant descriptors in addition to descriptors based on analysis of stereo air photos. Finally, the greater number of mapping units on the 1:50,000 scale photo mosaic combined with the fact that most of the landform units were associated with one, rather than two, tor groups and with the greater similarity between statistically defined tor types and the actual distribution, suggests that smaller scale photos maybe more useful than larger scale photos in relating photo-derived landform patterns to groups of tors defined statistically using field and laboratory data.

**BATTLEFIELD ASSESSMENT AND DECISION ASSISTANCE SYSTEM USING
NEURAL NETWORKS AND AN EXPERT SYSTEM DIRECTOR
February 1992**

John A. Neal, III
R. Richard Avent, III

American Research Corporation of Virginia

DACA76-91-C-0016

Keywords: Tactical Decision Aids, Expert Systems, Neural Networks, Supply Routes

The U.S. Army has identified a need for computer-based command decision assist systems capable of tactical battlefield parameter analyses. To address this need, American Research Corporation of Virginia (ARCOVA) is developing an intelligent resource allocation and command decision recommendation assistant capable of analyzing battlefield parameters and generating resource deployment suggestions, logistical support architectures and command decision recommendations. The feasibility of artificial intelligence application to battlefield parameter assessment was demonstrated by ARCOVA during a Phase I program sponsored by the Topographic Engineering Center. This research included development of a weather analysis sub-module composed of an expert system user interface and a neural network prediction architecture and development of a main supply route (MSR) identification sub-module based upon expert system analysis of natural and man-made transportation corridors within a low resolution topographic database. The research effort also included work on development of a neural network optimization architecture for application to the problem of optimal MSR selection given an array of fixed and transitory trans-ship and destination sites. These sub-modules were developed within the context of a comprehensive system approach that is built upon a modular architecture capable of addressing and relating all significant features of an overall battlefield parameter assessment requirement.

**TERRAIN MODELING: SHORTEST PATH, DRAIN PATTERNS,
AND INTERSPERSED CONTOURS**

December 1991

Christoph Witzgall¹
Randall S. Karalus²¹National Institute of Standards and Technology
Center for Computing and Advanced Mathematics²U.S. Army Topographic Engineering Center**Keywords:** Automated Cartography, Blocked Drain, Digitized Contour, Drainage Network, Interspersed Contour, Elevation Matrix, Interpolation, Drain Pattern, Surface Generation, Terrain Modeling

A computational approach to the task of generating contour-true and drain-consistent cartographic terrain surfaces from given grid-digitized contour lines is proposed and demonstrated for a still somewhat limited class of such contours. This approach is as follows: Consider all grid points located between two adjacent contours, and for each such grid point determine a shortest path towards the lower contour with respect to a grid metric that penalized proximity to either contour. The pattern contains the major drain (ridge) lines as implied by the contour information and thus permits the extraction of such features directly from grid-digitized contours. In a further development, the pattern is utilized to construct a grid elevation matrix by prorating elevations along its paths. An alternate drain (ridge) pattern derives naturally from that elevation matrix. This suggests an iterative procedure, alternating between extracting a drain (ridge) pattern from a grid elevation matrix and then generating a new elevation matrix from such a pattern. This procedure will be described and demonstrated. It will be considered as a method for interspersing contour lines of intermediate elevations.

**HYPERSPECTRAL IMAGE EXPLOITATION
SBIR PHASE I FINAL REPORT**

January 1992

SETS Technology, Inc.

DACA72-88-C-0003

Keywords: Hyperspectral, Spectroscopy, Computer Image Processing, Remote Sensing

The overall objectives of Phase I were to carry out the necessary research and design and to develop the techniques needed to demonstrate the feasibility of an overall concept and approach to the development of a hyperspectral image processing system. The development of a working system would then be the goal of Phase II. All of the main objectives of Phase I were accomplished to one degree or another. It was determined that a next generation Hyperspectral Image Processing system could be designed and built which would allow the customer to evaluate the current state-of-the-art in hyperspectral data processing and to get an idea on how it could be useful in their environment.

TEC-0005

AD A251 026

**HYPERSPPECTRAL GAS ANALYSIS SYSTEM (HyGAS)
SBIR PHASE I FINAL REPORT
January 1992**

SETS Technology, Inc.

DACA76-91-C-0013

Keywords: Hyperspectral, Spectroscopy, Computer Image Processing, Remote Sensing, Gas Analysis

The overall objectives for Phase I were to develop the conceptual design for a Hyperspectral Gas Analysis System (HyGAS) for gas detection and identification and to show the feasibility and applicability of this system for real time, spectrum data-base-referenced, processing of high spectral resolution image data, and "hyperspectral" data of gases in a tactical environment. It is concluded that a Hyperspectral Gas Analysis System (HyGAS) can be designed and built which would provide for real time identification and analysis of gas spectra from hyperspectral and ultraspectral imaging sensors.

TEC-0006

AD A252 017

**COMPARISON OF AIR PHOTO LINEATIONS AND JOINT
PATTERNS, DARTMOOR, SOUTHWEST ENGLAND
May 1992**

Judy Ehlen

Keywords: Lineations, Joints, Air Photo Analysis, Granite, Statistics

Joint spacing and orientation data were collected at 58 sample sites in the field. Lineations delineated on 1:24,000 and 1:50,000 scale air photo mosaics were digitized, and orientations of and spacings between lineations were determined using a Geographic Information System (CAPIR). Common trends for lineations on both photo mosaics and from outcrop are east-northeast (40-90°) and west-northwest (300-340°). Thus, lineations from the air photos and the fractures in outcrop probably comprise samples from the same population, but different individuals are seen at each scale: as scale decreases, visible lineations become increasingly longer and more widely spaced. Although the joint and lineation spacing distributions are significantly different from each other, the three distributions have similar modes (100 ± 25). Weaker modes are similarly located near even 100's for all three distributions, suggesting spacing may be periodic. Spacing between fractures increases for similar orientations with decreasing scale. The scale independence of these fractures suggests they are fractal in nature.

**INTELLIGENT TDA SYSTEMS USING NEURAL NETWORKS
PHASE I FINAL REPORT
May 1992**

Richard H. Stottler
Andrea L. Henke

Stottler Henke Associates, Inc.

DACA76-91-C-0026

Keywords: Helicopter Path Planning, Helicopter Avenues of Approach, Airborne Avenues of Approach, Artificial Intelligence, Tactical Decisions Aids, Translation Neural Networks, Expert Systems

The overall objective of Phase I was to develop a prototype intelligent Tactical Decision Aids (TDA) neural network system through the use of an expert system to neural network translator. From the resulting prototype network, the performance of the complete TDA system could be determined. The Phase I results absolutely demonstrated the feasibility of this concept and cleared the way for development of a complete system in Phase II. Current TDA systems require too much expertise from the user and run too slowly for use in tactical situations, when time is in short supply. In tactical situations, terrain is an extremely important factor and represents one of the main inputs to these systems. The Airborne Avenues of Approach (AAA) Planning problem was chosen. While initial route planning is performed prior to the start of the mission, a need exists to automate and speed the process. Additionally, a system which could meet the rigorous real-time requirements of an on-board AAA re-planner would prove enormously beneficial in many time-critical tactical situations.

**EVALUATION OF THE BATHYSCAN
SWEEP SURVEY SYSTEM
May 1992**

Anthony Niles

Keywords: Depth Accuracy, Sweep System, Interferometric Side-Scan Sonar, Reconnaissance Survey, Condition Survey

The U.S. Army Corps of Engineers has an interest in hydrographic survey "sweep" systems, which produce depth soundings over the total bottom area. Such systems can have significant advantages, such as shorter survey times and more complete bottom representations, over the single-trace systems commonly used in the Corps. Such a sweep system, the Bathyscan Hydrographic Survey System that used interferometric side-scan sonar, was demonstrated to the Corps. The Bathyscan proved to be a well-engineered and innovative design that would be well suited to Corps reconnaissance surveys. Although the system was not survey ready due to some minor software problems and an error in an input parameter, the Bathyscan may be well-suited to condition and contract-payment surveys performed by the Corps.

RESULTS OF EARTH OBSERVATION STUDY
ON STS-31 FOR TERRA GEODE
May 1992

CPT John Karpiscak, III

U.S. Army Engineer School

Keywords: Terra Geode, MMIS (Military Man in Space), Army Shuttle Experiments

Terra Geode is a MMIS experiment developed by the U.S. Army Engineer School. The experiment is designed to evaluate the utility of a trained military space-based observer providing information for tactical movement. The experiment is being done in four phases: (1) military astronaut observations, (2) geologist-astronaut observations, (3) military payload specialist observations, and (4) permanent manned presence in space. Phase I consisted of the planning stages and informal discussions with military astronauts who had been asked to observe certain geologist features. It was determined that further investigations were warranted for future phases. A geologist-astronaut flying on STS-31 agreed to conduct Phase II on a time available basis. The flight of STS-31 was 5 days long, from 24 April to 1 May 1990. Many data points were observed during STS-31's high altitude, short duration flight. It was determined that it is feasible to identify and record the various elements that comprise a mobility prediction, and to explore the degree of accuracies that can reasonably be expected from a trained observer in orbit.

SYMBOLIC MODEL-BASED SAR FEATURE ANALYSIS
AND CHANGE DETECTION
February 1992

James C. Curlander
Wolfgang Kober

Vexcel Corporation

DACA76-91-C-0013

Keywords: Model, Classification, Change Detection, Image Processing, Feature, SAR, Automated, Rule, Expert System

The feasibility of a model-based approach to feature classification and change detection in synthetic aperture radar imagery is investigated. The models include quantitative, qualitative and relational aspects of feature signatures. The intended Phase II classification system will consist of an automated model-driven processor linked to an image understanding library such that during automated classification, the model-based processor will call various library routines as required to reach solutions. The Phase I effort consisted of: (1) Investigation of various methodologies for rule-oriented model-based approaches; (2) Development and test results of a numerical scoring function for tracking uncertainties during rule-based processing; (3) Development and specification of the required image processing library functions; (4) Development and testing of a 120-rule prototype classification system; and (5) Results from testing the combination rule prototype and image processing library on four SAR images. The initial testing of the 120-rule prototype over the four SAR data sets resulted in a 71% correct classification rate overall.

TEC-0011

AD A255 708

**TERRAIN VISUALIZATION FOR THE PORTABLE
ALL-SOURCE ANALYSIS WORK STATION
May 1992**

Loral Defense Systems - Akron

DACA76-90-C-0018

Keywords: Terrain Visualization, Terrain Analysis, Cartography, Digital Mapping

This report for the Terrain Visualization program was written to document significant program design elements. It reflects the successful achievement of the principal objective of the program - the implementation of sophisticated visualization capabilities using low to medium performance computing platform. By requiring that this platform be the same as that used in the Digital Topographic Support System (DTSS), this program also advanced the potential use of terrain visualization technology in terrain analysis.

TEC-0012

AD A254 724

**AN EVALUATION OF THE HYDROGRAPHIC INLAND MARINE
ACOUSTIC PLATFORM (HI-MAP) SURVEY SYSTEM
July 1992**

Anthony Niles

Keywords: Fansweep Acoustic System, Echo Sounders, System Comparisons, Side-Scan Sonar, Class I, II, and III Surveys

The U.S. Army Corps of Engineers has an interest in new technology and techniques in hydrographic surveying for more accurate, efficient, and productive surveys. The use of such new systems by contractors can also produce a more accurate and timely service product for the Corps. Such a system, the Hydrographic Inland Marine Acoustic Platform (HI-MAP), produced and used by John E. Chance and Associates was evaluated in test surveys on the Mississippi River. The HI-MAP effectively integrates many new technologies, such as a phased-array sweep system and differential GPS positioning on board a trailerable twin-hull vessel, to produce a system well-suited to surveys of typical U.S. harbors, rivers, and lakes.

**AUTOMATED CLASSIFICATION OF BASIC-LEVEL TERRAIN
FEATURES IN DIGITAL ELEVATION MODELS**

August 1992

Linda H. Graff

Keywords: Terrain Analysis, Automated Terrain Classification, Terrain Reasoning, Geomorphology, Geomorphometry, Digital Elevation Data

This study addresses a two-class problem in automatic terrain classification. The basic-level terrain feature selected for initial delineation is a "mount" -- an aggregation of elevated features including hills, mountains, and ranges. All remaining areas are classified collectively as "non-mount." A method was developed to partition digital elevation models (DEMs) into mount and non-mount areas automatically. Then, the developed method is compared to those results obtained by a manual classification of synthetic stereo images produced from the same digital elevation data. The results of this work suggest that it may be possible to replicate the manual identification of mounts in certain hysiological regions. However, the general utility of the mount/non-mount classification approach appears to be limited by nature of the regional terrain and by the quality of available digital data.

**METHODS OF MONITORING THE PERSIAN GULF OIL SPILL
USING DIGITAL AND HARDCOPY MULTIBAND DATA**

August 1992

Robert S. Rand
M.B. Satterwhite
Donald A. Davis
John E. Anderson

Keywords: Persian Gulf, Oil Spill, AVHRR, Landsat TM, Euclidean Distance, Bayesian Discriminant, Classifiers, Hardcopy Processing

A quick response demonstration was performed during the Persian Gulf War that showed a capability to monitor the path of oil dumped into the bay near Kuwait City using commercial satellite imagery. Both manual and semi-automated methods of image analysis were performed on AVHRR and Landsat TM imagery. Estimates of the oil area coverage were obtained using conventional classification methods. A hardcopy generation and reproduction capability was also demonstrated.

TEC-0015

AD A256 931

**HYPERSENSPECTRAL IMAGE EXPLOITATION
SBIR PHASE II FINAL REPORT
October 1991**

SETS Technology, Inc.

DACA72-89-C-0018

Keywords: Hyperspectral, Spectroscopy, Computer Image Processing, Remote Sensing

The primary goal of the Hyperspectral Image Exploitation project is the development of a prototype software system for the processing and analyzing of hyperspectral data sets. This software system will be used by the Topographic Engineering Center (TEC) to help evaluate the field of Hyperspectral Remote Sensing in general, and computer-based, hyperspectral analysis techniques in particular. The primary software system being developed under this project is called the Hyperspectral Image Cube Processing System, or HIPS. HIPS is being developed on Sun Microsystems workstations, and utilizes a state-of-the-art, window-based graphical user interface for user input and the display of images, graphs, tabular data, and other system output.

TEC-0016

AD A256 933

**BUILT-UP AREA FEATURE EXTRACTION:
FINAL REPORT
October 1991**

Digital Mapping Laboratory
Carnegie Mellon University

DACA72-87-C-0001

Keywords: Computer Vision, Automated Cartography, Digital Mapping

This final technical report describes the overall research progress during a three-year period. In July 1987, the Digital Mapping Laboratory at Carnegie Mellon University began work with the U.S. Army Topographic Engineering Center (TEC) to explore the detailed analysis of aerial imagery with particular emphasis on built-up areas containing large numbers of complex man-made structures. During the past three years research was done in several important areas including scene registration, stereo analysis, shadow analysis, and building detection. Each of these areas addresses an important set of issues toward the development of automated tools for cartographic feature extraction.

**AN IMAGE UNDERSTANDING ENVIRONMENT FOR DARPA SUPPORTED
RESEARCH AND APPLICATIONS, FIRST ANNUAL REPORT
October 1991**

Tod Levitt¹ Scott Barclay¹
Scott Johnson¹ John Dye¹
Daryl Lawton²

¹Advanced Decision Systems

DACA76-89-C-0023

²Georgia Institute of Technology

Keywords: Vision Environment, Image Understanding (IU), Computer Vision (CV), Object Oriented Programming

This report presents the functional specifications and top-level constructs of the core design of an image understanding (IU) application development environment. The core environment presented in this report provides tools to leverage the development of IU applications and to facilitate transfer of IU and reasoning technology from its origins in research laboratories into IU applications. The core environment provides both a development platform and reusable components including a library of image processing and IU routines and data structures, and an integrated set of high-level reasoning capabilities such as Bayesian networks, and logic engines. The environment design is an object oriented structure built on the C++ programming language. The report also addresses system engineering issues in applying the environment to develop workstations specialized for terrain analysis and medical applications.

**DIGITAL TERRAIN ANALYSIS MODULE (DTAM)
October 1991**

T. Shaffer J. DeVries
G. Ettinger R. Chestek

Advanced Decision Systems

DACA76-89-C-0018

Keywords: Terrain Reasoning and Analysis; Spatial, and Model-Based Reasoning; Bayesian Networks, and Inference; Probabilistic Certainty Calculus; Force Location Prediction

The goals of the DTAM program were to develop a methodology that can be used as a framework to solve the spatial terrain reasoning problem, and in general, the terrain analysis problem. A model-based evidential accrual reasoning methodology was explored and developed. To demonstrate this approach, a prototype system was specified and built. The application chosen to demonstrate this methodology was military force location prediction. This document focuses on describing the work done to fulfill the goals of exploring a model-based evidential accrual approach to spatial and terrain reasoning. The primary technologies explored were model-based Bayesian probabilistic inference and spatial region matching. A Bayesian probabilistic inferencing approach provides a framework (i.e., a probabilistic certainty calculus) that specifies how evidence from diverse sources can be matched together and consistently combined. The goal in exploring this approach was to demonstrate that elements of the terrain analysis process can be modeled, specifically spatial relationships and terrain dependencies, and that a consistent methodology for combining evidence from various information sources can be achieved.

TEC-0019

AD B168 061L

BRIGADE LEVEL HARD COPY DEVICE
October 1991

Gordon C. Alling, Jr.

acumen

DACA76-91-C-0004

Keywords: Portable Ruggedized Printer, Printing Technologies, Terrain Analysis Device

The overall objective of the completed work was to select from the field of commercially available products, the technology which was best suited to produce hard copy records of terrain analysis data at lower echelon (brigade and lower) Army units. The operational objectives were to create a matrix of hard copy technologies versus requirements which would identify the technology best suited to the Army's needs; and plan a hardware development program which would result in a prototype demonstration of the selected technology. An unspecified goal of the program was to make the Brigade Level Hard Copy Device (BLHCD) a multi-purpose device, if possible, without compromising the primary terrain analysis functions. This goal would benefit both the Army and the BLHCD manufacturer. The Army would be able to standardize on a single device for several applications, achieving logistical and cost advantages. The manufacturer would benefit from the resultant larger quantity orders and the economies of larger production volumes.

TEC-0020

AD A259 998

**MOTION ANALYSIS AND OBJECT RECOGNITION
FOR AUTONOMOUS NAVIGATION**
October 1991

Edward M. Riseman
Allen R. Hanson

University of Massachusetts at Amherst

DACA76-89-C-0017

Keywords: Computer Vision, Autonomous Vehicle and Landmark-Based Navigation, Robust Statistics, Low-Level Vision, Pose Recovery, Stereo and Motion, Kalman Filtering

The research in computer vision described in this final report is directed towards the achievement of autonomous vehicle navigation using passive visual sensing. Navigation in both modeled and unknown environments has been investigated; in addition, research has been carried out in related areas of static image interpretation. For a modeled environment, we have implemented a navigation system incorporating reactive planning, and based on the identification of known landmarks in the 3-D scene. Also, robust algorithms have been demonstrated for the recovery pose--the position and orientation of the camera--from model-matching between the image and known environment. For an unknown environment, a navigation system has been demonstrated in which image-based homing is used to move between neighboring target locations. We have also developed and experimentally tested techniques for acquiring a detailed environmental model automatically, starting from an unknown or partially known environment. For a completely unknown environment, multiframe structure from motion algorithms have been developed which use image sequences for the reconstruction of the camera motion and environmental structure. In a partially modeled environment, the combination of pose recovery with triangulation over image sequences yields a robust, accurate algorithm for incremental acquisition of a 3-D scene model. Lastly, a new framework for obstacle detection from motion has been developed and demonstrated experimentally.

**AN IMAGE UNDERSTANDING ENVIRONMENT FOR DARPA SUPPORTED
RESEARCH AND APPLICATIONS, SECOND ANNUAL REPORT
May 1992**

Douglas Morgan¹
Daryl Lawton²

¹Advanced Decision Systems

DACA76-89-C-0023

²Georgia Institute of Technology

Keywords: Vision Environment, Image Understanding (IU), Computer Vision (CV), Object Oriented Programming, C++

This report on Image Understanding Environment (IUE), describes the design of the base classes, the structure of the class hierarchy and the user interface. The design benefits the IUE by allowing integration of the diverse concepts of IU within one environment; rapid introduction of new users to the IUE; and an organized extension of the base IUE developers (including new users).

**KNOWLEDGE-BASED VISION TECHNIQUES FOR THE AUTONOMOUS
LAND VEHICLE PROGRAM, FINAL REPORT
October 1991**

Martin A. Fischler
Robert C. Bolles

SRI International

DACA76-85-C-0004

Keywords: Computer Vision, Autonomous Navigation, Image Understanding, Unmanned Ground Vehicles

The goal of this research was to develop techniques for automatically acquiring and representing knowledge about complex cultural and natural environments for such purposes as autonomous navigation, planning, intelligence analysis, and manipulation. Our research strategy was to (1) develop representations and techniques for storing (or incrementally learning) semantic and geographic information about a specific geographic area to permit both mission planning and knowledge-based interpretation of sensed data, (2) develop representations for natural and man-made objects, (3) develop techniques to recommend distinctive features of these objects that can be used for recognition purposes, and (4) develop techniques for building three-dimensional descriptions of an environment from data gathered by range or intensity sensors moving through this environment. In this report we describe our accomplishments in these areas. Near the end of the original contractual period a new task was added to evaluate the application of our cartographic stereo techniques to ground-level imagery. We characterized the strengths and weaknesses of the techniques, enhanced them based on the insights provided by the evaluation, and then evaluated the resulting systems. In this report we briefly describe the enhancements and our evaluation process.

**INVESTIGATION OF THE REAL-TIME ACCURACY
OF THE DGPS METHOD**

November 1992

Dariusz Lapucha
Kurtis L. Maynard

John E. Chance and Associates, Inc.

DAAL03-91-C-0034

Keywords: Real-Time DGPS, C/A Code, Positioning Hydrographic Surveying, Selective Availability (SA), 1-3 meters RMS

The Real-Time Differential GPS (DGPS) method using the C/A code (not carrier) has the potential to provide positional accuracy to 1-3 meters (1σ). DGPS is a viable option for positioning tasks in hydrographic surveying. Determination of the real-time DGPS accuracy is the main objective of this study. Accuracy provided by DGPS may deteriorate depending upon operational conditions. Factors influencing DGPS accuracy are discussed. Background of the DGPS method is given including mathematical description, but emphasis is on general concepts and discussion of DGPS error sources. DGPS implementation problems are discussed. Specific real-time data links and their throughput are analyzed. The RTCM-104 standard for meter level DGPS applications and the different DGPS systems used in the study are discussed. The analysis is performed using real-time and post-processed DGPS results. The influence of two major factors affecting the DGPS accuracy: distance from the monitor station and data rate of differential corrections, is investigated. The role of the data rate is evaluated using simulated data rate scenarios. Particular attention is given to the impact of Selective Availability (SA) on meter level DGPS performance during specific days of heavy SA.

TEC-S-0001

C049 697L

SUBTERRANEAN DETECTION AND ANALYSIS (SDA) (U)

December 1991

John V.E. Hansen
Judy Ehlen**Keywords:** Subterranean Detection and Analysis, Remote Sensing

This report describes presentations on subterranean detection and analysis given at a multi-agency meeting sponsored by the U.S. Army Topographic Engineering Center, Fort Belvoir, Virginia, in July 1991. The presentations are described with respect to various missions, applicable sensor technologies, and related problems. Presentation material from the participants is included as appendices.

**GLOBAL CLIMATE CHANGE (GCC) ISSUES AND THEIR IMPACTS
ON THE U.S. ARMY CORPS OF ENGINEERS
November 1991**

Jack E. Huntley
John E. Neander

Keywords: Climate, Climate Change, Global Circulation Models, Greenhouse Effect, Global Warming

This report is a survey of recent findings and arguments within the scientific arena on the subject of global climate change. This report looks at global, continental, and regional issues, as well as surface and upper atmospheric effects. Potential responses by the biosphere as well as the impacts on Army operations by global climate change are examined.

**MANUAL OF ENVIRONMENTAL EFFECTS,
CENTRAL AMERICA
April 1992**

Mark A. Flood
Jack E. Huntley

Keywords: Environment, Central America, Topography, Climate, Gulf of Mexico, Operations Systems, Belize, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Caribbean Sea, Pacific Ocean

This is the first of a series of manuals reporting on the effects of the environment on military activities for a specific region. In the context of this manual, the environment includes weather effects and terrain effects on the military. This manual focuses on the tropical region in Central America. The topography and climate of the region are investigated. Environmental threshold and impact statements are then provided in detail to illustrate the environment's impact on military operations, systems, and personnel.

WATER RESOURCES OVERLAYS USERS GUIDE
December 1990

Joel Frisch
Richard P. Thomas
Roger Peebles

U.S. Geological Survey, Water Resources Division

Keywords: Water Resources, Water Supply, Ground Water Resources

The purpose of this guide is to assist the intelligence, engineer, logistics, terrain analysis and command functions responsible for locating, developing, storing, treating and distributing water. The guide is designed to assist in the interpretation and use of these map-linked overlays. It describes and defines the data and information on the overlays, how they can help determine the location and availability of water, and when used with information in the base map, plan for water storage and distribution. The guide covers the content of each overlay and such topics as reliability, limitations, definitions of terms, security classification, and acquisition procedures. These overlays are used for comprehensive contingency planning, immediate water acquisition in the field, and for planning and developing additional water supplies by means including well drilling.

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Associative Array Processing of Raster Scanned Data for Automated Cartography	ETL-0046	1976
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TITLE	REPORT NO.	YEAR
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Astrogeodetic-Inertial Methods for Vertical Deflection Determination	ETL-0414	1985
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ATF-Hadego Photocompositor Photolettering Machine Atmospheric Refraction	1414-TR TR-61-505	1955 no date
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Autocorrelation of Control Points on 11-Band Multispectral Imagery	ETL-0473	1987
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Approach to Model Formation Based on Formal Geometric Reasoning, Second Annual Report, An	ETL-0527	1989
Automated Classification of Basic-Level Terrain Features in Digital Elevation Models	TEC-0013	1992
Automated Extraction of Airport Runway Patterns From Radar Imagery	ETL-0567	1990
Automated Feature Attribute Accessing From Map Text	ETL-0517	1988
Automated Industrial Feature Extraction from Synthetic Aperture Radar Imagery	ETL-0459	1987
Automated Processing of Geographic Information in Image Data Forms	ETL-0114	1977
Automated Route Finder for Multiple Tank Columns	ETL-0480	1987
Automated SAR Change Detection for Combat Support Phase I	ETL-0574	1990
Automated Segmentation and Extraction of Area Terrain Features From Radar Imagery	ETL-0554	1990
Automated Software System for Updating Digital Terrain Databases From All-Source Imagery, Phase I SBIR	ETL-0584	1991
Automated Technique for Measuring Built-Up Urban Areas from Map Graphics through Analog Image Processing	ETL-0012	1975
Automatic Contour Digitizer (ACD)	ETL-ETR-71-2	1971
Automatic Contouring Instrumentation	1488-TR	1957
Automatic Control of Digital Stereo Correlation Methods	ETL-0356	1984
Automatic Correlation of USGS Digital Line Graph Geographic Features to GNIS Names Data	ETL-0426	1986

TITLE	REPORT NO.	YEAR
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Automatic Line Network Extraction From Aerial Imagery of Urban Areas Through Knowledge Based Image Analysis	ETL-0568	1989
Automatic Map Compilation System	AD 277 456	1962
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Automatic Point Transfer Instrument	AD 834 230L	1968
Automatic Reseau Measuring Equipment (ARME)	ETL-0099	1976
Automatic Stereo Perception of Aerial Photography by Means of Optical Correlation	AD 406 363	1962
Automatic Radar Feature Extraction System Using Descriptors	ETL-0533	1989
Automatic Type/Symbol-Placement Developments	ETL-TR-74-9	1975
Automation of Airborne Profile Recorder Data Reduction (Interim)	AD 805 562L	1966
Automation of Airborne Profile Recorder Data Reduction (Final)	AD 825 545L	1967
Autonomous Ground Vehicles: Control System Technology Development	ETL-0375	1984
Autonomous Land Vehicle	ETL-0413	1986
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Autonomous Land Vehicle (ALV) Program Phase II - First Quarterly Scientific and Technical Report, The	ETL-0515	1988
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Autonomous Land Vehicle 1st Quarterly Report, The	ETL-0430	1986
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TITLE	REPORT NO.	YEAR
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Backscattering of Electromagnetic Waves from a Slightly Rough Surface with a Lossy Layer	ETL-TR-74-10	1974
Backscattering of Electromagnetic Waves from a Surface Composed of Two Types of Surface Roughness	ETL-TR-71-4	1971
Backscattering of Radar Waves by Vegetated Terrain	ETL-0105	1977
Backscattering of Radar Waves from a Tilted, Slightly Rough Surface	ETL-0124	1977
Base Plant Correlator	ETL-CR-71-15	1971
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Basic Factors Limiting the Accuracy of Mapping and Aerotriangulation by Photogrammetric Procedures	AD 77 390	1955
Battlefield Assessment and Decision Assistance System Using Neural Networks and an Expert System Director	TEC-0002	1992
Bayesian Approach to Identification of a Remotely Sensed Environment	AD 860 060	1969
Bibliographic Literature Search Concerning the Relationship Between Soils and Plants in Arid and Semi-Arid Regions in North America	ETL-0171	1978
Bibliography and Abstracts of Analytical Photogrammetry	1487-TR	1957
Bibliography of In-House and Contract Reports	ETL-SR-70-1	1970
Bibliography of In-House and Contract Reports, Supplement 1	ETL-SR-71-3	1971
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Broad-Spectrum Electromagnetic Spectrum Backscatter	AD 878 341L	1970
Brush Surfaced Lithographic Press Plates	1452-TR	1956
Building a 3-D World Model for a Mobile Robot from Sensory Data	ETL-0490	1988
Built-Up Area Feature Extraction: First Year Report	ETL-0561	1990
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Camera Calibration Study		no date
Capabilities of Remote Sensors to Determine Environmental Information for Combat	ETL-0081	1976
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Cartographic Design Standards — A Preliminary Investigation		1967
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TITLE	REPORT NO.	YEAR
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Change Detector Maintenance Instructions		1966
Change Detector Operation Manual		1965
Change Detector Studies		1961
Characterization and Optimization of an Electro-Optic Imaging Device for Real-Time Map Profiling	ETL-CR-74-18	1974
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Chemical Array Studies	ETL-0130	1977
Circularly Polarized Measurements of Radar Backscatter from Terrain	ETL-0199	1980
Circularly Polarized Measurements of Radar Backscatter from Terrain and Snow Covered Terrain	ETL-0234	1980
Circumpolar Method for Determining Azimuth	ETL-0317	1983
Classification and World Distribution of Vegetation Relative to V/STOL Aircraft Operations	ETL-SR-74-4	1973
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Classification of Selected Radar Imagery Patterns Using a Binary Tree Classifier	ETL-0442	1986
Climatic Information for Application in Designing and Testing U.S. Army Materiel	ETL-0474	1987
CMU (Carnegie-Mellon University) Strategic Computing Vision Project Report: 1984 to 1985	ETL-0466	1987
Coated Paper and Developer for Continuous Tone Electrophotography	AD 674 241	1968
Cold Weather Testing of 10-Second Direction Theodolite, 1-Minute Direction Theodolite (Foreign Model), Astronomical Attachment, and Winterization Kit	1288-TR	1953
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
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TITLE	REPORT NO.	YEAR
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Comparative Study of Photography for Soils and Terrain Data	38-TR	1968
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Comprehensive Summary of Project Trend	ETL-0041	1975
Computer-Assisted Likely Minesite Prediction Model and Estimated Electromagnetic and Thermal Soil Properties	ETL-0391	1985
Computer for Army Artillery Inertial Survey System (GEISHA)	AD 814 052	1963
Computer Generation of Fractal Terrains	ETL-0504	1988
Computer Program to Simulate Scenario Functions	ETL-0025	1975
Computer Strategy for Detecting Line Features on Simulated Binary Arrays in Support of Radar Feature Extraction	ETL-0478	1988
Computing a Line-of-Sight Using Digital Image Matching and Analytical Photogrammetry	ETL-0027	1975
Consensus Theory in Expert Systems: An Adaptive Inference Framework and Application to Image Understanding	ETL-0524	1988

TITLE	REPORT NO.	YEAR
Concept Development of Automated Image Analysis	ETL-0194	1979
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Contour Digitizing and Tagging Software (CONTAGRID)	ETL-0228	1980
Contour-to-Grid Interpolation with Nonlinear Finite Elements: A Feasibility Study	ETL-0472	1987
Contribution to the Philosophy of Climatic Design Limits for Army Materiel: Extreme Hot-Desert Conditions	ETL-TR-72-5	1972
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Correlation of Noisy Images	ETL-0230	1980
Cultural Data Base Implementation Study and Computer-Aided Scene Modeling System Users Manual	ETL-0380	1984
Cumulative Probability Tables for Testing Consensus in Ranking Experiments	ETL-0418	1986
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TITLE	REPORT NO.	YEAR
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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
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Design and Development of Power Package for Surveying Instrument: Azimuth, Gyro, Lightweight	ETL-CR-71-5A	1971
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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
Design and Feasibility Study of HOC as a Van Mounted Stereo Model Digitizer	ETL-0109	1977
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TITLE	REPORT NO.	YEAR
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Development of an Integrated Mobile Robot System at Carnegie Mellon University	ETL-0546	1989
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TITLE	REPORT NO.	YEAR
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Development of Automatic Names Placement Software	ETL-0484	1987
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Development of Computer Vision Techniques for Automatic Feature Extraction	ETL-0451	1987
Development of Descriptor Sets for the Unambiguous Characterization of Geographic Features on SAR Imagery	ETL-0369	1984
Development of Electronic Control of a Superconducting Gravity Gradiometer	ETL-0397	1985
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Development of Height Finder Oblique, Topographic	1383-TR	1954
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TITLE	REPORT NO.	YEAR
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Digital Cartographic Study and Benchmark	ETL-0168	1978
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Digital Image Manipulation and Enhancement System (DIMES) User's Handbook	ETL-CR-73-7	1973
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Digital Mapping System Concepts Study	ETL-CR-71-26	1971
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Discrimination of Water from Shadow Regions on Radar Imagery Using Computer Vision Techniques	ETL-0404	1985
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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
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Empirical Surface Temperature Model, An	ETL-0503	1988
Emergency Target Location Function	21-TR	1965
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Engineer Design Test and Evaluation of a Planimetric Compiler	35-TR	1966
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Engineer Route Reconnaissance Feasibility Study	AD 486 337L	1966
Engineer Test and Evaluation of the Command-Retrieval Information System/Direct Input (CRIS/DI)	42-TR	1968
Engineer Tests of 2.5x Reduction Printer	ETL-ETR-74-7	1975
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TITLE	REPORT NO.	YEAR
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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
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Engineering Tests of Translucent Cartographic Bases	1461-TR	1956
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Enhanced Photomap Evaluation Study	AD 651 396	1967
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Error Propagation in Two-Photo Intersection	ETL-RN-72-1	1972
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Evaluation of Automatic Mapping APQ as a Radar Mapping System	31-TR	1966
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TITLE	REPORT NO.	YEAR
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TITLE	REPORT NO.	YEAR
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TITLE	REPORT NO.	YEAR
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Multisensor Approaches for Determining Deflections of the Vertical	ETL-0314	1983
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Multisource Image Analysis	ETL-0208	1979
Multispectral Capability of H&W Film (Photographic Technology Series)	ETL-0101	1977
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Near-Real-Time Application of Digital Terrain Data in a Minicomputer Environment	ETL-0142	1978
Near-Surface Bathymetry System (Report No. 11 in the ETL Series on Remote Sensing)	ETL-0163	1978
Neural Networks for Object Detection Using All-Source Imagery	ETL-0585	1991
New Analyses and Methods Leading to Improved Acquisition Requirements Involving Systems, Geodetic and Reentry Errors, and Increased Weapons Effectiveness for Conventional Weapons (Part I)	RN-35	1970
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New Methods of Change Detection Using Multispectral Data	ETL-0586	1991
New Solution for the Anomalous Gravity Potential Resulting from a Modification of Molodensky's Linear Approximation, Its Practical Significance and Numerous Ramifications, A	RN-33	1970
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Noise Removal on Radar Imagery Using Local Gradient and Statistics	ETL-0402	1985
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Observations on Multi-Peg Towers of Hanoi	ETL-0476	1986
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On the Energy Integral for Satellites	RN-29	1968
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Optical-Electronic Precision Pointing System	AD 883 021	1965
Optical Power Spectral Analysis for Machine-Readable Factor Maps	ETL-0212	1980
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TITLE	REPORT NO.	YEAR
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3rd Interim Report	AD 432 243	1963
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Optimized Method for the Derivation of the Deflection of the Vertical from RGSS Data	ETL-0122	1977
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3rd Interim Report	AD 271 438	1961
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Propagation of Very Short Radio Waves Through the Ionosphere and the Investigation of Ionospheric Models	ETL-RN-74-1	1973
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Prototype Automatic Mosaicking System	17-TR	1963
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