



LARS · Purdue University · VOL. 1 · NO. 2 · January 30, 1976

## ITEMS OF INTEREST

- \* Just as our country is celebrating its birthday, so LARS is deep in making preparations to celebrate its tenth anniversary. A steering committee (Dave Landgrebe, Terry Phillips, J. B. Peterson, Shirley Davis, Pam Roberts, and Barbara Pratt) has been busy collecting ideas and beginning to make definite plans. Suggestions were made to prepare stories for the local news media, and displays in various locations on campus and at Purdue Airport are being considered. An Open House at LARS has also been tentatively set for Friday, April 23 - the end of Purdue's Gala Week.

No celebration is complete without a party - and the first one is the Skating Party at Aca-Y-Alla on Sunday, February 15, at 7:00. Others are being planned and more information will be forthcoming.

During the next few weeks we hope to be "digging" back into the history of LARS highlighting milestones and accomplishments not only of the lab but also in Remote Sensing. Your help and suggestions are needed and will be greatly appreciated. Any ideas are welcome by the committee as we plan together to celebrate our TENTH.

- \* "IEEE Transactions on Geoscience Electronics," Vol. GE-14, Number 1, has been received. Selected papers from the 1975 Symposium, Machine Processing of Remotely Sensed Data, as well as invitational papers by M. E. Bauer and K. S. Fu, are included in these transactions.

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*Prepared by the Laboratory for Applications of Remote Sensing for distribution at Purdue. Contact Susan Ferringer, SCAN LINES editor, to be placed on the mailing list (749-2052, ext. 273).*

- \* Marion Baumgardner recently committed to videotape a glimpse of recent work he and his staff have been doing in the Sudan. The 30-minute color videotape begins with a description of LANDSAT and the geography of the Sudan. Marion then identifies the kinds of information needed by a government wishing to develop its agricultural productivity and describes how both visual interpretation and numerical analysis of LANDSAT data can aid in this quest.

The videotape is available for viewing in the Technology Transfer area (except during the first week of every month when short course participants need the facilities). See Sally Sunderman for viewing help. The tape is also available for direct transmission from the Telecommunications Center to campus classrooms able to receive it.

This is LARS thirteenth videotaped production. Inquiries about this one or others may be directed to Shirley Davis.

- \* The LARS Library is seeking copies of the journal, "Photogrammetric Engineering and Remote Sensing." If you have copies that you would like to donate please send them to the attention of Sally Sunderman, Flex II. If complete sets can be put together, they will be bound and put on the library shelves.

Volumes needed are as follows:

May, August, September 1973  
March, October, December 1974

Your cooperation is greatly appreciated.

- \* The Program Leaders and other LARS personnel are in the process of updating and revising the color brochure entitled, "Remote Sensing of Agriculture, Earth Resources, and Man's Environment." The booklet has played an important role in educating people here and abroad about the fundamentals of remote sensing. Plans call for the new version to be available by June 1st.

The Program Leaders agreed that the message should remain the same, but new, updated illustrations and text should be considered to better inform its audience where the technology is today. If you have any comments or suggestions about the brochure, please send them to Jim Russell (Technology Transfer, Flex II) who is coordinating the revision.

## PERSONNEL CHANGES

- \* RON BOYD joined LARS January 1 in a professional staff position and will be working in the Crop Survey area on the SR&T Spectral Strata and Field Measurements projects.
- \* New computer operators joining LARS are KEN BROWN and ROBERT MCMILLEN.

## VISITING SCIENTISTS

- \* RENÉ VALENZVELA, ISAAC UGARTE, and MOISES UREÑA are visiting LARS from December 1, 1975 to March 1, 1976. To date these Bolivian scientists have been primarily concerned with learning remote sensing technology and getting acquainted with various LARSYS-3 processing functions. In addition, contracts have been made with EROS Data Center in order to obtain LANDSAT-2 data over the Desaguadero River. Mapping of Bolivia's natural resources using computer-aided processing and analysis of this data has already begun.
- \* Six scientists from the Sudan arrived at LARS January 12 for approximately 3 months of training in remote sensing, and in particular computer-aided analysis and interpretation of multispectral scanner (MSS) data. In addition and concurrent with the training, the Sudanese scientists:
  - ABDELRAHIM MOHAMED ALI
  - YOUSIF YAGOUB
  - EL MARDI A. HASSAN
  - HASSAN ELSHEIKH ELBASHIR
  - YAHIA I. M. BUSHARA
  - KHALID AHMED KHALIL IBRAGIMand LARS personnel will work together to analyze ERTS MSS data covering a small portion of Sudan.

## TRAVEL: SEMINARS AND ADDRESSES

- \* Dick Mroczynski and Bud Goodrick travelled to Jacksonville, Florida January 13-16 to prepare a proposal for the Technical Forestry Department of St. Regis Paper Company, Southern Division.
- \* Marion Baumgardner was guest speaker at the Soil and Water Conservation Department Banquet in Sullivan, Illinois on January 26.
- \* Dave Landgrebe presented a paper at the IBM Invitational Symposium January 27-29 in Clear Lake City, Texas. Bill Simmons also attended the symposium to present demonstrations on LARSYS to the Agri-Business attendees.

- \* Marion Baumgardner was in Washington, D. C. January 27-30 attending meetings of the National Academy of Sciences Committee on Remote Sensing for Development.
- \* Roger Hoffer attended a SKYLAB Author's meeting on January 27 & 28 in Houston.
- \* On January 28 & 29 LeRoy Silva, Dave DeWitt and Ed Hanley collected thermalgraphic data at Cincinnati General Hospital.

## VISITORS

- \* Professor J. A. Greefkes of the University of Einthouerns Holland at Kenezsel, Holland visited with Dave Landgrebe on December 11.
- \* Dr. Dick Frevert, Director of the Arizona Agriculture Experiment Station was here on December 12 to discuss Remote Sensing Technology with J. B. Peterson.
- \* Jack Conbett, Dave Denison, Terry Lehman (former LARSIAN) and Paul Harrison visited Paul Anuta on January 7-8 reviewing progress on the Cities Service study.
- \* Dick Weismiller and Frank Kirschner hosted William B. Barnes and James Keith of the Department of Natural Resources on January 8. These people are interested in acquiring some land in Lake County with hopes of creating a State Preserve to be dedicated as a National Natural Landmark.
- \* Earl Park of SRS was here January 9 to see Marv Bauer and Dave Landgrebe.
- \* Leo Childs and Michael McEwen, NASA/JSC, and Jerry Walsh and Will White, Lockheed Electronics Corporation met with Marv Bauer, LeRoy Silva, Barrett Robinson and Bill Simmons January 15-16 to discuss the Joint Soil Moisture Project.
- \* On January 22 five people (two from the University of Illinois, an ERIM representative, a JSC representative, and Ruth Whitman of NASA/HQ) were here to discuss a large area clustering project with Dave Landgrebe.
- \* Carlos Brockman and Bob Durland are expected at the Lab on February 4-6 to see Luis Bartolucci, Don Levandowski and Roger Hoffer concerning the Bolivian project.

## COMING ATTRACTIONS

\* Break out your roller skates and come to the LARS skating party. It's FREE, and all LARS personnel, their families and guests, are invited to join in the fun on Sunday, February 15 from 7-10 P.M. Bring your own skates or 50¢ for skate rental to the ACA-Y-ALLA Skating Rink, just east of K-Mart on State Road 38 East.

\* Seminar schedule for the month of February is as follows:

WEDNESDAY, February 4    The Sudan, with Marion Baumgardner and the Sudanese visiting scientists.

TUESDAY, February 10    Dick Mroczynski on FAP

TUESDAY, February 16    John Lindenlaub will talk on Technology Transfer activities and a paper to be presented to the American Society of Photogrammetry.

TUESDAY, February 24    TO BE ANNOUNCED

\* A tentative list of the February Short Course participants is as follows:

Peter Lees United Nations Environmental Program Nairobi, Kenya	Brian Martin United Nations Environmental Program Nairobi, Kenya
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George S. Martin Arlington, Virginia	Billie D. Smith Gallup, New Mexico
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Mohammed Said Kilana Institute of National Research Iraq	Ali M. H. Almashat Institute of National Research Iraq
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## PROPOSALS AND PROJECTS FUNDED

\* TECHNICAL RESEARCH CENTER OF FINLAND - The Technical Research Center of Finland has purchased LARSYS Version 3. This project was funded from November 1 - December 31, 1975 for \$2500 to assist them in installing it and making it operational in their computer, an IBM 370/145. Howard Grams was the principal investigator.

- \* BOLIVIAN LANDSAT - Donald W. Levandowski (principal investigator), Luis Bartolucci, Terry Fralick, and Davida Parks are working together with three visiting scientists in evaluating computer-aided analysis of LANDSAT-1 and LANDSAT-2 MSS data in order to map the natural resources in Bolivia. The project was funded for \$32,243 from November 15, 1975 to May 15, 1976.
- \* Three projects were funded to support Earth Resources Data Processing Terminals for 1976. Terry Phillips (principal investigator), Sue Schwingendorf, Barb Davis, and Marlene Hodge are working on these projects:

WALLOPS TERMINAL - Funded for \$20,835 from December 15, 1975 to September 15, 1976 to support a terminal in Wallops Flight Center, Wallops Island, Virginia.

EDC TERMINAL - Funded for \$47,340 from September 1, 1975 to May 31, 1976 to support a terminal at the EROS Data Center, Sioux Falls, South Dakota.

INDIANA STATE TERMINAL - Funded for \$39,714 from September 1, 1975 to June 30, 1976 to support a terminal at Indiana State University, Terre Haute, Indiana.

## RECENT ACQUISITIONS IN THE LARS LIBRARY

- \* A114 SKYLAB EARTH RESOURCES DATA CATALOG. 1974. NASA:  
N21 Houston JSC 09016 359 pages.  
74  
A basic description of EDEP sensors and the applicability of the data they produce to earth resources problems. Includes coverage maps for the six sensors and information on obtaining data.
- \* A200 ENVIRONMENTAL DATA HANDLING by George B. Heaslip.  
H35 Wiley Interscience, 1975.  
75  
A text covering fundamentals of remote sensor data acquisition and data handling. A large part of the book is devoted to basic transducer and sensor data-recording methods and to descriptions of final data display. Contains glossary of environmental and test data handling terminology.
- \* P PROCEEDINGS OF THE NASA EARTH RESOURCES SURVEY  
N21 SYMPOSIUM, Houston, Texas, June 1975.  
75 Vol. I-A: Agriculture, Environment  
Vol. I-B: Geology, Information  
Vol. I-C: Landuse, Marine  
Vol. I-D: Water

Volumes contain all technical papers presented at the "first comprehensive symposium" on the practical application of earth resources data.

- \* A060 MANUAL OF REMOTE SENSING, American Society of  
AM3 Photogrammetry. 1973. 2 volumes  
    Vol. I - Theory, Instruments, and Techniques  
    Vol. II - Interpretation and Applications

This is the one we've been waiting for! Covers everything from the history of remote sensing to present date uses. Heavily biased toward photo-interpretation and photogrammetry. Includes contributions by Landgrebe, Swain, and Baumgardner.

- \* An interdisciplinary journal entitled "Remote Sensing of Environment" is now available through Pam Roberts.

## INFORMATION NOTES

- \* 022675 Purdue/LARS Digital Display User's Guide by  
Leslie L. Wilson.

To acquaint new users with the digital display system, as well as to refresh and enhance the knowledge of those already familiar with its usage, the Purdue/LARS Digital Display User's Guide was created. It is a comprehensive manual incorporating all the information needed to control and to make efficient use of the 4507 digital display and its associated hardware. Included in the text is a description of the digital display system and its capabilities, utilization of the display (both hardware and software), advanced theory and techniques, as well as a comprehensive photographic operations manual. This publication supersedes the Digital Display Photographic Operations Manual, LARS Information Note 101574.

This work was sponsored by Purdue University/LARS Computer Facility.

- \* 110475 LARS Computational Facility Users Guide by Howard  
L. Grams.

The LARS Computational Facility User's Guide is designed to document and incorporate all the basic information one needs in order to gain access to the machine and to use the equipment. Topics covered include a description of the LARS Computer Facilities (both hardware and software), administrative procedures, documentation available,

procedures for operating terminals and/or submitting jobs, and notes for programmers.

This work was sponsored by Purdue University with the IARS Computer Facility account.

- \* A set of revised pages for the Users Guide (I.N. 110475) is now available for updating your copy. A set of these pages may be obtained from Howard Grams.

- \* 1111575 Selective Radiant Temperature Mapping Using a Layered Classifier by L. A. Bartolucci, P. H. Swain and C. L. Wu.

A method of measuring temperatures of selected ground cover types using remotely sensed multi-spectral scanner data and a layered classification approach is described. A brief review of radiation theory is presented to show that for the wavelength bands and temperature ranges involved in remote sensing applications, a linear calibration function can be satisfactorily utilized. Finally, an example of the application of the layered classifier for temperature mapping of water is shown.

This work was sponsored under contract number NAS5-21773 and Grant Number NGL-15-005-186.





LARS · Purdue University · VOL.1 · NO.3 · February 29, 1976

## ITEMS OF INTEREST

- \* The Data Library now has 16mm microfilm of all LANDSAT-1 and LANDSAT-2 frames through Fall 1975. The microfilm viewer is available in the Flex I Resource Room (180C). For further information contact DONNA SCHOLZ, Data Librarian, Flex I.
- \* C. D. MCGILLEM, Professor of Electrical Engineering, Purdue University, assumed the responsibilities of President of the IEEE Geosciences Electronics Group January 1, 1976.
- \* The LARS Library is still seeking copies of the journal, "Photogrammetric Engineering and Remote Sensing." If you have any copies that you would like to donate please send them to the attention of SALLY SUNDERMAN, Flex II. When complete sets have been put together they will be bound and put on the library shelves.

Volumes still needed are:

May, August, September 1973

March, October, December 1974

Your cooperation is greatly appreciated.

- \* Three slide notebooks are now being circulated throughout the program leaders to enable distribution of the new slides created for the Minicourse Series. All interested people should contact their program leader or SUE FERRINGER, Visual Designer, Flex II.

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- \* The March Short Course has been cancelled. Each of the remaining three months: April, May, and June, have partial enrollment, although space is still available.
- \* One-page abstracts of short papers for the third annual LARS Symposium on Machine Processing of Remotely Sensed Data can be submitted until April 16. If interested contact PHIL SWAIN.

## PERSONNEL CHANGES

- \* TINA CARY returns to LARS on March 1 to assist the Sudanese visiting scientists in their analysis of four LANDSAT frames covering a central test site of Sudan in order to generate a general cover type classification map.
- \* CHRIS PARKER joined LARS February 9 as a half-time undergraduate research assistant under MARV BAUER. He will be assisting in the acquisition and analysis of remote sensing data for the Spectral Strata and Field Measurements projects.
- \* Three new people joined the Computer Facility in February: GARY BRUGHER and PETE WILKINSON are new computer operators for BILL HOCKEMA; GARY SELZER is a graduate student programmer under HOWARD GRAMS.
- \* New faculty member to the PY project, Assistant Professor of Forestry and Natural Resources, ANN SPACIE is working with ROGER HOFFER 10% time.
- \* The Ecosystems Research Programs also gained a new graduate student, GLORIA MCGREW, Geosciences. She is working with TERRY FRALICK in helping the Bolivian visiting scientists under LUIS BARTOLUCCI, project manager.

## VISITING SCIENTISTS

- \* Six Iraqi scientists are visiting LARS from the Iraqi State Organization of Minerals. Working with MARION BAUMGARDNER (LARS sponsor), DON LEVANDOWSKI, HANS HAUSKA, STEVE KRISTOF, and DONNA SCHOLZ, these scientists:

HAMEED M. AL-AMIRI	Geology
HAFIDH M. AL-MEHAIIDI	Geology
BASSAM M. AHMED	Geology
SALIM S. JARDAQ	Forestry
FLAYEH H. ALTAIE	Soil Science
TALIB K. A. AL-ALLAG	Computers and Physics

are learning remote sensing technology, and through analysis of two test sites in Iraq they hope to determine if computer-aided analysis is feasible for Iraq.

- \* JOSE LABRANDERO, Geologist and Agricultural Scientist, joined LARS visiting scientist program from the Madrid Scientific Center, Madrid, Spain. He is here on an IBM Fellowship to study remote sensing technology with MARION BAUMGARDNER (LARS sponsor) and DON LEVANDOWSKI.

## TRAVEL-SEMINARS & ADDRESSES

- \* Washington, D.C. was the setting for the joint annual meetings of the American Congress of Surveying and Mapping (ACSM) and the American Society of Photogrammetry (ASP) from February 22-28. ROGER HOFFER and MIKE FLEMING traveled to the 1976 Convention to present a paper entitled "Definition of an Optimal Wavelength Band Combination for Forest Cover Type Mapping Using Skylab S-192 Data" to the ASP. DR. HOFFER also presided over one of the technical sessions.
- \* JOHN LINDENLAUB and JAMES RUSSELL made a presentation to the ASP entitled, "A Minicourse Series on the Fundamentals of Remote Sensing." LARS personnel had a chance to preview this presentation February 17 at the weekly seminar. While in Washington DR. LINDENLAUB also attended the IEEE Administrative Committee and visited the NSF about a proposal.
- \* PAUL ANUTA presented a paper to the ASP entitled, "Digital Registration of Topographic Data and Skylab MSS Data for Augmented Spectral Analysis."
- \* LEROY SILVA and DAVE DEWITT visited Cincinnati General Hospital, Cincinnati, Ohio January 28-29 to obtain photographic and thermographic data on fourteen patients of the Breast Cancer Detection Center. This information will be used in a proposal to the National Science Foundation to establish the feasibility of applying MSS classification techniques to breast cancer detection.
- \* DICK WEISMILLER and DICK MROCYNSKI were in Washington, D. C. on February 17-19 to consult with their contract monitor on the PY semi-annual report and goals for next year's proposals.
- \* DAVE LANDGREBE traveled to St. Louis February 12 to attend the Purdue Alumni Association, then on to Washington, D.C. February 16-19 for an evaluation panel on the National Science Foundation Graduate Fellowship Programs.
- \* ROGER HOFFER attended a NASA Skylab review in Houston February 19-20.

## VISITORS

- \* CHARLES PATRICK and ALAN FURNER from NDM, Dayton, Ohio visited LEROY SILVA and DAVE DEWITT on January 23 to negotiate a contract with LARS and the Biomedical Engineering Center, Electrical Engineering, Purdue. The proposal is to examine the effect of heating in humans by electro-surgical dispersive electrodes using thermography.
- \* CARLOS BROCKMANN, Director of the Bolivian/LANDSAT Program, and ROBERT DURLAND were here February 5-6 to see LUIS BARTOLUCCI, DON LEVANDOWSKI, and ROGER HOFFER to discuss future cooperative research projects between LARS and Bolivia.
- \* JACK CORBETT from the Cities Service Project was here February 11-12 as the guest of PAUL ANUTA and DON LEVANDOWSKI to participate in an analysis meeting.
- \* JOHN LINDENLAUB is working with GERALD PETERSON, Electrical Engineering, University of Arizona, and HELEN PLANTS, Engineering Mechanics and Education, University of West Virginia on the 1976 Frontiers in Education Conference. They met at LARS February 13 to formulate the program for this Conference to be held at the University of Arizona during October 1976.
- \* PHILIP MARSHALL from the Indiana Department of Natural Resources Division of Forestry, Vallonia State Nursery, Vallonia, Indiana visited DICK MROCZYNSKI February 24. DR. MARSHALL was here consulting about the Forest Tent Caterpillar infestation in the southern part of the state. A pilot program is scheduled for May under the PY contract to assess the possibility of using Color IR film to detect the extent of the outbreak.

## COMING ATTRACTIONS

- \* The weekly seminar scheduled for March is as follows:

TUESDAY, March 2	Biological Criteria for Sensor Design DR. JAMES TUCKER, Goddard Space Flight Center
TUESDAY, March 9	Physical Plant and You FRED PLANT, LARS Business Office
TUESDAY, March 16	Thermal Modeling of Crop Canopies RANDY BURCH, Measurements Program Area

TUESDAY, March 23

Acquisition and Analysis of Field  
Measurements Data  
MARVIN BAUER, Program Leader, Crop  
Inventory

TUESDAY, March 31

Cities Service Minerals Project  
DON LEVANDOWSKI, Professor, Geoscience

## PROPOSALS AND PROJECTS FUNDED

- \* GREAT LAKES II - The Environmental Protection Agency has funded \$35,291 for December 2, 1975 to March 1, 1976 for the production of color-coded land use maps of the Great Lakes watershed with MSS data from LANDSAT. The counties are the same as included in Great Lakes I. DICK WEISMILLER is the principal investigator, with DAVE FREEMAN and the Computer Facility working with him.
- \* FAST ICE MAPPING - The University of Colorado has funded \$5,629 for January 1, 1976 to March 31, 1976 for multispectral analysis of fast ice. DON LEVANDOWSKI and LUIS BARTOLUCCI are working on this project.

## RECENT ACQUISITIONS IN THE LIBRARY

- \* Now available in the LARS Library is "Pixel Facts." This is a newsletter by NASA, Ames Research Center, Moffett Field, California. The Goddard Space Flight Center, "LANDSAT Newsletter", is also available.
- \* The January 1976 issue of "Photogrammetric Engineering and Remote Sensing" is now on the Library shelves. Briefly, its technical articles include:

Non-Topographic Photogrammetry, 1972-1976  
Dr. H. M. Karara

Photogrammetric Potentials of Non-Metric Cameras  
Prof. Dr. Ing. Wolfgang Faig

Biostereometrics '74-A Report  
R. E. Herron, Ph.D.

A Review of Close-Range Engineering Photogrammetry  
K. B. Atkinson

State-of-the-Art of Close-Range Photogrammetry  
A. Kennert I. Toregard

Analytical On-Line Systems in Close-Range Photogrammetry  
Dr. V. Kratky

The Use of Non-Metric Cameras in Monitoring High Speed Processes  
M. C. Van Wijk and H. Ziemann

Metric or Non-Metric Cameras  
Otto R. Kolbl

Comparison of Optical Contouring Methods  
N. Balasubramanian

## INFORMATION NOTES

121874 Variance Comparisons for Unbiased Estimators of Probability of Correct Classification by David S. Moore, Stephen J. Whitsitt, and David A. Landgrebe.

Variance relationships among certain count estimators and posterior probability estimators of probability of correct classification are investigated. An estimator using posterior probabilities is presented for use in stratified sampling designs. A test case involving three normal classes is examined.

This work was supported in part by the Air Force Office of Scientific Research, Air Force Systems Command, under Grant AFOSR-72-2350B and in part by NASA under Grant NGL 15-005-112.

061575 Natural Resource Mapping in Mountainous Terrain by Computer Analysis of ERTS-1 Satellite Data by Roger M. Hoffer and Staff.

This report describes the significant results of a two year interdisciplinary study involving the use of computer-aided analysis techniques applied to ERTS/MSS data collected over rugged mountainous terrain in southwestern and central Colorado. These results involve five specific areas of research, including: 1) Ecological Inventory, with emphasis on the utilization of ERTS data and computer-aided analysis techniques for forest cover mapping and acreage estimates; the results also include a cost analysis; 2) Hydrological Features Survey involving the capability for utilizing ERTS to monitor the change in snow cover and inventory water bodies; 3) Geomorphological Features Survey, with a discussion on the utilization of ERTS data in combination with ancillary information; 4) Interpretation Techniques, discussing the concepts of modeling topographic relief in order to be able to develop better analysis procedures; and 5) Data Collection Platform, a review of the operations of a DCP under adverse climatic conditions.

A section is devoted to a large number of specific results and conclusions of significance, and recommendations for future earth observational systems.

This report was prepared under Contract No. NAS5-21880.

012176

Results from the Crop Identification Technology Assessment for Remote Sensing (CITARS) Project  
by R. Bizzell, F. Hall, A. Feiveson, M. Bauer,  
B. Davis, W. Malila and D. Rice.

The CITARS task design and objectives are reviewed and final results are presented, together with conclusions and recommendations. It was found that several factors had a significant effect on crop identification performance: (a) crop maturity and site characteristics, (b) which of several different single-date automatic data processing procedures was used for local recognition, (c) nonlocal recognition, both with and without pre-processing for the extension of recognition signatures, and (d) use of multirate (multitemporal) data. It also was found that classification accuracy for field center pixels was not a reliable indicator of proportion estimation performance for whole areas, that bias was present in proportion estimates, and that training data and procedures strongly influenced crop identification performance.

The work was sponsored by NASA under Contract Number NAS9-14016.

012276

A Study of the Utilization of EREP Data from the Wabash River Basin by L. F. Silva and L. L. Biehl.

This report describes the research performed during the total contract period (April 1, 1973 - December 8, 1975) of Skylab EREP Investigation 397, Study of the Utilization of EREP Data from the Wabash River Basin, contract number NAS9-13301.



A series of seven thick, black, curved lines that sweep from the top right towards the center, creating a sense of motion or a stylized 'S' shape.

LARS · Purdue University · VOL.1 · NO.4 · March 31, 1976

## ITEMS OF INTEREST

- \* Mark your calendars; FRIDAY, APRIL 23 is the LARS Open House. Displays are being planned and constructed as PAM ROBERTS, BARBARA PRATT, and SUSAN FERRINGER are working with the Program Leaders in order to tutorially explain the research being conducted in each program area.

The Open House, to be held in Unit D of Flex Lab II from 2-5 P. M., is open to anyone interested in increasing their knowledge of remote sensing. To date, memos have been sent to Heads of Schools, Directors, and Deans of Purdue asking that they inform their staff members. Although the public is most welcome, no outside publicity is planned.

- \* ROGER HOFFER, Professor of Forestry and Program Leader of Ecosystems Research, was elected to be the Director of the Remote Sensing and Interpretation Division, one of three divisions, of the American Society of Photogrammetry. Dr. Hoffer was installed during the annual meeting of the ASP in Washington, D. C. on February 23-27. He was also appointed to the Board of Directors for a one year term.
- \* The lab has recently received approval from NASA to purchase the following new equipment: (1) PDP minicomputer, (2) printer/plotter, (3) table digitizer, (4) generator, and (5) leaf area meter. NASA is also installing a DATAFAX machine in the lab to enable LARS to transmit printed material directly to NASA installations.

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- \* Distribution of LARS program abstracts and users guides should be flowing smoothly with two full-time people now responsible. See NANCY BAKER, Computer Facility secretary, for program abstracts, and MIKE COLLINS for users guides.
- \* The "Shop" in Flex Lab I is being expanded during the period of April 1 - May 7.
- \* Two open seminars will be featured during the April Short Course. M. F. BAUMGARDNER will present "An Application of Remote Sensing to Sudan" at 3:30 P.M. on Wednesday, April 7. D. A. LANDGREBE's "Milestones" will be presented at 3:30 P. M. on Thursday, April 8.

Participants in the April 5-9 Course include two LARS Staff members, ROYAL SAND and BILL HOCKEMA, as well as

Ali Virasteh  
Ministry of Agricultural  
& Natural Resources  
Iran

Fred Gordon  
NASA/Goddard Space Flight  
Center  
Greenbelt, Maryland

Hector Hernandez  
IBM/Mexico  
Mexico City

## TELEPHONES

- \* In the past few weeks many LARSIANS have been experiencing telephone difficulties in the form of (or "to the tone of") buzzing, whistling, dialing sounds or static during conversations. Some have had difficulty dialing into LARS while others have had difficulty dialing out of LARS.

If any of these circumstances (or any others not mentioned) befall you, please contact Barbara Pratt at extension 248. A log including date, incident and extension number are being compiled in an attempt to locate the problem(s) and isolate the cause(s) and alert General Tel to our difficulties so we can get them repaired.

## PERSONNEL CHANGES

- \* KATHY FREEMAN (Mrs. Dave Freeman) began work on March 1 as LARS new Librarian/Photographer.
- \* The Computer Facility gained two new programmers; BRUCE CLARK will be working with HOWARD GRAMS, and JAMES MEYERSON will be working with PAUL SPENCER.

- \* JOE BRICKLER will be providing photographic work for the LARS Open House during the month of April.
- \* JOHN BERKEBILE is leaving the first week of April to accept a job as Park Manager for the Lake County Parks & Recreation Department.

## VISITING SCIENTISTS

- \* The Sudanese Visiting Scientists were joined for their final week at LARS (March 22-29) by two Government officials who visited the lab to review the overall progress and to look at the overall applications of remote sensing technology. BABIKER MOHAMMED SAIED, Head of Projects Section, Soil Conservation, Land Use, and Water Program Administration and EL RASHEED ABDEL MAGID, Director, Range and Pasture Administration will be traveling with the Sudanese scientists through Europe and then home to the Sudan.
- \* Two representative from the EROS Data Center, MICHELLE ENGEL and DALE GEHRING, were here at LARS March 29 - April 2 for an Extended Analysis Training Course with BARB DAVIS and SUE SCHWINGENDORF. Besides analyzing the Monroe Reservoir data set (Unit VII of the Educational Package), they compared the output of experimental programs to that obtained from LARSYS, and went through a majority of the available mini-courses.
- \* MR. ALI VIRASTEH, Deputy Director-General, Agricultural Economics and Statistics Department, Ministry of Agriculture and Natural Resources, Teheran, Iran and his wife have joined LARS for nine months in the Visiting Scientist Program. Working under MARV BAUER, MR. VIRASTEH will be studying the various remote sensing techniques which are potentially applicable to the field of agricultural statistics with a view to developing methods of applying remote sensing techniques in agricultural statistics.

## TRAVEL-SEMINARS & ADDRESSES

- \* DICK WEISMILLER recently presented an educational program on "Applications of Remote Sensing in Agriculture" to the annual meeting of the Union County (Liberty, IN) Annual Agricultural Extension Advisory Council Meeting. He also lectured to the science classes and faculty of Elwood High School, Elwood, Indiana on remote sensing in general.
- \* ROGER HOFFER gave an invitational paper at the Symposium which was held at the University of New York at Syracuse from March 10-11. Dr. Hoffer was also in Houston, Texas from March 15-18 for a Skylab author's meeting.

- \* The Field Measurements Program area has been traveling lately; M. BAUER, L. BIEHL, B. ROBINSON, and B. SIMMONS were at Texas A&M for a field measurement project meet on March 10-11 and will be participating in a field measurements data quality and verification meeting at NASA/JSC on April 6-7. MARV BAUER also traveled to Garden City, Kansas on the field measurements mission.
- \* JAMES RUSSELL traveled to Atlanta, Georgia to attend the National Society for Performance Instruction Conference from March 29 - April 2.
- \* The LACIE (Large Area Crop Inventory Experiment) third review was held at JSC on March 16 - 18. Evaluation by a team of experts, including an army of LARS personnel: DAVE LANDGREBE, TERRY PHILLIPS, PHIL SWAIN, MARV BAUER, PAUL ANUTA, and ROGER HOFFER, focused on improvements implemented at the last review.

Direct and indirect contributions from many LARS projects, as well as personnel from NASA, USDA, and NOAA are involved in the experiment in an application of theoretical remote sensing technology and the use of LANDSAT-1 and LANDSAT-2 satellite data. While helping to establish workable approaches, the LACIE worldwide survey of wheat is evaluating the feasibility of this remote sensing approach to crop inventory with possible international implications.

## VISITORS

- \* Department of Natural Resources representatives MIKE COGGESHALL and PHIL MARSHALL visited with PY personnel on February 24. LARS' involvement in mapping the investation of the Forest Tent Caterpillar in Southern Indiana was discussed.
- \* PIERRE-MARIE ADRIEN of the Inter-American Development Bank, Washington, D. C., (and former short course attendee) visited with DRS. LANDGREBE, PETERSON and BAUMGARDNER on March 1-3 to discuss the Guatemala Proposal.
- \* Measurements and Analysis of Crop Canopies was the major issue of discussion between MARV BAUER and his March 2nd and 3rd visitor, C. JAMES TUCKER of NASA/GSFC, Greenbelt, Maryland.
- \* GOTTFRIED KONECNY, BERNARD WROSEL, WALTER SCHUHR from Technology University, Hanover, Germany, visited PAUL ANUTA on March 4. They reviewed Remote Sensing techniques and geometric corrections.

- \* On March 25, DR. CHARLES PATRICK of New Dimensions in Medicine, Inc., Dayton, Ohio, met with DRS. SILVA and DEWITT for the purpose of proposal negotiating.
- \* DOUG MORRISON discussed remote sensing techniques with PROFESSOR BLAIR BUTLER and his freshman engineering class when they visited the lab March 25.

## COMING ATTRACTIONS

- \* The weekly seminar schedule for April is as follows:
  - Tuesday, April 6 Crop Identification and Acreage Estimation over Kansas and Indiana  
C. F. Walker, Research Agronomist
  - Tuesday, April 13 LARSYS Support  
W. R. Simmons, Manager of Applications Systems
  - Tuesday, April 20 Thematic Mapper Simulation Revisited  
L. Biehl, Project Manager/Engineer
  - WEDNESDAY, April 28 West of the White Nile (I'd Walk a Mile for a Camel)  
M. F. Baumgardner, Program Leader,  
Earth Sciences Research Programs

## RECENT ACQUISITIONS IN THE LIBRARY

- \* The ITC Journal, Volume 1975-4 is now available in the Flex II library. Its technical articles include:

Archaeological Interpretation of a Viking Site	Hilwig-Sjosted
Vector Geometry in Automated Cartography	Anda
Multi-Disciplinary Surveys	Nossin
Nine Aspects of Remote Sensing	Eckhart
Generalisation de L'Ecart-Type	Jalba
Satellites, a Puzzle for the UN	Moore
Erosion in Volcanic Soils	Elbersen and Nieuwenhuis
Landforms and Inundations in Java	Verstappen
Geochemical Investigation of Latosols	Dijkstra, Van den Hul, Kuhnelt and Shei



## NEW INFORMATION NOTES

- 052175 Experimental Examination of Similarity Measures and Preprocessing Methods Used for Image Registration by M. Svedlow, C. D. McGillem and P. E. Anuta.

A variety of image registration algorithms have been developed over the past several years by various authors. This study examines the applicability of several of these to the temporal registration problem of LANDSAT data. The results indicate that most methods work well for highly correlated images but only a few are effective for the low correlation case. The magnitude of the gradient enhancement method coupled with a magnitude of the difference correlator is observed to produce the best results.

This report was done under Contract NAS9-14016.

- 072475 Computer-Aided Analysis of LANDSAT-1 MSS Data: A Comparison of Three Approaches, Including a "Modified Clustering" Approach by M. D. Fleming, J. S. Berkebile and R. M. Hoffer.

Three approaches to computer-aided analysis of LANDSAT-1 MSS data were evaluated utilizing data from a test site in rugged, mountainous terrain. The approaches compared included non-supervised (clustering), modified supervised, and modified clustering. The modified clustering approach proved to be the optimal technique because of minimal computer time, highest classification accuracy, and most effective analyst/data interaction. This paper was presented at Purdue University's Symposium on Machine Processing of Remotely Sensed Data, June 1975.

The research reported in this paper was supported by NASA Contract NAS9-14016, NASA Contract NAS5-21880, and NASA Contract NAS9-13380.

- 100675 Computer-Aided Analysis Techniques for Remote Sensing Data Interpretation by Paul E. Anuta.

The preprocessing and analysis algorithms available at LARS are described briefly. Applications to non-multispectral scanner are discussed in conclusion. This is an overview paper presented at a conference and does not present any new or previously not reported techniques. The applications to non-MSS data are new.

The research reported in this paper was supported by the Cities Service Minerals Corporation.

- 122075 The Role of Remote Sensing in Determining the Distribution and Yield of Crops by M. E. Bauer.

The role of remote sensing in obtaining information about the distribution and yield of crops is discussed. Topics discussed under the physical basis for remote sensing are: energy sources, the atmosphere, spectral properties of vegetation, remote sensing data acquisition, and analysis and interpretation of remotely sensed data. The discussion of agricultural applications of remote sensing covers: crop identification and area estimation, crop condition assessment, yield prediction, range surveys, soil mapping, and agricultural land use in developing countries.

This report was produced under Contract NAS5-20793.

- 012376 A Forestry Application Simulation of Man-Machine Techniques for Analyzing Remotely-Sensed Data by J. Berkebile, J. Russell and B. Lube.

The manual is a detailed step-by-step description of an actual analysis of remotely-sensed data performed by a forester for a portion of the Hoosier National Forest. The decisions made during the analysis and their rationale are described. The importance of the man-machine interactions are emphasized. The steps are documented with illustrations and examples. The reader is asked to display a mastery of each step through self-check items.

This report was produced under Contract NAS9-14016.

- 030176 Technological Basis and Applications of Remote Sensing of the Earth's Resources by Marvin E. Bauer.

This paper briefly describes the development of remote sensing, then discusses the physical and technological basis for obtaining earth resources information from airborne and spaceborne sensors. It points out that information may be obtained from analyzing the spectral, spatial, and temporal variations of energy emanating from the earth's surface. Two types of analysis, image-oriented and numerical are discussed, with emphasis on the latter. Finally, applications of remote sensing technology are discussed.

This report was produced under Contract NAS5-20793.





LARS · Purdue University · VOL. 2 · NO. 1 · Summer 1976

## ITEMS OF INTEREST

- \* The Laboratory for Applications of Remote Sensing has received two citations from the National Aeronautics and Space Administration for an evolving method of data analysis. DAVID LANDGREBE, director of LARS and a professor of electrical engineering, and TERRY PHILLIPS, deputy director and a research engineer for the Engineering Experiment Station, accepted the awards for the "creative development of technology, which was the subject of a NASA Tech Brief publication (entitled) Multi-spectral Data Analysis: LARSYS III."

A concept for analyzing multispectral data began to evolve at Purdue in 1964. The concept was a key in the creation of the laboratory in 1966, established at that time primarily for applications of remote sensing techniques to agriculture. Soon after the laboratory was established, this concept took on a more specific form. It became known as LARSYS and underwent continual development. By 1972 it had become widely recognized as the accepted method for analyzing multispectral data for earth resources information.

Documentation of LARSYS III, a computer software package, comprises three computer tapes and 3,000 pages of written information. Continual development of this system has led to its current usage at LARS: LARSYS Version 3.1.

- \* The 3rd SYMPOSIUM ON MACHINE PROCESSING OF REMOTELY SENSED DATA was a success! Approximately 250 attendees, including

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*Prepared by the Laboratory for Applications of Remote Sensing for distribution at Purdue. Contact Susan Ferringer, SCAN LINES editor, to be placed on the mailing list (749-2052, ext. 273).*

about 60 from Purdue, participated in a lively exchange of recent results on methods and applications of the technology. Look for the 4th Annual Symposium, with JOHN LINDENLAUB as the General Chairman, to be held June 21-23, 1977, in Stewart Center.

\* Weekly seminars on remote sensing are planned to resume in September. Interested participants should contact GLENDA BAUER.

\* REMINDERS FOR COMPUTER USERS:

1. BTREF Schedule is Tuesday and Friday night from 1:00AM to 8:00AM. Also BTREF will be run on other nights after all normal users have left.
2. ON BATCH MACHINES: Please think twice before you submit a job to BATQUICK. BATQUICK is intended only for very short turnaround jobs, such as deck listing or duplicating. Most other types of jobs will tie BATQUICK up enough that the turnaround time goal for other users' jobs cannot be met. Any job requiring a tape is too long (in terms of turnaround time) for BATQUICK, even if it requires less than 1 CPU minute. Please use BATSHORT for such jobs.
3. If you have signed up to use computer resources (such as the digital display) and you will not be able to make the appointment, please call the operator to remove your name from the reservation list.
4. When in the computer room, please adhere to the rules of no smoking or consuming food or beverages.

\* There are now four additional commands available to CP and CMS users. CP commands are:

1. QUERY *userid* NAME - to display any *userid*'s name
2. SET NAME *name* - to change the name for your id from what you entered at logon time (up to 16 characters)
3. SET LINESIZE *nnn* - to change the number of characters printed on a CRT or TI terminal. The default is now 72 (changed from 71).

CMS commands are:

1. GETDISK (with parameters) - to easily obtain access to read-only disks. See the bulletin boards in the users' areas for a complete description.

\* Anyone with a suggestion or creative idea on improving Computational Facility services is encouraged to contact the appropriate person within the area involved. Since the two labs are separated, more work is necessary in achieving proper communications on items of common concern. Feel free

to contact ROYAL SAND personally about any ideas on how to improve communications between the two labs.

- \* TERRY PHILLIPS has recently received documentation for a software system called "LANDSAT Imagery Analysis Package (LIMAP). This system was created and documented by Paul A. Tressar, Roger L. Miller, and Jeff Eidenshink of the South Dakota State Planning Bureau. In the letter of transmittal Paul indicates that the cluster and maximum likelihood algorithms of LARSYS are used in LIMAP and "while they comprise less than 1% of the Fortran source they are probably one of the most important parts of the system." If anyone would like to see this documentation it can be obtained from Terry.
  
- \* Flex Lab I is now undergoing some reorganization to provide areas for new equipment and better usage of available space. The darkroom area has been compacted and the Crop Inventory area changed to include a secretary and the large light table. Field Measurements has also purchased new moveable Lundia film storage units which have been installed in the data library area. The xerox machine was moved into Room 130 (just south of the terminal area) which allows for storage of extra supplies.  
  
The terminal area of Flex I has also been reorganized to include the new DATA 100 which is to replace the IBM 2780. A second DATA 100 has been installed in the Flex II terminal area to replace unit record equipment such as the card reader and printer. Both new machines arrive August 2 and will be operable soon after.
  
- \* The monthly Short Course has been extended for another year from July 1976 to June 1977. It is still the first full working week of every month. If you are interested or know of anyone who is, further information can be obtained from:  
DOUG MORRISON  
LARS - Flex Lab II  
749-2052, ext. 271
  
- \* The final report for the USGS Project is now being compiled and is due at USGS, Reston, Virginia, by the end of August. Working closely with the sponsoring agency, LARS staff members have made quite a number of significant technology advancements in the process of applying machine-assisted analysis techniques to the land-use mapping problem. This project made some of the first inroads in the areas of change detection, digitization and use of arbitrarily shaped boundaries, and evolution of the analysis approach which effectively combines supervised and unsupervised classification. The results of this research have been widely publicized and have had a substantial impact on the remote sensing community. This impact will continue to

be felt through the efforts of people such as Len & Pat Gaydos, Dick Ellefsen, Jim Wray and others from outside of LARS who have been affiliated with the project. PHIL SWAIN, principal investigator for the USGS project, extends his thanks to all who have worked with him on this project over the years.

- \* The Minicourse Series, FUNDAMENTALS OF REMOTE SENSING, is now available for purchase through Continuing Education Administration. Contact: JERRY O'BRIEN  
116 Stewart Center  
749-2227

## PERSONNEL CHANGES

- \* RON BOYD joined Technology Transfer as a Remote Sensing Data Analyst and Training Specialist replacing PAULA PICKETT BLINE, who was married on May 15 and moved to Florida. Ron is currently working on the Field Measurement and LANDSAT Stratification projects, as well as instructing at the monthly Short Course. He will also assist in developing educational and training materials.
- \* Congratulations to LUIS BARTOLUCCI, research geophysicist in the Ecosystems Research Area, on the completion of his Ph. D. from Purdue University.
- \* The Measurements area gains a number of new graduate research assistants this summer and fall to work on the New Dimensions in Medicine (NDM) project. HUGH SONTAG, JOHN PEARCE, and FRANK BOHAC are graduate assistants in Electrical Engineering, JOSEPH BOURLAND is coordinator for Engineering, and KRISTEN OVERMYER is from Mechanical Engineering.
- \* Other graduate students joining LARS include: CAROL ERNST in Ecosystems; CHARLES CURTIS, a student assistant instrumentation engineer in Field Measurements; CARLOS ARTURO POMALAZA under Phil Swain; and ERIC HINZEL from Agronomy involved in soil survey.
- \* DONNA SCHOLZ has replaced CARL WALKER, who is working for Huntington County as a soil scientist for the Indiana Department of Natural Resources. Donna is currently working in the Earth Sciences area on RAP and PY.
- \* JEANNE ETHERIDGE has taken over as project manager of LANDSAT Crops, dividing her time between Flex I and Flex II.
- \* LARS' new program developer is JIM KAST. He will be responsible for developing sources of funds for LARS, assisting in determining management alternatives, and will participate in research at the lab. Currently Jim is working as an analyst on ECHO.

- \* New in the Computational Facility are DAVE HUMES, who replaces RAY MALONI as the analog to digital computer operator; GARY MUZZILLO, student operator; and BILL SHELLEY who replaces BILL ZURNEY in the Reformatting Area. Bill is involved in precision registration, EXOTECH reformatting, and special tape and accounting problems.
  
  - \* Congratulations to DICK MROCZYNSKI, new associate program leader for the Ecosystems Research Program.
  
  - \* SHIRLEY DAVIS began a one-year leave of absence after seeing the two-year long FUNDAMENTALS OF REMOTE SENSING Minicourse Series completed. Shirley, her husband Gene and their two children will reside in Hamburg, West Germany while Gene serves as the 1976-77 Resident Director of the Purdue University-Indiana University Studienprogramm an der Universitat Hamburg.
  
  - \* There have been a number of clerical changes this summer. Technology Transfer secretary SALLY SUNDERMAN, upon her husband's graduation, moved to Marion, Indiana. DEBBE SCHERER filled that vacancy as of July 6. JANE BUCKLES transferred from the Computer Facility to receptionist in the Director's Office and typist for the Measurements Area. Another new face in the Director's Office is SHARON WHITLOCK, secretary to Dr. Landgrebe and Dr. Peterson. Filling the opening in the Computer Facility, COURTNEY BROWN joined LARS in the early summer and will move into NANCY BAKER'S position when she leaves on August 13. Nancy will be moving to Bloomington, Ill. DEBI SHAFER has accepted a teaching position in Fort Wayne. JULIE HANOVER and JOANN TINKLE can now be found in the Ecosystems Area.
- The Business Office has a number of new faces also. When DONNA FELDMAIER accompanied her husband to Birmingham, Mich., MARTA DZIUBINSKYJ transferred into that position. PAM MICHIE from the Chief Accountant's Office filled the payroll clerk vacancy.
- \* Joining LARS on September 15, CRAIG DAUGHTRY will be the Crop Inventory Systems Research Programs new research agronomist. He is currently completing his Ph. D. in Crop Physiology from Purdue University and will be working on various crops projects.
  
  - \* LARS' new Business Representative is STEVE ASH. He comes to LARS from the Purdue Business Office where he was an accountant working in the Residence Halls system. FRED PLANT has accepted a position as Business Administrator for the School of Veterinary Science.

## TRAVEL - SEMINARS & ADDRESSES

- \* Eleven members of the Crop Inventory and Measurements Areas: JOHN AHLRICHS, LARRY BIEHL, BYRON BLAIR, CHARLES CURTIS, VIC FLETCHER, CHRIS PARKER, BARRETT ROBINSON, LEROY SILVA, JOE WODJA, JOE SMITH, AND MARVIN BAUER, have spent two-week periods off-and-on from the end of May to the second week in August in Wiliston, North Dakota collecting data. The data collected will be used both at LARS and at other SR&T funded institutions directly in many research efforts to define future remote sensing data collection systems and to develop advanced analysis techniques.

## VISITORS

- \* MARV BAUER and DAVE LANDGREBE met July 20 and 21 with Michael McEwen and Leo Childs from NASA/JSC, Cliff Harlan from Texas A&M, and William Malila from ERIM to discuss future Field Measurements projects.
- \* Two scientists from the University of Connecticut at Storrs, visited LUIS BARTOLUCCI and JOHN LINDENLAUB on July 20. William Kennard, Natural Resources Conservation Department, and Daniel Civco, Institute of Water Resources have been working with LARSYS at the Wallops Flight Center Remote Terminal, Wallops Island, Virginia, and visited LARS to see first-hand how processing was done for land use and water resource management.

## COMING ATTRACTIONS

- \* Through the SR&T Task 2.1 LARS is endeavoring to transfer the ECHO (Extraction and Classification of Homogeneous Objects) method of remote sensing data analysis to NASA. Project Manager JIM KAST, working with PHIL SWAIN, BARB DAVIS, and PHIL ALENDUFF, has been unearthing and assessing the state of the ECHO research software developed by Bob Kettig. Part of the job involves surveying the ECHO user community to determine the strong points and the weak points of the software as it now stands. One thing which has been determined is that from user to user there is a tremendous variation in the level of understanding of what ECHO does and how to make ECHO do it! Plans are afoot to organize an ECHO Users Workshop to try to bring all interested parties to the same working level. Watch for this probably in September.
- \* Care for league bowling? A lot of LARSians do and at least one league team will be fielded this fall. If you are interested and haven't yet contacted PHIL SWAIN or MIKE KASER, you ought to do so. Looks like there's a strong possibility of several mixed doubles teams.

## PROJECTS AND PROPOSALS FUNDED

- \* 1976-1977 SR&T TASK DESCRIPTIONS: The primary research objectives of the LARS programs include the development of machine recognition techniques and application of these to the identification of important earth resource situations. Opportunities for increasing and sustaining the productivity of natural resources and for facilitating product flows are identified and measured by accurate, comprehensive and timely information on resource use, availability, productivity, potential, and other characteristics. These objectives are pursued through studies in instrumentation and measurement, data processing, basic investigations regarding the nature of earth surface materials, and considerations of specific needs for the uses of information which could be generated by such systems.

2.1 TEST OF BOUNDARY FINDINGS/PER FIELD CLASSIFICATION (ECHO)  
Evaluate existing (LARS developed) spatial clustering and per field classification algorithms over MSS LACIE segments with aircraft and simulated thematic mapper data. Provide products that will enable the determination of the utility of the field map to a LACIE Analyst Interpreter and also determine the resulting classification accuracy.

2.2 STRATIFICATION OF SCENE CHARACTERISTICS  
Develop a machine processing technique using primarily LANDSAT data to stratify an area for signature extension applications. Develop improved methods for using ancillary data. Compare crop inventory methods using full frame classification with the LACIE segments classification sampling methods.

2.3 LACIE FIELD MEASUREMENTS  
There is a continuing need for remote sensing data sets complete with ground observations and meteorological data with which to investigate relevant problems. Acquire, process, and collate spectral-agronomic-meteorological data sets for wheat and associated crops throughout the growing season for typical spring wheat, winter wheat, and spring-winter wheat test sites. Quantitatively determine the temporal-spectral characteristics of wheat canopies, soil background, and other crops which are spectrally similar.

2.4 SCANNER SYSTEM PARAMETER SELECTION  
Derive an analytical procedure applicable to any well - defined remote sensing problem which will provide a standard (a theoretically optimal design) against which to evaluate any candidate selection of multispectral system design parameters. The procedure will account for at least the following factors: spatial resolution, spectral band width and locations in spectrum, signal to noise ratio, available number of training samples, spectral characteristics of classes to be identified, and finite aperture effects. The procedure will be capable

of predicting optimal or achievable classification accuracy for the given information extraction program (classifier, etc.) and scanner design. This is required to provide continued design analysis for future NASA scanner systems required for future earth resources applications.

#### 2.5 TECHNOLOGY TRANSFER

Develop and test hardware, materials and training programs for the transfer of users of the principles and techniques for analysis of earth resources data.

#### 2.6 LARGE AREA CROP INVENTORY DESIGN (LACID)

Develop a preliminary design of a multi-crop system for inventorying wheat, soybeans, corn, and rice.

#### 2.7 FORESTRY APPLICATIONS PROJECT

Develop remote sensing inventorying methods for forest and range land application. Determine an efficient, statistical methodology in terms of sampling procedures/strategy, and an overall system integration design that can be employed for performing a nation-wide inventory of forest and range land resources.

#### 2.8 REGIONAL APPLICATIONS PROJECT

Develop a computer procedure for inventorying and categorizing Texas coastal zone environments and monitoring and identifying significant alterations in these environments.

#### 2.9 INTERPRETATION OF THERMAL BAND DATA

Develop a model that describes the heat transfer from wheat and other crop canopies.

#### 2.10 SUPER SITE DATA MANAGEMENT

Establish (at LARS) a central data bank and management facility for data derived from EOD remote sensing projects to satisfy the data requirements for on-going and future research projects which require a wide range of calibrated and correlated multi-spectral ancillary data.

#### 2.11 SOIL CLASSIFICATION AND SURVEY

Develop the analytical methods and interpretive skills for effective use of satellite multispectral data in classifying and surveying soils.

#### 2.12 IMPROVED ANALYSIS TECHNIQUES FOR MULTITEMPORAL DATA

Techniques do not yet exist for effectively using multitemporal data from LANDSAT. Uncontrolled multiplicity of spectral subclasses and data loss due to clouds are typical problems which cannot now be handled effectively with available classification procedures. Develop and test algorithms and procedures for analysis of multitemporal data sets. Evaluate the potential of advanced classifier technology (such as per field classifiers, layered classifiers) for contributing to effective multitemporal analysis.



- \* Funding has been approved by NASA for LARS to provide technical implementation for an international project (entitled): REMOTE SENSING EXPERIMENT FOR ANALOGOUS VEGETATIVE AREAS IN THE UNITED STATES AND THE SOVIET UNION. This is one of several experiments to be conducted by NASA and the USSR on remote sensing of the natural environment, including the areas of geology, meteorology, oceanology, and water resources.

MARV BAUER, principal investigator for the project, attended a meeting in Washington D.C. to plan specifics of the project with Soviet scientists and other NASA personnel. There will be test sites in both the United States and Soviet Russia. Data will be collected by truck-mounted spectrometers, multi-spectral photography, and multispectral scanners; then it will be analyzed by each country and exchanged for comparison. Emphasis will be put on wheat initially, with possibilities for other long-range experiments extending up to a 5-year effort.

## RECENT ACQUISITIONS IN THE LARS LIBRARY

- \* The library has received two new volumes of **SELECTED WATER RESOURCES ABSTRACTS**, a semi-monthly publication of the Water Resources Scientific Information Center, Office of Water Research and Technology, Department of the Interior. Both volumes, July 1, 1976 and July 15, 1976, contain material in the following subject areas:

1. Nature of water
2. Water cycle
3. Water supply agumentation and conservation
4. Water quality management and control
5. Water quality management and protection
6. Water resources planning
7. Resources data
8. Engineering Works
9. Manpower, grants and facilities
10. Scientific and technical information

- \* Two other bibliographic sources have also been received:  
CCRS (Canada Centre for Remote Sensing) PUBLICATION LIST  
Technical Information Service  
Ottawa, Canada

### QUARTERLY LITERATURE REVIEW OF THE REMOTE SENSING OF NATURAL RESOURCES,

First Quarter 1976

Published by the Technical Applications Center, one of six NASA sponsored, nonprofit regional centers for the transfer of technology to industry, local government, and the private sector in general.

The University of New Mexico  
Albuquerque, New Mexico

- \* Many technical journals have been received by the LARS Library; contents pages are reproduced here for convenience.

### JOURNAL OF SOIL AND WATER CONSERVATION

CONTENTS: January-February 1976

Vol. 31 / No. 1

#### Features

4 Conservation Viewpoint: There is a point in nonpoint!  
By J. G. Speth and T. J. Barlow

5 Use and misuse of the universal soil loss equation  
By W. H. Wischmeier

10 Metro-area environmental planning: The Twin Cities experience  
By Gunner Isberg and Ray Diedrick

#### Research reports

14 Feedlot waste runoff and mortality of windbreak trees  
By David F. VanHaverbeke, Leon Chesnin, and David R. Miller

17 Plant growth on fluorspar mine tailings  
By M. S. Johnson

20 Economic and environmental impacts of agricultural land drainage in Ontario  
By W. C. Found, A. R. Hill, and E. S. Spence

24 Nutrient and sediment characteristics of tile effluent in Ohio  
By T. J. Logan and G. O. Schwab

#### Notes

27 Using models in resource planning to communicate with laymen  
By Sterling Slupe

28 The San Antonio River Walk: A user and environmental analysis  
By David J. Reed

The ITC Journal

1976-1

<i>Contents</i>	<i>page</i>
Priorities in International Education Aimed at Development <i>J.P. Pronk</i>	1
Annual Address of the Rector of the ITC <i>A.J. van der Weele</i>	14
The Migration of Copper as a Result of an Electric Current <i>F.G. van der Hoeven</i>	21
Visual Interpretation of Landsat Imagery for a Soil Survey of the Ganges River Fan, Hardwar <i>F.W. Hilwig</i>	26
Data Processing in Photogrammetry <i>A. van den Boogaart</i>	45
A Digital Terrain Model System <i>B. Makarovic</i>	57
The National Demographic Survey of Afghanistan: Air Photos and Photo-Counting Techniques <i>Hari H. Dayal and B.A. Khairzada</i>	84
Airphoto Interpretation in the Identification of Areas Planted to Vines <i>K. Feldner and J.A. Allan</i>	98

# Soil Science Society of America JOURNAL

Vol. 40 January-February 1976 No. 1

CONTENTS Page

SOIL BRIEFS—Synopsis of articles in this issue ..... iii, v, vi  
 BOOK REVIEWS ..... iv  
 SSSA PUBLICATION POLICY (revised 28 August 1975) ..... 1

Division S-1—Soil Physics

In situ Measurement of Gas Diffusion Coefficient in Soils ..... 3  
*Sung-Ho Lai, James M. Tiedje, and A. Earl Erickson*  
 Determination of Soil-Water Diffusivity for Anisotropic Stratified Soils ..... 7  
*B. L. Sawhney, J.-Y. Parlange, and N. C. Turner*  
 Comparisons of Calculated and Measured Capillary Potentials from Line Sources ..... 10  
*Adrian W. Thomas, Harold R. Duke, David W. Zachmann, and E. Gordon Kruse*  
 Soil Moisture Flux and Evapotranspiration Determined from Soil Hydraulic Properties in a Chaparral Stand ..... 14  
*David G. Scholl*  
 Comparison of Field-measured and Calculated Soil-heat Fluxes ..... 18  
*B. A. Kimball, R. D. Jackson, R. J. Reginato, F. S. Nakayama, and S. B. Idso*  
 Soil-heat Flux Determination: Temperature Gradient Method with Computed Thermal Conductivities ..... 25  
*B. A. Kimball, R. D. Jackson, F. S. Nakayama, S. B. Idso, and R. J. Reginato*  
 Bulk Density, Saturation Water Content, and Rate of Wetting of Soil Aggregates ..... 28  
*F. A. Gumbs and B. P. Warkentin*

Division S-2—Soil Chemistry

Infrared and X-ray Study of Parathion-Montmorillonite Sorption Complexes ..... 34  
*Sarina Salzman and S. Yariv*  
 Solubility and Solubility Product of Dicalcium Phosphate Dihydrate in Aqueous Solutions and Soil Solutions ..... 39  
*A. C. Bennett and Fred Adams*  
 Octa-*in-situ* Extraction of Molybdo-phosphoric Acid in the Colorimetric Determination of Orthophosphate ..... 43  
*K. R. Helyar and A. L. Brown*  
 The Slow Reaction which Continues After Phosphate Adsorption: Kinetics and Equilibrium in Some Tropical Soils ..... 46  
*D. N. Munns and R. L. Fox*  
 Adsorption of Selenite and Phosphate on an Allophane Clay ..... 51  
*S. S. S. Røjen and J. H. Watkinson*

Division S-3—Soil Microbiology and Biochemistry

Nitrite Decomposition in Flouided Soil Under Different pH and Redox Potential Conditions ..... 55  
*O. Van Cleemput, W. H. Patrick, Jr. and R. C. McIlhenny*  
 Degradation of a Nonionic Surfactant in Soils and Peat ..... 60  
*N. Valaras, J. Leary, J. P. Martin, and J. Osborn*

Division S-4—Soil Fertility and Plant Nutrition

Protein and Free Amino Acid Composition of Sesame Meal as Affected by Nitrogen, Phosphorus, and Potassium Nutrition ..... 64  
*G. A. Mitchell, F. T. Bingham, C. K. Labanauskas, and D. M. Yermanos*  
 Phosphorus Fertilization with Drip Irrigation ..... 68  
*R. S. Rauschkorb, D. E. Rolston, R. J. Miller, A. B. Carlton, and R. G. Burau*

Division S-5—Soil Genesis, Morphology, and Classification

Properties of Some Tidal Marsh Soils of Florida ..... 72  
*C. L. Coultes and F. G. Calhoun*  
 Effects of Vegetation on the Distribution of Carbon, Iron, and Aluminum in the B Horizons of Northern Appalachian Spodosols ..... 77  
*C. R. DeKoning and Y. A. Mariel*  
 Landsat Data, Its Use in a Soil Survey Program ..... 81  
*Frederick C. Westin and C. J. Frazee*  
 Denning Ranges of Soil Characteristics ..... 89  
*I. J. Jansen and R. W. Arnold*

Division S-6—Soil and Water Management and Conservation

Soil and Water Balance in Imperial Valley, California ..... 93  
*M. T. Kadlak and J. D. Rhoades*

## PHOTOGRAMMETRIC ENGINEERING and REMOTE SENSING

Volume XLII June 1976 Number 6

COVER PHOTO—View of a portion of the Great Sand Dunes National Monument in Colorado taken by Jack Scharf on October 3, 1975, with a Zeiss RMK 15/23 aerial camera on Eastman color negative film No. 2415. Photo furnished by Scharf and Associates, Inc., Photogrammetric Engineers, of Denver, Colorado.

TECHNICAL ARTICLES

Applied Photo Interpretation for Airbrush Cartography ..... 749  
*Jan L. Inge and Patricia M. Bridges*  
 Solicitation of Comments on a Draft ASP Standard ..... 761  
*C. S. McCamy*  
 Statistical Testing Procedures Applied to Analytical Camera Calibration of Non-Metric Systems ..... 777  
*Mitsuru Nasu and Dr. James M. Anderson*  
 Illumination and Measurement Precision for Lunar Photography ..... 791  
*Sherman S. C. Wu*  
 Education for Users of Photogrammetry ..... 803  
*Prof. Dr. J. Hothmer*  
 Photogrammetric Measurement of the Human Optic Cup ..... 807  
*G. D. Currie, C. D. Leonard, and C. L. Martonji*  
 Aerial Photo-Interpretation Techniques for Classifying Urban Land Use ..... 815  
*N. C. Gautam, M.A., B.J.Sc.*

# Journal of research and development

IFAF J. Res. Develop., Vol. 20, No. 3, pp. 197-300, May 1976

J. J. Rissanen	198	Generalized Kraft Inequality and Arithmetic Coding
F. G. Gustavson	204	Analysis of the Berlekamp-Massey Linear Feedback Shift-Register Synthesis Algorithm
B. J. Liu	213	Deep-UV Conformable-Contact Photolithography for Bubble Circuits
J. A. Barker, M. L. Elsin, and M. V. Bhebe	222	Lattice Dynamics with Three-Body Forces: Solid Xe and Kr
C. H. Stappert	226	LSI Yield Modeling and Process Monitoring
B. Biechle, C. Schuenemann, G. Skudelyny and V. Zimmermann	235	Delayed Closed-Loop Schema for Stepping Motor Control
P. A. V. Hall	244	Optimization of Single Expressions in a Relational Data Base System
C. A. Bruce	258	Dependence of Ink Jet Dynamics on Fluid Characteristics
C. H. Bajorek and R. J. Koblika	271	Amorphous Materials for Micrometer and Submicrometer Bubble Domain Technology
<i>Communications</i>		
H. J. Nassbarnner	282	Complex Convolutions via Fermat Number Transforms
I. M. Andrews and J. W. Leendertz	285	Speckle Pattern Interferometry of Vibration Modes
<i>Letter to the Editor</i>		
G. Wiederhold	290	Comment on "Segment Synthesis in Logical Data Base Design"

## PHOTOGRAMMETRIC ENGINEERING and REMOTE SENSING

Volume XLII May 1976 Number 5

COVER PHOTO—Vertical view of Santa Barbara, harbor shortly after a winter storm with huge waves pounding the sand breakwater. Taken with a Wild tCS camera at an altitude of 1,600 feet on 19 January 1973 by Pacific Western Aerial Surveys of Santa Barbara, California.

TECHNICAL ARTICLES

Orthophotography in Architectural Photogrammetry ..... 625  
*E. Seeger*  
 A Non-Metric Close-Range Photogrammetric System for Mapping Geologic Structures in Mines ..... 637  
*V. D. Brandow, H. M. Karara, H. H. Damberger, and H. F. Krauss*  
 Scanning Electron Micrography and Photogrammetry ..... 649  
*Dr. Sanjib K. Ghosh and Dr. Hebbur Nagaraja*  
 Least Squares Collocation in Photogrammetry ..... 659  
*Kunwar K. Rampal*  
 Land-Use Map Accuracy Criteria ..... 671  
*R. Michael Ford and William Brooner*  
 Detection of Saline Soils with Skylab Multispectral Scanner Data ..... 679  
*A. J. Richardson, A. H. Gerbermann, E. W. Gausman, and J. A. Cueilar*  
 Utilization of Satellite Data for Inventorying Prairie Ponds and Lakes ..... 685  
*Edgar A. Work, Jr., and David S. Gilmer*  
 Correlation between Multispectral Photography and Near Surface Turbidities ..... 695  
*D. L. Wertz, W. T. Meador, M. L. Steele, and J. W. Pinson*

## INFORMATION NOTES

111275 Field Measurements of the Spectral Response of Natural Waters by L. A. Bartolucci, B. F. Robinson and L. F. Silva.

The spectral response (air-water interface reflectance and water volume-scattering) of turbid river water and clear lake water was measured in situ with a field spectroradiometer. The influence of the river bottom on the spectral response of the water also was determined using a modified Secchi disc approach.

The results indicated that turbid river water had a higher spectral response than clear lake water ( $\approx 6\%$ ) in the red ( $0.6-0.7\mu\text{m}$ ) and near infrared ( $0.7-0.9\mu\text{m}$ ) portions of the spectrum. Also, the reflectance characteristics of the river bottom did not influence the spectral response of the turbid river water when the water was deeper than 30 cm.

This work was sponsored by NASA under contract NAS9-13301.

121275 Computer-Aided Analysis of SKYLAB Multispectral Scanner Data in Mountainous Terrain for Land Use, Forestry, Water Resource, and Geologic Applications by Roger M. Hoffer and Staff.

This report describes the results of an interdisciplinary research project involving the analysis of SKYLAB data obtained over the San Juan Mountains in SW Colorado. Computer-aided analysis techniques were applied to the S-192 MSS data for purposes of mapping land use, forest cover types, hydrologic and geologic features of significance. In spite of the vegetative and topographic complexity of the test site, computer classification accuracies of 85% and 71% were obtained for Level II Land Use maps and Forest Cover maps, respectively. Accurate acreage estimates of forest cover were obtained by computer analysis of SKYLAB S-192 data. A detailed wavelength band study clearly indicated the importance of the near infrared wavelengths for vegetation mapping. The value of the improved spectral resolution of the SKYLAB MSS, as compared to LANDSAT, was also shown. Another result of particular significance involved the use of digital computer techniques

to geometrically correct and overlay multiple data sets, including SKYLAB, LANDSAT, and topographic (elevation, slope and aspect) data.

SKYLAB MSS data clearly showed for the first time that the middle infrared wavelengths are essential for reliably separating snow from clouds on the basis of spectral response. Forest density and snow melt differences within the snowpack area could be mapped through the use of the near infrared wavelengths. Calibration of the thermal infrared band allowed the surface temperature of a high elevation reservoir to be accurately determined from space. Geologic mapping, involved a variety of ratioing and classification techniques, indicated the need for additional study to better define the theoretical basis for use of these analysis procedures, in order to obtain reliable, predictable results. A number of additional significant results and recommendations are included in this report.

This work was sponsored by NASA Contract No. NAS 9-13380.

022676

A Minicourse Series on the Fundamentals of Remote Sensing by J. C. Lindenlaub and J. D. Russell

A minicourse series which presents, in a tutorial manner, concepts fundamental to remote sensing technology has been developed. Each of the 19 minicourses in the series includes a set of 35mm slides, an audio tape and a study guide. The content has been modularized so that, after completing the two introductory units, remaining modules may be studied in varying numbers as well as different logical orders. This flexibility allows the minicourses to be used in a variety of ways. They are presently being used in university credit courses, training of new staff and, along with some video taped presentations, make up the core content of a one week short course on Remote Sensing Technology and applications. The educational philosophy used in the development of the minicourses includes clear statements of objectives for each minicourse, student activities to reinforce concepts when they are presented, self evaluation check tests and a permanent record in the form of a printed study guide. Design of the materials was carried out by a team of subject experts and education specialists. The conference presentation will use excerpts from the minicourse series to illustrate the modular format, flexible usage and educational philosophy.

The work reported in this report was sponsored by Continuing Education, Purdue University.

030576

Evaluation of Surface Water Resources from Machine Processing of ERTS Multispectral Data by P. W. Mausel, W. J. Todd, M. F. Baumgardner, R. A. Mitchell and J. P. Cook.

Water resource data that are useful to environmental scientists and planners frequently are missing, incomplete, or obtained irregularly. A new source of surface hydrological information can be obtained as often as every 18 days in some areas through machine-processing of Earth Resources Technology Satellite (ERTS) multispectral scanner data. This research focused on the surface water resources of a large metropolitan area. Marion County (Indianapolis), Indiana, in order to assess the potential value of ERTS spectral analysis to water resources problems.

The results of the research indicate that all surface water bodies over 0.5 ha were identified accurately from ERTS multispectral analysis. Five distinct classes of water were identified and correlated with parameters which included the i) degree of water siltiness; ii) depth of water; iii) presence of macro and micro biotic forms in the water; and iv) presence of various chemical concentrations in the water. The machine-processing of ERTS spectral data used alone or in conjunction with conventional sources of hydrological information can lead to the monitoring of the i) area of surface water bodies; ii) estimated volume of selected surface water bodies; iii) differences in degree of silt and clay suspended in water; and iv) degree of water eutrophication related to chemical concentrations. Water resources information obtained from ERTS analysis will be useful in helping to solve or better understand selected pollution, erosion, and planning problems in metropolitan and other environments.

The work reported in this report was sponsored by NASA under contract number NAS9-14016.

031276

An Analysis of Metropolitan Land-Use by Machine Processing of Earth Resources Technology Satellite Data by P. W. Mausel, W. J. Todd and M. F. Baumgardner.

The technology available at Purdue University's Laboratory for Applications of Remote Sensing (LARS) to classify earth surface features from multispectral data is sophisticated. This paper describes the

results of a successful application of state-of-the-art remote sensing technology in classifying an urban area into its broad land-use classes. This research proves that numerous urban features are amenable to classification using ERTS multispectral data automatically processed by computer. Furthermore, such automatic data processing (ADP) techniques permit areal analysis on an unprecedented scale with a minimum expenditure of time. Also, classification results obtained using ADP procedures are consistent, comparable, and replicable; hence many spatial analysis problems caused by human errors or decisions are eliminated. The results of classification are compared with the proposed USGS land-use classification system in order to determine the level of classification that is feasible to obtain through ERTS analysis of metropolitan areas. (Anderson, Hardy, and Roach, 1972, 6).

The work reported in this report was sponsored by NASA under contract NAS9-14016.

032576

Urban Land Use Monitoring from Computer-Implemented Processing of Airborne Multispectral Data by W. J. Todd, P. W. Mausel, and M. F. Baumgardner.

Machine processing techniques were applied to multispectral data obtained from airborne scanners at an elevation of 600 meters over central Indianapolis in August, 1972. Computer analysis of these spectral data indicate that roads (two types), roof tops (three types), dense grass (two types), sparse grass (two types), trees, bare soil, and water (two types) can be accurately identified. Using computers, it is possible to determine land uses from analysis of type, size, shape, and spatial associations of earth surface images identified from multispectral data. Land use data developed through machine processing techniques can be programmed to monitor land use changes, simulate land use conditions, and provide "impact" statistics that are required to analyze stresses placed on spatial systems.

The work reported in this report was sponsored by NASA under contract NAS9-14016.

052075

Description and Operation of a Field Rated ERTS-Band Transmissometer by D. P. Dewitt and B. F. Robinson.

This report describes a field rated instrument for the measurement of normal hemispherical transmittance at four wavelength bands: 0.5-0.6 $\mu$ m, 0.6-0.7 $\mu$ m, 0.7-0.8 $\mu$ m, and 0.8-1.0 $\mu$ m.

The instrument consists of a detector system and a transmittance attachment comprised of an integrating sphere with collimator. The principle of measurement permits direct comparison of field results with a laboratory spectrophotometer such as a Bechman DK-2A spectrophotometer with integrating sphere attachment.

The work reported in this paper was supported by the National Aeronautics and Space Administration under NASA Contract NAS9-14016.

052576

Matrix of Education and Training Materials in Remote Sensing, by J. C. Lindenlaub and B. M. Lube.

Remote sensing education and training materials developed by LARS have been organized in a matrix format. A description of the matrix is followed by three examples designed to illustrate how the matrix can be used to synthesize training programs tailored to meet the needs of individual students. A detailed description of each of the modules in the matrix is contained in a "catalog" section.

The work reported in the report was sponsored by NASA under contract NAS9-14016.

062076

Remote Sensing Technology - A Look to the Future by David A. Landgrebe.

If one is bothered by the possibility of being wrong perhaps one of the most risky things to do is to attempt to predict future directions of technology. However, in these days of extremely limited resources, good planning for development is essential to get the greatest bang for the buck spent on technology development. Such a plan must be based upon some anticipation of the direction that development will go. Thus, one must attempt to project both the potential for and direction of the future development of a technology. It is important to know at any given time what one's plan for development is, even if that plan must be revised frequently. This then, is our motivation for attempting to visualize and anticipate the results that will be presented at this and future such symposiums.

But how do we begin? What can a projection be reasonably based upon? We will use two points of reference. First, we must rely on the fundamentals of the technology because of their invariance. It is unusual and certainly unexpected that events would occur which alter the fundamentals of a technology.



Second, a historical perspective of the development of the technology to this point may suggest indications as to the direction future developments will carry us. Thus, we will begin by examining these two very briefly, beginning with the fundamentals.

The work reported in this report was sponsored by NASA under contract number NAS9-14016.

062176

The Use of Spatial Characteristics for the Improvement of Multispectral Classification of Remotely Sensed Data by D. J. Wiersma and D. A. Landgrebe.

Two parallel and overlapping approaches to classification of remotely sensed data with the aid of spatial information are underway at the present time. The image processing approach attempts to model after the human visual system, while the second approach is primarily numerical. The technique of texture features<sup>1,2</sup>, representing the image processing approach, and the sample classifier ECHO<sup>3,4</sup>, representing the numerical approach are compared. The numerical approach is demonstrated to be superior in classification accuracy as well as being more efficient computationally.

The work reported in this report was sponsored by NASA under contract NAS9-14016.



LARS · Purdue University · VOL.2 · NO.2 · September 20, 1976

## ITEMS OF INTEREST

- \* **CALL FOR PAPERS:** Authors wishing to contribute long-papers to the Fourth Symposium on MACHINE PROCESSING OF REMOTELY SENSED DATA should submit a 1000 word summary by December 31, 1976. Selection of papers will be made by a committee of nationally prominent workers in the area on the basis of originality, usefulness to others in the field and clarity of presentation.

A limited number of short papers describing recent results will be accepted for presentation at the Symposium. These papers will be selected on the basis of a one page double spaced typed abstract which must be received by March 18, 1977.

Four copies of the 1000 word summary or short paper abstracts should be sent to: DR. JOHN C. LINDENLAUB  
Flex II (LARS)

### CALENDAR FOR CONTRIBUTED PAPERS

Deadline for submission of long paper 1000 word summary	December 31, 1976
Author's notification of paper selection	February 18, 1977
Completed long papers submitted as typed reproducible copy	March 18, 1977
Deadline for submission of short paper abstracts	March 18, 1977

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*Prepared by the Laboratory for Applications of Remote Sensing for distribution at Purdue. Contact Susan Ferringer, SCAN LINES editor, to be placed on the mailing list (749-2052, ext. 273).*

SYMPOSIUM

June 21-23, 1977

- \* The "LARS" bowling team (guys, that is) was forced to go commercial in order to find a sponsor to pick up the sponsor's fee. Come out and see them, SAMBO's TIGERS, in action at Rose Lanes almost any Monday night at 6:30 PM. They tore up the lanes the first night (PHIL SWAIN managed a 221) -- and now they have to worry about giving away lots of handicaps.

## PERSONNEL CHANGES

- \* LARS has recently gained three new secretaries: MELANIE SHROYER joins Data Processing and Research after returning to Indiana from Portland, Oregon. Before coming to LARS, Melanie worked at the Administrative Service Building in Personnel. Working in Crop Inventory, BEVERLY CARPENTER recently moved to W. Lafayette with her husband, a freshman in Engineering, from Indianapolis. JOANNE RAYBURN joins the Flex II staff as System Services new secretary.
- \* BOB MCMILLEN has returned for the fall semester to work in the Field Measurement data processing area. Bob is a co-op undergraduate student working as a computer programmer at JSC during alternating semesters.

Two new Computer Operators have been hired for the fall, DAVE ALENDUFF (brother of PHIL ALENDUFF) and STEVE PAULEY. Dave is a sophomore in M.E.T. and Steve is a freshman in Computer Science.

Returning to work after summer vacation is LARRY KOMAREK, TELL GATES, and PETE WILKINSON. Larry and Pete are both seniors in Industrial Management, and Tell is a senior in EE.

- \* A new position, but not a new face: DAVIDA PARKS is now Publication Coordinator of LARS. Among her responsibilities are all duplicating and distribution services for LARS personnel.

This service includes determination of production method, initiation and monitoring of duplication requests, transportation of original manuscript to campus, checking for reproduction quality, completeness of order and distribution of the final document.

Davida maintains the body of printed materials and will keep in the centralized file any original manuscript, figure, artwork, metal plates, etc. She handles Information Notes from allocating the number to distribution and filing of original material, as well as updates of the LARS Bibliography and preparing the Annual Report Volumes.

## TRAVEL: SEMINARS & ADDRESSES

- \* MARV BAUER visited Moscow and Kurst in the USSR from August 27 to September 5 in connection with the NASA funded project: "Remote Sensing of Analogous Areas in the US and USSR." Representatives discussed the crops, soil, and remote sensing instrumentation to be used by the Soviet Union for their part of the joint project.

- \* DAVID LANDGREBE was in Houston on September 17 for a USRA (Universities Space Research Association) meeting to discuss the formation of a committee on remote sensing.

Upcoming travel for Dr. Landgrebe will include a trip to Anaheim, California on September 29 to speak at a workshop on remote sensing sponsored by the United Nations and the XXVII International Astronautical Federation. October 6-10 he will journey to Mexico City to lecture in an image processing short course sponsored by IBM, Mexico.

- \* DAVID LANDGREBE and TERRY PHILLIPS will be at Goddard Space Flight Center, Greenbelt, Maryland on September 23 to discuss our current contract.

- \* A paper entitled "Digital Preprocessing and Classification of Multispectral Earth Observation Data: by PAUL ANUTA was presented at a conference in Helsinki, Finland by Professor ED MIKHAIL.

- \* HOWARD GRAMS attended a SHARE (IBM Computer Users Organization) meeting in Montreal, Canada, on August 16-20. He met with representatives of other installations running the CP67 and VM370 to compare notes and problems and to hear reports on hardware of potential interest to LARS.

DAVE FREEMAN and MARION BAUMGARDNER visited Mead Technology Laboratories on September 8 to discuss full-color and output hardcopy, and trial run new colors and results data for the Sudan Project. Scaled colored hardcopy classified images are being produced at a maximum size of 14"x23".

- \* MARION BAUMGARDNER also traveled recently to England to participate in a seminar sponsored by FAO/UN on use of remote sensing for surveying and monitoring natural resources in the developing countries.

Dr. Baumgardner plans to meet with officials of the Lilly Endowment and Africare in Indianapolis on September 20 to discuss agriculture and village development programs in the Sahel.

## VISITORS

- \* Dr. and Mrs. WOLFRAM DRENES, World Bank, Washington, D.C., visited MARION BAUMGARDNER on September 5 to see LARS facilities and to discuss potential use of LARSYS in international development. CHRIS NANAYAKKARA, Deputy Surveyor General of the Survey Department of Sri Lanka, also visited with Dr. Baumgardner in regards to possible implementation of LARSYS in Sri Lanka.

LARS expects the visit of Dr. ROBERT BURGERT, Director General of Babolna Agricultural Combine, Hungary; THOMAS KISS, president, and Dr. THOMAS ARMY, vice-president of Corn Production Systems, Inc., Chicago on September 30. They will be visiting Dr. Baumgardner to receive a briefing on remote sensing applications and potential use in Hungary.

## VISITING SCIENTISTS

- \* A former short course participant, PIERRE-MARIE ADRIEN, joins LARS as a Visiting Scientist during the week of September 13. Initially from Haiti, Mr. Adrien is a representative of the Inter-American Development Bank, based in Washington D.C.

He will be training at LARS, under the sponsorship of MARION BAUMGARDNER, until mid-December, then will return for a second period during June and July 1977. During these training periods Mr. Adrien will analyze LANDSAT data over the Tempisque area in Costa Rica to help in evaluation of other proposed remote sensing projects.

Two Costa Rican scientists, ALEXIS VASQUEZ MORERA and CARLOS L. E. SOLIS, will be joining Mr. Adrien in October to proceed with joint analysis work over the Tempisque test site. Both Costa Rican scientists are jointly sponsored through the Inter-American Development Bank and the Costa Rican government.

## COMING ATTRACTIONS

- \* Seminars will be held on a trial basis on THURSDAY MORNINGS, 8:30 AM, in the Flex II Conference Room. Anyone interested in giving a seminar should contact MARILYN HIXON, Flex I.

SEPTEMBER 30	"Crops, Soils, and Remote Sensing in the Soviet Union" MARV BAUER, Program Leader, Crop Inventory
OCTOBER 7	"Quantitative Methods for Evaluating Multi-spectral Sensor Data Quality" BILL SIMMONS, System Services
OCTOBER 14	"Crop Area Estimation Using LANDSAT Data" MARV BAUER, Program Leader, Crop Inventory

OCTOBER 21 (Title to be announced)  
TERRY PHILLIPS, Deputy Director, LARS

OCTOBER 28 TO BE ANNOUNCED

NOVEMBER 4 "An Alternative Approach to Classification:  
Levels Classification"  
DICK HYDE, SAM GOWARD, DR. PAUL MAUSEL  
Indiana State University, Terre Haute

NOVEMBER 11 "Use of Ancillary Data in Soil and Land Use  
Classifications"  
DICK WEISMILLER, Assoc. Program Leader,  
Earth Sciences

## PROPOSALS AND PROJECTS FUNDED

- \* RESEARCH ON PREPROCESSING AND ANALYSIS OF GEOPHYSICAL REMOTE SENSING DATA has been funded by the National Science Foundation for 24 months under PAUL ANUTA, principal investigator. Drs. ANUTA, DON LEVANDOWSKI, and CLARE MCGILLEM will work to develop preprocessing and analysis techniques for information extraction from combined geophysical and surficial remote sensing data.
- \* BOB BAILEY, principal investigator, DICK WEISMILLER, and other staff have received funding on a project requested by the citizens of the Madison, Indiana area. The project, entitled: IMPACT ASSESSMENT OF ENERGY CONSERVATION FACILITIES IN THE OHIO RIVER BASIN will employ environmental impact analyses of site-specific energy generating facilities.



RECENT ACQUISITIONS IN THE LIBRARY

- \* NEW FOCUS TITLES How the Earth Reflects  
Crop Species Identification  
Multispectral-Multitemporal Concept

Each FOCUS is a two-page foldout consisting of a diagram or photograph and an extended caption of three to four hundred words treating a single concept. A student typically spends 10 to 20 minutes studying these materials. They are especially useful for general briefings or introductory treatments of remote sensing topics.

- Previous FOCUS Titles:
- The Multispectral Scanner
  - Cover Type Classification
  - Pattern Recognition
  - Mapping Soil Characteristics
  - Sample Classification
  - Earth Resources Data Processing
  - Remote Sensing
  - LANDSAT: An Earth Resources Data Collection System
  - Role of Images in Numerical Data Analysis
  - What is LARSYS?
  - LANDSAT Multispectral Scanner Data Clustering

REMOTE SENSING  
OF ENVIRONMENT

An Interdisciplinary Journal

Volume 5, Number 1, 1976

Contents

Editorial .....	1
W. R. McCLUNEY (Greenbelt, Maryland) Remote Measurement of Water Color .....	3
PETER S. RAY (Norman, Oklahoma) Examination of a Dual Wavelength Doppler Radar Technique to Measure Vertical Wind Velocity and Drop-Size Distributions .....	35
JOHN C. PRICE (Greenbelt, Maryland) The Nature of Multiple Solutions for Surface Wind Speed Over the Oceans from Scatterometer Measurements .....	47
L. J. ROUSE and J. M. COLIMAN (Baton Rouge, Louisiana) Circulation Observations in the Louisiana Bight Using LANDSAT Imagery .....	55
LADIMIR KRATKY (Ottawa, Ontario, Canada) Grid-Modified Polynomial Transformation of Satellite Imagery .....	67
Letter to the Editor .....	75

REMOTE SENSING  
OF ENVIRONMENT

An Interdisciplinary Journal

Volume 5, Number 2, 1976

Contents

Editorial .....	77
T. G. LONGSHAW and B. GILBERTSON (Randfontein, Republic of South Africa) Multispectral Aerial Photography as Exploration Tool-III: Two Applications in the North-Western Cape Province, South Africa .....	79
B. GILBERTSON, T. G. LONGSHAW and R. P. VILJOEN (Randfontein, Republic of South Africa) Multispectral Aerial Photography as Exploration Tool IV-V: An Application in the Khomas Trough Region, South West Africa; and Cost Effectiveness Analysis and Conclusions .....	93
ADIGUN ADE ABIODUN (Ottawa, Canada) Satellite Survey of Particulate Distribution Patterns in Lake Kairua .....	109
JOHN R. APEL (Seattle, WA), H. M. CHAEL BYRNE, JOHN R. PRONI and RONALD SEILERS (Miami, FL) A Study of Oceanic Internal Waves Using Satellite Imagery and Ship Data .....	125
J. L. HEILMAN, E. T. KANEMASU, N. J. ROSENBERG and B. L. BLAD (Lincoln, NB) Thermal Scanner Measurement of Canopy Temperatures to Estimate Evapotranspiration .....	137
C. F. WIZERNAK, F. J. TANIS and C. A. BAIJA (Ann Arbor, MI) Trophic State Analysis of Inland Lakes .....	147
Announcement .....	167



# REMOTE SENSING OF ENVIRONMENT

*An Interdisciplinary Journal*

Volume 4, Number 2, 1975

## Contents

GEORGE A. MAUL (Miami, Florida) and HOWARD R. GORDON (Coral Gables, Florida) On the Use of the Earth Resources Technology Satellite (LANDSAT-1) in Optical Oceanography .....	95
B. GILBERTSON and T. G. LONGSHAW (Randfontein, Republic of South Africa) Multispectral Aerial Photography as Exploration Tool - I: Concepts, Techniques and Instrumentation .....	129
T. G. LONGSHAW and B. GILBERTSON (Randfontein, Republic of South Africa) Multispectral Aerial Photography as Exploration Tool - II: An Application in the Bushveld Igneous Complex, South Africa .....	147
FRED M. VUKOVICH and BOBBY W. CRISSMAN (Research Triangle Park, North Carolina) Case Study of Exchange Processes on the Western Boundary of the Gulf Stream Using NOAA-2 Satellite Data and Ship Data .....	165
L. R. STONE and E. T. KANEMASU (Manhattan, Kansas), and M. L. HORTON (Brookings, South Dakota) Grain Sorghum Canopy Temperature as Influenced by Clouds .....	177
Announcements .....	183

# REMOTE SENSING OF ENVIRONMENT

*An Interdisciplinary Journal*

Volume 4, Number 4, 1976

## Contents

Editorial .....	247
R.D. JACKSON, R.J. REGINATO and S.B. IDSO (Phoenix, Arizona) Timing of Ground Truth Acquisition During Remote Assessment of Soil-Water Content .....	249
KARL THEODOR KRIEBEL (W. Germany) On the Variability of the Reflected Radiation Field Due to Differing Distributions of the Irradiation .....	257
R. EVANS (Cambridge, U.K.), J. HEAD (Norwich, U.K.) and M. DIRKZWAGER (Bedford, U.K.) Air Photo-Tones and Soil Properties: Implications for Interpreting Satellite Imagery .....	265
R. STORY, G.A. YAPP and A.T. DUNN (Canberra City, Australia) Landsat Patterns Considered in Relation to Australian Resources Surveys .....	281
<b>Short Communication</b>	
BERTIL ÖSTRÖM (Gothenburg, Sweden) Fertilization of the Baltic by Nitrogen Fixation in the Blue-Green Alga <i>Nodularia Spumigena</i> .....	305
<b>Book Review</b>	
W.G. Collins and J.L. Van Genderen, Eds. <i>The Fundamentals of Remote Sensing</i> (reviewed by G.J. Zissis) .....	311
Announcements .....	313
Erratum: <i>RSE</i> , Volume 4, Number 3, pages 199-209, 1975, Robert Vincent <i>et al.</i> .....	316
Author Index to Volume 4 .....	317
Title Index to Volume 4 .....	319

# REMOTE SENSING OF ENVIRONMENT

*An Interdisciplinary Journal*

Volume 4, Number 3, 1975

## Contents

Editorial .....	185
D. J. GERSON (Saitland, MD), and A. ROSENFELD (College Park, MD) Automatic Sea Ice Detection in Satellite Pictures .....	187
ROBERT K. VINCENT, LAWRENCE C. ROWAN, RICHARD E. GILLESPIE, and CHARLES KNAPP (Ann Arbor, MI) Thermal-Infrared Spectra and Chemical Analyses of Twenty-Six Igneous Rock Samples .....	199
G. A. MAY and G. W. PETERSEN (University Park, PA) Spectral Signature Selection for Mapping Unvegetated Soils .....	211
JOHN C. MUNDAY, JR. (Clarkson, Ontario, Canada), and T. T. ALFÖLDI (Ottawa, Ontario, Canada) Chromaticity Changes from Isoluminous Techniques Used to Enhance Multispectral Remote Sensing Data .....	221
<b>Short Communication</b>	
R. E. CARLSON and C. ASPIAZU (Ames, IA) Cropland Acreage Estimates From Temporal, Multispectral ERTS-1 Data .....	237
Meeting Report: Remote Sensing at the 12th International Botanical Congress .....	245

## INFORMATION NOTES

122475

Highway Route Location Utilizing Remote Sensing Techniques, Ft. Wayne, Indiana by S. G. Jordan and T. R. West

Analysis of LANDSAT imagery (June 8, 1973) for northeastern Ft. Wayne, Allen County, Ind., provided evaluations of several route corridors for the Indiana Highway Commission currently planning a dual-lane by-pass around the city. County engineering soils and agricultural soils maps, plus 9" x 9" aerial photography, were used as ground-based data. Classifications showed recent growth patterns of the city and poorly drained organic areas not indicated on surface-materials maps. Poorly drained soil areas were designated as one spectral class suggesting these widely spaced deposits possess common properties. The study allowed for corridor-sitting beyond trouble-some areas early in the planning process. This paper appears in the Proceedings of the Indiana Academy of Science for 1975, Vol. 86, 1976.

The work reported in this paper was sponsored by NASA under Grant No. NGL 15-005-186.

060176

Computer-Aided Analysis of SKYLAB Scanner Data for Land Use Mapping, Forestry and Water Resource Applications by R. M. Hoffer

SKYLAB data were obtained over a mountainous test site containing a complex association of cover types and rugged topography. The application of computer-aided analysis techniques (CAAT) to the multispectral scanner (MSS) data produced a number of significant results. Techniques were developed to digitally overlay topographic data onto the S-192 MSS data to provide a method for increasing the effectiveness and accuracy of computer-aided analysis techniques for cover type mapping.

The research reported in this report was sponsored by NASA under Contract Number NAS9-13380.

070576

Computer-Aided Extension of Digitized Remotely-Sensed Water Surface Temperatures into the Third Dimension by J. K. Cochran and R. E. Bailey

By using pattern recognition and basic physical laws, the emitted thermal radiation from water as measured by an airborne multispectral scanner system may be analyzed to produce a surface temperature map of

that body of water. In this paper, it is shown how maps of the discharge plumes from electric generating stations which release into natural waters may be first generated and then combined with other simple boundary conditions to solve the partial differential equations which describe the conservation properties of heat transfer in water. The solution is achieved through the use of a digital map for the Gallagher Plant operated by Public Service of Indiana at mile 610 on the Ohio River is produced and then compared with field collected data to check the accuracy of the solution.

The research reported in this report was sponsored by NASA under Contract Number NGL-15-005-186.

081176

Spectral Characteristics of Soils Related to the Interaction of Soil Moisture, Organic Carbon and Clay Content by R. H. Beck, B. F. Robinson, W. W. McFee and J. B. Peterson

The spectral reflectances of 15 Wisconsin-aged, glacial till soils capped with loess in Indiana were measured with the Exotech 20-C from 0.53 $\mu$ m to 2.32 $\mu$ m. The soils were predominantly silty with a range of organic carbon from .60 to 1.33% and moisture contents of those soils were controlled at oven dry (105°C for 24 hours), 1/3 BAR, and 15 BAR. The interpretation of the results allows us to suggest three wavelength band widths for use in the field when attempting to classify surface soils and increase the accuracy in mapping them by multispectral scanner techniques:

1. To map organic carbon, use the band from 0.90 to 1.22 $\mu$ m.
2. To map water content, use the band from 1.50 to 1.73 $\mu$ m.
3. To map clay, use the band from 1.50 to 1.73 $\mu$ m.

# COMPUTER BITS

SEPTEMBER 20, 1976

## BASIC SYSTEMS GROUP

### INFORMAL MEETING

HOWARD GRAMS and BILL SIMMONS will hold the second in a continuing series of informal discussion sessions at 3:30 PM on Thursday, September 23, in the Flex I Conference Room.

Like the initial session last June 29, this will be an informal "information exchange session". There will not be any prepared presentation-rather it will be a forum for you to ask any questions you wish, make any suggestions or complaints you want to, or start discussions on any topic of interest. As to subjects - anything goes.

### INTELLIGENT TERMINAL

Progress in the implementation of the LARS Intelligent Terminal for Earth Resources has been delayed because of stretched out deliveries from manufacturers, but nevertheless good progress is being made. The heart of this system, the PDP-11/34 minicomputer, has been running since August 30. Current plans call for installation of the software to permit a link-up to the 360/67 during the week of September 13.

On the other hand, we are not yet able to connect the table digitizer because the necessary interface hardware components for the PDP-11 were backordered and will not be shipped until later in September. The Varian plotter has been connected to the PDP-11, but we are as yet not able to do anything with it because Varian has yet to ship the necessary support software to drive it. Their current schedule is to ship on September 10. We are also having similar delays in other minor hardware components, but these do not seriously impact our plans.

### DATA-100 TERMINALS

As everyone knows, the 2780 at Flex I is gone, having been replaced by a faster-printing Data-100 machine. In addition, the user area at Flex II now has similar facilities owing to installation of a second Data-100 at that site. Initial reaction from users seems to be highly favorable. Please be sure to let us know if any problem areas develop.

### FLEX II DATA-100 OUTPUT

The output from the Data-100 is primarily the responsibility of the user. We therefore ask that if you remove output

from this unit, to place any other users' output in the box provided. The Computer Operators will remove the output from the box at least once a day and will place it in the proper output box, or send it to Flex I in the mail delivery.

### LOST

One of the Polaroid Film Holders used with the digital display at Flex II is missing. If anyone knows where it may be, please contact BILL SIMMONS or MIKE COLLINS.

### SYSTEM CHANGES AND ENHANCEMENTS

- \* An improvement has been made to the CMS tape handling routine to allow it to recover from tape write errors. (When a write error occurs, the system will now backspace, erase over the bad section of tape, and then retry the write on a fresh section of tape.) This will benefit all people who use tape - LARSYS users and CMS users. For LARSYS users, the primary visible effect should be a disappearance of the cryptic IHC218 errors that plague users who write classification results tapes.
- \* Anyone who has occasion to use the CP DUMP command has probably noticed that the format of the output has been slightly modified to avoid truncating the rightmost dozen columns of the EBCDIC translation. In addition, there is a new format that can be used in the DUMP and DISPLAY commands, as suggested by the following example:

display 12420.320 or dump 12420.320

is equivalent to

display 12000-1273F or dump 12000-1273F

In this format, the number before the period is the starting address, and the number following the period is the number of bytes to be dumped (both in hex, of course).

- \* It is now possible for a terminal user to issue the CP command QUERY FILES to get information about another virtual machine than your own. For example, to find out how many jobs are currently in the queue for the BATMED batch machine, one can issue the command "QUERY FILES BATMED". Similarly, one can find out how many files are stacked up to be printed or punched on the Flex I Data-100 by issuing the command "QUERY FILES FLEXLABI". (In this case, you need to know that both printer files and punch files for the Data-100 are listed as RDR-type files in the response to QUERY. Also, you cannot tell how many of these RDR-type files are for the printer and how many are for the punch - only the total).

### SUMMARY OF 360/67 USE FOR AUGUST 1976

Computer usage during August is traditionally low -- and this past month was no exception. The 131 hours of CPU time was the lowest monthly total since August 1975. A digest of possibly interesting statistics follows:

Basic Rate CPU Time	14.57 hrs (11%)	Terminal Sessions	3597
Priority Rate CPU Time	116.24 hrs (89%)	Batch Jobs	653
Total CPU Time	130.81 hrs (100%)		

#### Average Length

<u>Batch Machine</u>	<u>Jobs Run</u>	<u>Clock Time</u>	<u>CPU Time</u>
BATQUICK	149	1.1 min	0.2 min
BATSHORT	295	7.4 min	0.9 min
BATMED	55	23.7 min	3.8 min
MATLONG	63	21.3 min	5.9 min

	<u>Flex I</u>	<u>Flex II</u>
	<u>2780 &amp; Data100</u>	<u>Data100 (partial month)</u>
Cards read	48842 (10%)	3408 (2%)
Lines printed	433301 (88%)	17534 (97%)
Cards punched	11491 (2%)	1107 (1%)

<u>Terminal</u>	<u>Sessions</u>	<u>Total Time in Use</u>	<u>Avg Time per Session</u>
80 Infoton GTX	354	166 hrs	0.47 hrs
81 Hazeltine 1200	253	113 hrs	0.44 hrs
85 IBM 2741	182	89 hrs	0.49 hrs
86 IBM 2741	189	87 hrs	0.46 hrs

(Note: Similar data for terminals at Flex II is not available this month because of address changes.)



LARS · Purdue University · VOL. 2 · NO. 3 · October 15, 1976

## ITEMS OF INTEREST

- \* The Minicourse Series, **FUNDAMENTALS OF REMOTE SENSING**, is available for viewing in both Flex I and Flex II. Each of the 19 minicourses includes a set of numbered slides, an audio cassette tape and a printed study guide and typically requires from 45 to 75 minutes to complete.  
  
In Flex I contact **MELANIE SHROYER**, ext. 266, Monday-Friday from 8-12 and 1-5 to view the minicourses.  
  
In Flex II the minicourses can be viewed Monday-Friday from 8-12 and 1-5, by contacting **DEBBE SCHERER**, ext. 273 except during the monthly Short Course which is held the first full working week of every month.
- \* A color mosaic of Indiana was recently prepared for a LARS display at the annual Farm Progress Show held this year at Greenfield, Indiana on September 27-30. A special thanks goes to **CAROL LATOWSKI** and all others involved for their help in the production of this display.
- \* **MARION BAUMGARDNER** was recently named to the AAAS Committee on Desertification for the period of 1976-1978. Chairman of the Committee is Professor **HAROLD DREGNE**, Director of the International Center for Arid and Semiarid Land Studies, Texas Tech University. Dr. **PRISCILLA REINING** is the liaison member for AAAS.

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*Prepared by the Laboratory for Applications of Remote Sensing for distribution at Purdue. Contact Susan Ferringer, SCAN LINES editor, to be placed on the mailing list (749-2052, ext. 273).*

## PERSONNEL CHANGES

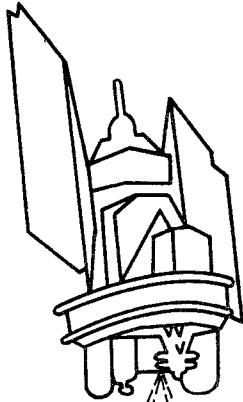
- \* LARS welcomes NANCY FUHS who joined the Computational Facility Applications Systems Group as Applications Programmer and Digital Display Supervisor on October 1. Nancy has earned both her B.A. in Sociology and her M.S. in Research Methodology at Purdue University. She will be involved with systems analysis and programming and is working on the Field Measurements project. In addition Nancy will assist users with the use of and supervise operation and maintenance of the Digital Display. She can be reached at ext. 268.
- \* Joining LARS on October 18, CRAIG DAUGHTRY will be the Crop Inventory Systems Research Programs new research agronomist. He has just completed his Ph.D. from Purdue University in Crop Physiology, and will be working on the Field Measurements and Spectral Stratification projects.
- \* BRUCE LUBE left LARS October 1 to accept a position as an Industrial Development Consultant for the School of Dentistry at the Texas State Technical Institute in Waco, Texas.
- \* Friday, October 1 was the last day for STEVE ASH, our Business Representative. Several weeks ago Steve gave his resignation to JIM DAVID, the Business Administrator for Engineering. Steve has accepted a position with a local accounting firm as a Certified Public Accountant.

## TRAVEL: SEMINARS & ADDRESSES

- \* MARV BAUER traveled to Goddard Space Flight Center on October 18 to present the results of our LANDSAT-Crops project to the NASA Agriculture Panel.
- \* DAVE LANDGREBE and ROGER HOFFER each attended a session of the two-week Second United Nations and American Astronautical Federation Workshop on Remote Sensing held from September 27 to October 8. Dr. Landgrebe presented a tutorial paper entitled: "Computer-Based Remote Sensing Technology - A Look to the Future," and Dr. Hoffer made a presentation on applications of computer processing to resource managers.  
  
Dr. Hoffer also spoke with the Forestry Management & Research representative of Weyerhaeuser Timber Company, Centralia, Washington on September 30 about the current capabilities and limitations of remote sensing technology and how it could be applied to their company.



\* The semi-annual meeting of the American Society of Photogrammetry and the American Congress to Surveyors & Mappers (ASP-ACSM) was held September 27 to October 1 at Seattle, Washington. ROGER HOFFER, Director of the Remote Sensing Interpretation Division, attended the Board of Directors' meeting, the National Planning Committee meeting, as well as chairing the technical session on forestry and agriculture applications.



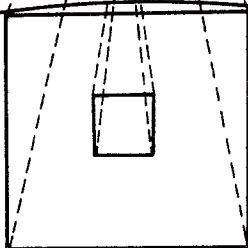
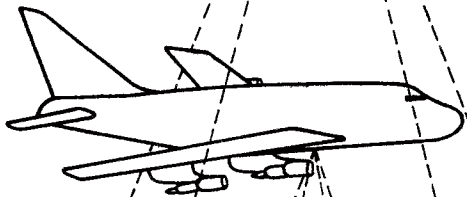
Included in this technical session was a presentation on one of the first actual operational applications of remote sensing technology. The Department of Natural Resources, the state of Washington, NASA, USGS, and the Northwest Regional Planning Commission are co-sponsoring a forestry inventory over the western half of the state of Washington.

Multilevel remote sensing techniques (see drawing) are being used: initial large scale data from the satellite is studied by computer-aided analysis to select an effective cross-section of timber samples which is surveyed through aircraft photography and then further broken down to obtain an accurate range of ground sampling.

Analysis of this remotely sensed data is being done at ESL, Berkely, CA by JIM NICHOLS using technology adapted in part from LARSYS.

This analysis will aid greatly in the management of Washington's forestry industry, increasing the efficiency of a large basis in their economy. Sale of these resources goes in part toward financing Washington's higher education programs.

Plans in the future call for similarly gathered remotely sensed data to be used in the management of forestry resources in the adjoining states of Idaho & Oregon.



\* At the end of September PAUL ANUTA visited Colorado to attend two National Science Foundation events. Dr. Anuta presented an invited paper on multivariate analysis of geophysical remote sensing data to the American Mining Congress Convention in Denver, Colorado on September 29. The next day he traveled to Grand Junction to confer with Energy Research & Development people on the availability of geophysical remote sensing data.

\* Among DICK WEISMILLER's travels during the past month was a trip to Indianapolis, Indiana on September 20 to discuss the direction of the Clinton County Soils Project sponsored by the SCS. He visited Mead Technology in Xenia, Ohio to check on the progress of the Great Lakes project output and picked up a 1:500,000 and 1:250,000 photo mosaic of Indiana from Precision Photo.

On September 26-28 Dick attended a conference on Management of Natural Resources in the South and Southwestern U.S.A. sponsored by TAMU/NASA at College Station, Texas. He also visited Tipton, Indiana on October 10 to give a presentation on remote sensing and its application to resources to the Tipton High School Science Club.

\* PHIL SWAIN traveled to Johnson Space Center September 20 to discuss research developments in the multitemporal analysis project funded by NASA SR&T.

\* At the request of Corn Production Systems, Inc. MARION BAUMGARDNER traveled to Chicago on October 4 to brief the Hungarian Minister of Agriculture on the potential applications of remote sensing to the management of agricultural resources in Hungary.

On September 15 Dr. Baumgardner was the banquet speaker at the 30th Annual Agricultural Credit Conference of the Illinois Bankers Association. He traveled to Champaign, Illinois to deliver his illustrated lecture entitled "Mapping the Earth from Space."

\* Upcoming travel includes a trip by JOHN LINDENLAUB to Tucson, Arizona on October 25-27 to attend the IEEE Education Group Conference on the Frontiers in Education. Dr. Lindenlaub is currently serving as Vice-President of the IEEE Education Group and was recently elected to President. He will assume that office January 1, 1977.

MARION BAUMGARDNER will be in Washington D.C. on October 18-19 to review the progress since the Snowmass Summer Study (July 1974). This review is sponsored by the Space Applications Board of the National Academy of Engineering, and will be considered in the light of the recommendations made by the Panel on Agriculture, Forest and Range Resources.

## VISITORS

- \* JON ERICKSON, the new Chief of NASA's Applied Physics Branch, visited LARS on September 29-30 to become acquainted with both our SR&T program and the future direction of the Lab. Dr. Erickson joined NASA from the University of Michigan's remote sensing facility, ERIM.
  
- \* October 6 was the date of RAY SINCLAIR's most recent trip to LARS to visit DICK WEISMILLER. His visit was used to plan and discuss the progress of the PY soil projects in Clinton and Jasper Counties, Indiana.  
  
DICK WEISMILLER was also visited by TERRY VIRTA, September 24, to discuss the usefulness of remote sensing to the Tippecanoe County Planning Agency.
  
- \* Dr. PRISCILLA REINING, International Office, American Association for the Advancement of Science, Washington D.C., visited MARION BAUMGARDNER on September 27 to discuss planned activities of the newly established AAAS Committee on Desertification.  
  
Dr. ILHAN AKALAN, Professor of Soil Science, University of Ankara, Ankara, Turkey visited LARS and the Agronomy Department during the period of September 29 to October 5. He discussed with Dr. Baumgardner the possibilities of a cooperative research project to identify, map and monitor a large basin in South Central Turkey where the major agricultural problem is salinization of soils.  
  
Mr. RICHARD DUGGER, Bremen, Indiana and the Rev. JOSEPH KIPFER, Marion, Indiana visited LARS on September 29 to discuss with Dr. Baumgardner agricultural development projects in Haiti.

## VISITING SCIENTISTS

- \* Two Costa Rican scientists will be visiting LARS from October to December 1976. ALEXIS VASQUEZ M., Department of Agriculture and CARLOS ELIZONDO S., National Geographic Institute, will conduct a resource inventory of the valley of the Tempisque River, Costa Rica. They will be working with PIERRE ADRIEN and MARION BAUMGARDNER and staff.
  
- \* Ing. CARLOS VARGAS, Petroleum Geologist from YPSB (Bolivian Petroleum Agency) and Ing. RUBEN ZERAIN, Geographer from the Bolivian LANDSAT program, will be training with LARSYS for 3 months ending December 31, 1976. Ing. Zerain, who brought the project's ground truth data with him, will be advising the Bolivian II Follow-up Program on how to interpret its classification results. Ing. LEONARDO PRUDENCIO, Computer Scientist, will join the project November 1 for one month to work with PAUL SPENCER on the implementation of LARSYS in Bolivia.

## COMING ATTRACTIONS

- \* A class entitled: SURVEYING AGRONOMIC RESOURCES will be taught during the spring semester of 1977 by MARV BAUER, MARION BAUMGARDNER, and DICK WEISMILLER on advanced techniques for surveying and monitoring agronomic resources.

AGRONOMY 598. Class 2, Lab. 2, cr. 3.

**SUMMARY:** Study of the information flow required for the development and management of agronomic resources; consideration of present and projected future methods of agricultural census, crop yield predictions; soil surveys, land use inventories, water resource surveys, rangeland inventories; examination of methods of data acquisition, data analysis and interpretation, and data utilization; conceptualization and design of a global earth resources information system and its relationship to local, regional and national planning for the development and management of agronomic resources.

### OBJECTIVES:

This course is designed to introduce students to the broad range of methods for observing, mapping and monitoring agronomic resources. Particular attention is devoted to the rapidly developing remote sensing technology, including field instruments, aircraft and satellite data acquisition systems and machine processing of remotely sensed data. The course should be of especial value to undergraduate students interested in crop production, soil management and interantional agriculture and to agronomy graduate students from other countries.

Consideration will be given to the concept and components of a global information system and the use of such a system by individuals, industries, research organizations and government agencies for the development, management and conservation of agronomic resources.

**PREREQUISITES:** AGRY 105 and AGRY 255 or AGRY 270, FOR 291 or consent of instructor

**TIME & PLACE OF MEETING:** 2:30-4:20 T-TH Room 3-409 L.S.

This is a pilot for a regular 500-level course to be considered for approval by the School of Agriculture for offering each spring semester. Interested students should call Dr. MARION BAUMGARDNER, 749-2052, ext. 257.

## RECENT ACQUISITIONS IN THE LIBRARY

- \* NEW FOCUS TITLES      Regional Land Use Inventories  
                                LARSYS Version 3.1

- \* The following papers and communications are contained in the September 1976 volume of the IEEE JOURNAL OF OCEANIC ENGINEERING:

A High-Resolution Pulse-Doppler Underwater Acoustic Navigation System, by R. C. Spindel, R. P. Porter, W. M. Marquet, and J. L. Durham

A Unified Approach to Array-Factor Synthesis or Line Arrays with Nonuniformly Positioned Elements, by J. J. Anton and A. J. Rockmore

Practical Experience with the Variosens Equipment in Measuring Chlorophyll Concentrations and Fluorescent Tracer Substances, Like Rhodamine, Fluorescein, and Some New Substances, by F. Frungel and C. Koch

N-Port Analysis of a Projector Consisting of a Coaxial Array of Ferroelectric Shells, by H. A. Sabbagh and T. F. Krile

Fluorometric *In-Situ* Measurements of Water Currents and Mingling of Waters in Cases of Heavy Turbidity, as in Coastal Shoal Areas, by F. Frungel and C. Koch

- \* The LARS Library has recently received an assortment of publication catalogs:

ENERGY-A Catalog of Demand Reprints, University Microfilms Internation

Physics and Related Engineering Sciences, New books from Academic Press, August/September 1976

New Publications of the Geological Survey, United States Department of the Interior, July 1976

Audio-Visual Products 1976-77, Lansford Publishing Company

Third Person Reports, Reviews of scientific and technical books for professional on-the-job academic use. Published by Ann Arbor Science Publishers, Inc. August 1976

## INFORMATION NOTES

- 062276 Techniques and Applications for Computer-Aided Analysis of Multispectral Scanner Data by R. M. Hoffer.

Several procedures for digitally processing and analyzing data from satellite scanner systems that have been found to be particularly useful are described. The techniques were applied to a mountainous test site of approximately one million hectares in area. In spite of the vegetation and topographic complexity of this test site, coniferous and deciduous forest cover, as well as other major cover types, could be mapped with an accuracy of approximately 85%, using both LANDSAT and SKYLAB data. Individual forest cover types were mapped with approximately 70% accuracy. Accurate acreage estimates of forest cover were obtained through use of these techniques over large geographic areas.

The work reported in this paper was sponsored by NASA under Grant No. NGL 15-005-112 and Contracts NAS9-13380 and NAS5-21880.

- 082776 An Investigation of the Relationship Between Spectral Reflectance and the Chemical, Physical, and Genetic Characteristics of Soils by O. L. Montgomery, M. F. Baumgardner, and R. A. Weismiller.

The purpose of this study was to examine the quantitative relationships between some of the most common chemical/physical properties and the reflectance (0.53 - 2.37 $\mu$ m) of 56 soils selected to represent a broad range of parent materials, climate, and drainage characteristics. Step-wise multiple regression analysis revealed that cation exchange capacity and contents of silt, clay, iron oxides and organic matter gave highest correlation with spectral response. This study indicated that the middle infrared region of the spectrum is the best region of reflectance for evaluating these relationships.

The work reported in this paper was sponsored by NASA under Grant No. NGL 15-005-112 and Contract No. NAS9-14016.

## SYSTEM SERVICES - OCTOBER 15, 1976

Many comments regarding the System Services title "Computer Bits" have been received and all agree its terrific! However, the connotation does not recognize or include all areas of System Services -- specifically the Support Products Area of Design, Publications, Data Library and Photography whose news will also regularly appear in this section of Scan Lines. Thus System Services Managers are seeking a new title to cover all area of services and YOUR HELP IS NEEDED. Please send all clever, catchy, intriguing and all-inclusive titles to Royal Sand. (As yet, the prize for the best title has not been selected, but the suggestion of a large black ink blot has been rejected!!) The judges are unhappy with the title "System Services" and hope to include the new title soon. We are confident that all LARSIANS will rise to the occasion and submit some great suggestions.

## INTELLIGENT TERMINAL

Progress in the development of LITER (the LARS Intelligent Terminal for Earth Resources) is progressing well despite several problems of delivery delays and hardware problems. Significant developments were made last month. Communication between the 360 and the PDP-11/34 was achieved September 24. All of the PDP-11 hardware has arrived--the last pieces (ports to plug in the digitizer, among other things) were operational on October 5. We are currently working on a minor hardware problem with the digitizer itself, and hope to have it in some kind of operation very soon.

The Varian Company is having serious problems in getting the plotter interface to the minicomputer working--it is going to require some circuitry redesign. All of the plotter software being supplied by Varian has now arrived, resolving one problem area.

Good suggestions for alternative names or acronyms better than LITER are solicited. First prize will be one hundred feet of free plotter output!!! Plus fame and recognition!!! Send suggestions to HOWARD GRAMS. Final decision on the name will be made by the LARS directors.

## INFORMATION EXCHANGE SESSION

Approximately a dozen people attended the informal information exchange session held by HOWARD GRAMS and BILL SIMMONS on September 23. The session was well received by the attendees, who had plenty of topics they wanted to ask about or discuss. It is planned to hold another of these sessions, probably at 1:00 p.m. on a Thursday afternoon in November. Among the subjects discussed in the September session were:

## "SYSTEM SERVICES" COMMUNICATIONS

We hope to make the "System Services" into a regular, timely, and accurate source of information in a newsletter format. Hopefully, this will replace the previous sporadic memos as a means for communicating with computer users. Users are encouraged to send questions to HOWARD GRAMS for inclusion in a "Question and Answer" section in "System Services." Speaking of accuracy, there was a typographical error in the second example line midway down page 12. It should read:

display 12420-1273F or dump 12420-1273F

## CRT TERMINALS

Howard solicited comments from users regarding the various types of CRT terminals to guide possible further actions regarding replacing some of them. In particular, since the lease term is up on the Hazeltine 1200 terminals, we can replace them if we wish. The Infoton terminals appear to be more popular, but we have not been able to find a means to lease them.

## PHOTOQUALITY OUTPUT

Users were asked for comments on the new procedure for photo-quality output. There was only one problem mentioned regarding the time taken to obtain this output.

## DATA-100 PRINTER SPEEDS

Howard reported on some experiments in which the speed of the Data-100 Printer was measured at 440 lines per minute. This is much faster than the 370 lines per minute originally anticipated, and even exceeds the rated speed of the printer hardware, which is 400 lines per minute. This can be compared to the speed of 220-230 lines per minute for the old 2780 terminal printer.

## SUMMARY OF 360/67 USE FOR SEPTEMBER, 1976

Computer usage was very light during September--indeed, the total of CPU hours was an all-time record low for the 360/67. Translated into real-live terms, this indicates that there is no time like the present to get started on any computing project you may have in the offing--response time is great, turnaround time is swift, and delays are minimal.

A digest of possibly interesting statistics follows:

Basic rate CPU time used	11.50 hrs. (10%)
Priority rate CPU time used	109.12 hrs. (90%)
Total CPU time used	120.62 hrs.
Terminal sessions	3262
Batch jobs	702



<u>Batch machine</u>	<u>Jobs Run</u>	<u>Average Clock Time</u>	<u>Average CPU Time</u>
BATQUICK	134	1.6 min.	.2 min.
BATSHORT	262	6.5 min.	1.0 min.
BATMED	127	11.5 min.	1.5 min.
BATLONG	94	12.3 min.	3.4 min.

(Note that all but BATLONG are charged the Priority rate for CPU time.)

<u>Data-100 machine</u>	<u>Cards Read</u>	<u>Lines Printed</u>	<u>Cards Punched</u>
FLEXI	24801 (7%)	312484 (91%)	6815 (2%)
FLEXII	959 (1%)	255459 (97%)	6336 (2%)

<u>Terminals at FlexII</u>	<u>Logins</u>	<u>Total Time in Use</u>	<u>Avg. Time per Session</u>
78 - 2741 Computer rm.	125	74 hrs.	.59 hrs.
7B - Hazeltine 1200 (digital display)	216	156 hrs.	.72 hrs.
7C - Hazeltine 2000	219	165 hrs.	.75 hrs.
7D - 2741	123	151 hrs.	1.23 hrs.
7E - Infoton GTX	272	250 hrs.	.92 hrs.
7F - Hazeltine 1200	280	213 hrs.	.76 hrs.

Terminals at FlexI

80 - Infoton GTX	300	161 hrs.	.54 hrs.
81 - Hazeltine 1200	243	122 hrs.	.50 hrs.
85 - 2741	170	76 hrs.	.44 hrs.
86 - 2741	146	75 hrs.	.51 hrs.

Dial-up Terminals

8D - First dial-up port	48	70 hrs.	1.46 hrs.
8E - Second dial-up port	26	38 hrs.	1.46 hrs.

## SLIDES, SLIDES, SLIDES

"Where do I go to get a slide?"

This is a question that's been floating around the Lab for some time and the Support Products Group offers the following solutions:

### UNDEVELOPED (EXPOSED) FILM

DAVIDA PARKS will be happy to take your film to Photographic Services on campus. Processing of color slides usually takes 3 to 5 days.

If, however, color prints or duplicate color slides are desired, allow between 2 and 3 weeks for printing and processing. This time is extended as Photographic Services sends all color work out.

### SLIDES FROM ORIGINAL ARTWORK

Contact SUE FERRINGER. Upon completion and approval of the original artwork, Sue will send it to Photographic Services for shooting and processing. Turn around time varies as Photographic Services routinely only shoots and processes a roll of film containing 20 exposures. If this minimum exposure requirement is met, turn around time averages between 3-5 days.

If, on the other hand, a slide is top priority, but does not meet the minimum exposure requirement; special arrangements will be made. Special handling increases production costs at Photographic Services.

### SLIDES FROM THE LARS SLIDE LIBRARY

Included in the Slide Library are photographs of data, equipment, personnel, points of interest, etc., and specially prepared graphs, charts, and diagrams. These slides are a product of the various Program Areas at LARS providing an unlimited variety of material from which to select.

Immediate availability of slides is the prime service being provided by the Slide Library. When a Master Slide is placed in the library, the librarian has six duplicate slides made and places these in the duplicate or "readily available" file. This enables the librarian to supply the user a slide upon request. Turn around time can be as little as 5 minutes!!

Slides placed in the Slide Library can be requested from SUE FERRINGER, Slide Librarian. If you have slides in your private collections that you feel would be of benefit to the Lab, Sue will be happy to include them in the Master Slide File.

## COMPUTER OPERATIONS NOTES

### DATA-100

Now that the Data-100 machines are well into operation (and hopefully all the bugs have been exterminated), we would be interested to hear any comments or suggestions you may have for these units. Please address your comments to BILL HOCKEMA at Flex II (signed or unsigned).

### COMPUTER SCRATCH TAPES

Although our policy is not to provide scratch tapes, in emergency cases, we do provide temporary scratch tapes for people who wish to create a temporary data set for subsequent immediate usage. Occasionally time constraints do not allow users to complete their tasks immediately. Therefore, we will reserve the scratch tape for you if you ask the operator. Since only eight tapes are reserved for this purpose, we cannot save a tape for longer than a week. We ask that you please release any reserved scratch tapes as soon as possible. Please purchase tapes when they are needed; this can be done through BILL HOCKEMA.



LARS · Purdue University · VOL. 2 · NO. 4 · November 16, 1976

## ITEMS OF INTEREST

- \* The 1976 WILLIAM T. PECORA Award was recently presented to the Laboratory for Applications of Remote Sensing and the Environmental Research Institute of Michigan as part of the William T. Pecora Memorial Symposium in Sioux Falls, South Dakota. This award is made annually by NASA and the Department of Interior for outstanding contributions to the field of remote sensing.

"The Laboratory for Applications of Remote Sensing (LARS) and the Environmental Research Institute of Michigan (ERIM) have been pioneers in developing methods for the acquisition and analytical processing of multispectral imagery. Early efforts of these two organizations were aimed at automating agricultural inventories. The same techniques are now being applied to many other discipline activities, including geology, hydrology, and land cover analysis. Many of the LANDSAT design concepts and analysis techniques are direct outgrowths of these original efforts."

"When LANDSAT-1 was launched in July 1972, few investigators were prepared to utilize fully the capabilities of the digital data acquisition system. The association between discipline scientists and these organizations has led to a rapid broadening of the user community capable of using data analysis methods."

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*Prepared by the Laboratory for Applications of Remote Sensing for distribution at Purdue. Contact Susan Ferringer, SCAN LINES editor, to be placed on the mailing list (749-2052, ext. 273).*

"The combination of technological expertise, knowledge of user requirements, and comprehension of the total acquisition and analysis systems has made these organizations a unique source for advice and special studies. Their contributions, both as organization and as individuals, have been critical to the success of the LANDSAT program."

"Special recognition is given to LARS for early demonstration of the importance of closely coordinating the acquisition of multispectral image data with extant digital processing capabilities and the simultaneous acquisition of ground information."

"Special recognition is given to ERIM for taking the lead in sponsoring a continuing International Symposium on Sensing of the Environment. Ten of these symposia have been held. These meetings and the documented proceedings have provided the stimulus necessary to advance civil applications of remote sensing beyond conventional aerial photography to its current state."

This citation can be seen in the reception area of Flex II, the award plaque itself is located in the Director's Office, Flex I.

In addition to the above awards, Director DAVID LANDGREBE, who accepted the award on behalf of LARS, received a volume on ERTS-1. This book is now available in the LARS Library:

A040     ERTS-1 A New Window on Our Planet  
W67     Geological Survey Professional Paper #929  
76     William D. Carter & Richard S. Williams, Jr. - Editors  
C1     United States Printing Office

The following application areas are explored in both explanatory text and color illustrations.

1. Cartography
2. Geology and Geophysics
3. Water Resources
4. Land-Use Mapping and Planning
5. Agriculture, Forestry, and Rangeland Management
6. Environmental Monitoring
7. Conservation
8. Oceanography

## PERSONNEL CHANGES

- \* LARS welcomes JIM MARIGA, who comes to us after 10 years with General Foods Corporation, where he worked as a Cost Accounting Supervisor and Data Processing Supervisor. Mr. Mariga accepted the position of Business Administrator for LARS, and has begun his duties here recently after completing his training at the Engineering Experiment Station.

- \* The computer area has gained two new student members: EARLENE HUGHS will be writing programs under the supervision of BILL SIMMONS. Also under Bill Simmons, JEFF McMEEKIN will work on implementing specific computer programs and processing of remote sensing data in support of the US-USSR Project.
- \* GLORIA MCGREW, a new graduate student at LARS, is doing analysis work on the Bolivian II project under LUIS BARTOLUCCI.
- \* EMIL HORVATH will be leaving LARS around Thanksgiving after completing his Masters Degree under MARVIN BAUER to return to his home in Venezuela. Next Semester he will begin study for his Ph.D. at the University of Arizona under DON POST.
- \* Several Purdue Staff members have joined LARS's interdisciplinary team to work with BOB BAILEY and DICK WEISMILLER on the Ohio River Valley Project. They include PEGGY HULL and MARY PEART, Consumer Sciences and Retailing; ROBERT JACKO, ROBERT MILES, RAMACHANDRA RAO, and DONALD GRAY, Civil Engineering; RONALD BARILE, Chemical Engineering; and P. DALASUBRAMANIAN, graduate student in Industrial Engineering.

#### TRAVEL: SEMINARS & ADDRESSES

- \* DAVID LANDGREBE was in Mexico City on October 6-10 to participate in an Image Processing Short Course. The course's coordinator, Electrical Engineering professor TOM HUANG is on leave in Mexico, so the course was not held at W. Lafayette this year.  
  
Dr. Landgrebe also participated in the Jet Propulsion/Cal Tech Image Processing Symposium held at the Jet Propulsion Laboratory in Pasadena, California, November 3-5.
- \* PAUL ANUTA traveled to the NASA remote terminal at Wallops Island on October 5 to discuss registration of synthetic aperture radar data and LANDSAT data. LARS is being asked to consider registering these data types and making it available to Wallops and JSC researchers.
- \* On October 18, MARV BAUER presented the results of the LANDSAT investigation "Crop Identification and Area Estimation over Large Geographic Areas Using LANDSAT Multispectral Scanner Data" to a NASA agriculture discipline panel at the Goddard Space Flight Center in Greenbelt, Maryland.  
  
Dr. Bauer also traveled to Washington D.C. on October 21 for a project meeting of the US-USSR exchange project. The next day he visited the Statistical Reporting Service, USDA, to see their remote sensing program.

- \* Field Measurement data collection activities included a trip by MARV BAUER to Hand County, South Dakota for field data collection for the US-USSR exchange project. BARRETT ROBINSON and LARRY BIEHL were in Garden City, Kansas from November 1-4 to also review measurement practices at various Field Measurement test sites.
  
- \* PHIL SWAIN chaired a session on Applications of Image Processing in Remote Sensing at the National Science Foundation sponsored Workshop on Advanced Automation, College Park, Maryland on October 29. As part of the session he also conducted a panel discussion on the topic "Image Analysis for Remote Sensing Applications: Can We Get It All Together?"  
The following week, November 1-3, Dr. Swain was one of twenty invited U.S. attendees at the U.S.-Japan Seminar on Image Processing in Remote Sensing, also in College Park, Maryland. He presented a paper entitled "Toward the Effective Use of Spatial Information in Multispectral Remote Sensing."
  
- \* Upcoming travel on December 1 and 2 will see TERRY PHILLIPS, ROYAL SAND, HOWARD GRAMS, and BILL SIMMONS attending the Advanced Technical Conference on IBM's direction in the immediate computer marketplace, to be held in Cincinnati, Ohio.
  
- \* PHIL SWAIN, MARV BAUER, JOHN LINDENLAUB, DICK WEISMILLER, DICK MROCYNSKI, DAVID LANDGREBE, TERRY PHILLIPS AND LEROY SILVA will be flying south to JSC at Houston, Texas to give a presentation, at the request of NASA, on our current SR&T research.
  
- \* On November 4 DICK WEISMILLER travelled to Cincinnati, Ohio to review the progress of regional technology configurations for the Ohio River Basin Study.  
Dr. Weismiller will be in Houston, Texas, November 28-December 2 to present a paper to the American Society of Agronomy meeting. STEVE KRISTOF will also attend.
  
- \* MARION BAUMGARDNER's travel will include a trip to Alexandria, Virginia, November 14-16 to give a presentation entitled: "Computers, Satellites, and Food -- A Global Perspective" to the North Atlantic Assembly of NATO.  
Dr. Baumgardner will be in Khartoum, Sudan from November 20 to December 3 to carry out field observation work to evaluate classification results of the Sudan project. He will also be out of the country from December 3-9 when he will visit Nairobi, Kenya to give illustrated lectures and participate in discussions on remote sensing with officials of the United Nations Environmental Programs (UNEP), the Government of Kenya, and the International Development Research Centre (IDRC) of Ottawa, Canada.

- \* FRANK KIRSCHNER, ERIC HENZEL, DONNA SCHOLZ, SUE KAMINSKI, STEVE KRISTOF, and CAROL LATOWSKI attended the Indiana Academy of Science meeting on November 5 held in Valparaiso Indiana. Frank presented a paper he co-authored with Sue and Eric. Steve presented a paper he co-authored with Sue and DICK WEISMILLER.
- \* On November 9 ERIC HENZEL, DONNA SCHOLZ, and FRANK KIRSCHNER went to Jasper County for field checking of boundaries of a general soils map being prepared under the PY/Jasper County project.

## VISITORS

- \* DUANE MOORE, a 1972 graduate in Agronomy from Purdue University, gave a seminar at LARS October 21. Mr. Moore and his wife have been in Bangladesh three years with the Mennonite Central Committee Agricultural Research Farm where a very successful research and demonstration program has been in operation.
- \* Technology Transfer will host two visitors; KEN BURDETT, from the United States Postal Service will be consulting LARS on November 16 on the use of self-instructional materials such as the Minicourse Series and the LARSYS Educational Package.  
  
TAMURA HIDEYUKI, Electro-Technology Laboratory of Japan, will visit at LARS November 18 to learn more about image processing.

## COMING ATTRACTIONS

- \* Next month's Short Course, December 6-10, will have a record high attendance of thirteen participants. Seven members of the National Remote Sensing Agency of India will be among these thirteen, with Dr.'s AYYANGAR and VENKATARATHNAM remaining at LARS through December 23 to learn about remote sensing as a tool to provide information on soil salinity and alkalinity and crop yields. They will be studying under DICK WEISMILLER.
- \* An Advanced Short Course entitled: "Advanced Topics in the Analysis of Remote Sensing Data" is planned for April 4-8, 1977. It will include subject matter in the areas of Multi-temporal Analysis, Layered Classification, Spatial Analysis Techniques, Sample Classification, Data Collection Planning, Results Evaluation, and Data Transformations.

Staff for this course will include: PHIL SWAIN, JOHN LINDENLAUB, DAVID LANDGREBE, MARV BAUER AND BARBARA DAVIS. The course agenda and/or brochure is expected to be available within a few weeks.

- \* Deadlines for the 4th Annual Symposium on Machine Processing of Remotely Sensed Data are quickly approaching.

Deadline for submission of  
long paper 1000 word summary December 31, 1976

Deadline for submission of  
short paper abstract March 18, 1977

Four copies of 1000 word summary or short paper abstracts  
should be sent to: Dr. JOHN C. LINDENLAUB  
Laboratory for Applications of Remote Sensin  
Purdue University  
1220 Potter Drive  
West Lafayette, IN 47906  
317-749-2052 (Ext. 271)

- \* Seminar topics for the remainder of the fall semester are as follows (unless noted, all seminars are at 8:30 AM, Flex II Conference Room):

November 18\* "The Role of Remote Sensing Technology in  
the Development Projects of the Inter-American  
Development Bank"  
PIERRE-MARIE ADRIEN  
\* 3:30 PM

November 25 THANKSGIVING

December 2 "Statistical Methods for Evaluating Results"  
(or, "How to Tell How Good You Are")  
BARB DAVIS and MARILYN HIXSON

December 9 "SPSS: A Painless Approach to Statistics"  
BARB DAVIS and MARILYN HIXSON

## NEW PROJECTS AND PROPOSALS FUNDED

- \* The National Institute of Health has funded "Optical Detection of Neonatal Jaundice" for two years under the direction of DAVE DEWITT, principal investigator. This project plans to develop a non-invasive technique and clinical instrumentation for the optical detection of neonatal jaundice. Other people involved in the project include Dr. R. E. HANNEMANN, Arnett Clinic, Dr. R. L. SCHREINER, I. U. Hospital, and BARRETT ROBINSON, LARS.
- \* An update on the St. Regis Project shows it is funded through NASA for 3 years. LARS will work with NASA and St. Regis Paper Company's Southern Timberland Division in developing and implementing a system which will utilize remotely sensed data to provide information relevant to the management of southern timber resources.



## RECENT ACQUISITIONS IN THE LIBRARY

- \* The LARS Library has recently received an assortment of new publications directly related to remote sensing:

A040      Space Shuttle  
N17      NASA  
75      February 1975  
C1

A040      Definition of the Total Earth Resources System for the  
G28      Shuttle Era - Volume 10  
75      General Electric, Space Systems Organization  
V10      TOSS-TERSSE Operational Systems Study  
C1

A040      Definition of the Total Earth Resources System for the  
G28      Shuttle Era - Volume 10  
75      General Electric, Space Systems Organization  
V9      Earth Resources Shuttle Applications  
C1

A090      Quarterly Literature Review of the Remote Sensing of  
N17      Natural Resources - First Quarter, Second Quarter 1976  
76      NASA  
N1C1      Technology Applications Center  
            The University of New Mexico  
            Albuquerque, New Mexico

A355      On the Numerical Evaluation of the Maximum Likelihood  
W15      Estimate of Mixture Means by Homer F. Walker  
75      Department of Mathematics  
44C      University of Houston  
            Houston, Texas  
            July, 1975

A111      ITC Textbook of Photo-Interpretation - Volume VIII  
M47      Use of Aerial Detection in Geology and Engineering  
72      Chapter VIII.2 - The Geological Interpretation of Radar  
V1      Images  
N11      J.F.M. Mekel  
            Enschede, The Netherlands

A900      Annual Report - Environmental Research Institute of  
En8      Michigan (ERIM) 1974  
74      University of Michigan  
C1

A617      Spacecraft and Aircraft Remote Sensing for Integrated  
C72      Unit Resource Inventory and Analysis in Northeast  
75      Colorado and Northwest Nevada  
C1      Final Report - June 30, 1975  
         Robert N. Colwell, PI  
         Dept of Forestry and Conservation  
         College of Natural Resources  
         University of California, Berkeley

A010      Remote Sensing - A Better View  
R83      By Robert D. Rudd  
74      From the Man-Environment System Series  
C1      Duxbury Press  
         Contents:

1. Toward a Greater Breadth of Vision
2. The Basics of Remote Sensing
3. Remote Sensing of the Natural Environment
4. Remote Sensing of Man's Use of the Land
5. The Development of Remote Sensing from Space
6. Pro and Con

\* ERIM - Final Report  
Ann Arbor, Michigan  
May, 1976

The following volumes:

A630      Forest Classification Accuracy as Influenced  
Sa2      by Multispectral Scanner Spatial Resolution  
76      F. Sadowski and J. Sarno  
C1

A351      System for Analysis of LANDSAT Agricultural  
K16      Data  
76      Automatic Computer-Assisted Proportion Estima-  
C1      tion of Local Areas  
         R. J. Kauth and G. S. Thomas

A610      Evaluation of Algorithms for Estimating Wheat  
R39      Acreage from Multispectral Scanner Data  
T6      Wyman Richardson and Alex P. Pentland  
C1

A354      Signature Extension Using Transformed Cluster  
L17      Statistics and Related Techniques  
76      P. F. Lambert and D. P. Rice  
C1

A351      Wheat Signature Modeling and Analysis for I  
M29      Improved Training Statistics  
76      W. A. Malila, R. C. Cicone and J. M. Gleason  
C1

A239      Investigation of Spatial Misregistration  
M29      Effects in Multispectral Scanner Data  
76  
C1

\* Symposium Proceedings:

- P030 Proceedings of the Un/FAO Regional Seminar on Remote Sensing  
Un3 of Earth Resources & Environment  
75 Cairo, Arab Republic of Egypt  
C1 September 4-15, 1974
- P628 Proceedings - Sandusky River Basin Symposium  
In8 Tiffin, Ohio  
75 May 2-3, 1975  
C1 Heidelberg College/Bowling Green State University  
International Joint Commission  
International Reference Group on Great Lakes Pollution  
from Land Use Activities
- P610 Proceedings to the NASA Earth Resources Survey Symposium  
N17 First Comprehensive Symposium on the Practical Application  
75 of Earth Resources Survey Data  
Houston, Texas  
June 1975  
The following volumes:  
VI - A Technical Session Presentations (TSP)  
Agriculture - Environment  
VI - B TSP  
Geology - Information Systems and Services  
VI - C TSP  
Land Use - Marine Resources  
VI - D TSP  
Water Resources  
VII-A Special Session Presentations (SSP)  
Plenary - Summaries  
VII-B SSP  
Coastal Zone Management  
State and Local Users  
User Services  
VIII Summary Reports

\* General Reference Publications:

- R628 Selected Water Resources Abstracts  
W29 U.S. Department of the Interior  
76 A semimonthly publication of the Water Resources Scientific  
V9 Information Center, Office of Water Research & Technology  
N13-19 Volume 9, Number 13 (July 1, 1976), Number 14 (July 15, 1976),  
Number 15 (August 1, 1976), Number 16 (August 15, 1976),  
Number 17 (September 1, 1976), and Number 19 (October 1, 1976).
- R628 Improved Application of Geophysics to Groundwater Resource  
Ad1 Inventories in Glaciated Terrains  
75 by Jerald M. Adams, William J. Hinze, and Lynn A. Brown  
C1 Purdue University  
Water Resources Research Center  
W. Lafayette, In - July 1975

R010 The NOAA Story  
N21 U.S. Department of Commerce  
73 National Oceanic and Atmospheric Administration  
C1

R628 Water Resources Research Catalog - Volume 10  
W29 U.S. Department of the Interior  
75 Office of Water Research and Technology  
C1 Water Resources Scientific Information Center  
Washington, D. C.  
1975

R628 1976 Directory of Great Lakes Research and Related  
In8 Activities  
76 International Joint Commission  
C1 Great Lakes Research Advisory Board  
Edited by Dennis E. Konasewich

R603 The Encyclopedia of Computer Science  
R14 Anthony Ralston and Chester L. Meek - Editors  
76 Petrocelli/Charter, New York 1976  
C1

The encyclopedia covers every aspect of the discipline and is divided into five broad subject areas: computer science, data processing, information science, information processing, and symbol manipulation. It is further divided into the areas of software, hardware, languages, programs, systems, mathematics, networks, applications, theory, history, and terminology. In addition, legal, societal, economic, and educational aspects of the field are covered along with biographical data on the important men and women in the field. Appendixes provide abbreviations, acronyms, and special notations and a number of useful numerical tables. In addition, the index contains all terms that would appear in a dictionary of computer science thus providing an invaluable aid to locating specific information.

## INFORMATION NOTES

090776 Analytical and Experimental Design and Analysis of an Optimal Processor for Image Registration  
by M. Svedlow, C. D. McGillem, and P. E. Anuta

The problem of registration of LANDSAT images taken at different times is studied. Several preprocessing methods were evaluated to determine the best method for improving registration accuracy. Alternative correlation methods were also evaluated. Theoretical bounds on registration error were derived and an evaluation of the effects of geometric distortion on registration accuracy are evaluated.

The work reported in this paper was sponsored by NASA under Contract No. NAS9-14016.

101476 Evaluation of Gravel Deposits Using Remote Sensing Data, Wabash River Valley North of Terre Haute, Indiana by T. R. West, S. A. Mundy and M. C. Mo

The objective was to locate high gravel content zones in the extensive outwash sand and gravel terrace. Non-supervised analysis of overlay data (three LANDSAT passes) proved best. Field checks tended to verify the existence of "gravel rich" and "gravel poor" classes. Cost comparisons of remote sensing with conventional exploration suggest an economic benefit for the procedure developed.

The work reported in this paper was sponsored by NASA under Grant No. 15-005-186.



# SYSTEM SERVICES

November 16, 1976

## INFORMATION EXCHANGE SESSION

- \* HOWARD GRAMS and BILL SIMMONS will hold the next in their continuing series of informal discussion sessions on Thursday afternoon, November 18, at 1:30 p.m. in the Flex I Conference Room.

If you have previously attended one of these sessions, you know that the format is informal. We talk about anything and everything you want to talk about (although our particular fields of expertise are LARSYS and the computer system in general). There will not be any prepared presentations; instead the floor is open for you to ask questions, make suggestions, or air complaints about any subject you wish.

If you have not attended one of these sessions before, we especially invite you to come and spend a few minutes even if you cannot afford to stay for the entire session (which usually lasts for an hour or a little more).

## QUESTIONS, ANYONE?

- \* Every other computer newsletter I have ever seen features a popular section comprised of answers to questions or suggestions from users. The only thing that keeps us from including a similar feature in these notes is a lack of questions. C'mon guys and gals, what would you like to see answered or responded to in these pages? Scribble a short note or question on a scrap of paper and send it to HOWARD GRAMS (signed or unsigned, as the mood strikes you).

## LARS INTELLIGENT TERMINAL FOR EARTH RESOURCES

- \* Progress in the development of LITER (LARS Intelligent Terminal for Earth Resources) continues -- not as rapid as we had hoped, but definite measurable progress nevertheless. A more-or-less formal status report was completed during October and circulated, supplementing a previous status report in June. (If you are interested, loan copies may be borrowed from HOWARD GRAMS).

During the July-October period, five of the 22 significant milestones of the Phase I development plan was achieved. This, coupled with the four that had previously been completed, leaves 13 to be achieved.

With regard to the Varian plotter aspect of the project, we are still slipping behind schedule because of Varian's inability thus far to get the interface hardware between the PDP-11/34 and the plotter to work. We have a great deal of plotter software ready for testing and debugging.

On the other hand, progress has been gratifying on the work related to getting the table digitizer ready to be used. We succeeded in getting the hardware to work on October 8, and we expect to have Version 0 prototype software available in the very near future.

## DEMONSTRATION/OPEN HOUSE

- \* If you are interested in looking at the PDP-11/34, the table digitizer, and the plotter and seeing how that hardware works, plan on coming over to the user area of Flex II on Thursday, December 9 at about 9:30 a.m. -- just after the conclusion of the regular LARS seminar. We will try to have it all up and running so that you can get a feeling for what it looks like in operation.

## COMPUTER PRINTED OUTPUT

- \* Significant amounts of computer output are being sent to the wrong people or being lost entirely because "first names only" or nicknames are being used at login. Please use your first and last name both (especially your last name) if you want to receive your output; otherwise the output will be considered "salvage."

"Goofy" and "Donald Duck", would you care to stop in and claim your output?

## SUDAN MEAD COLOR PLATES

- \* The Reformatting Group of the Computer Facility has just received the eight chromolin color plates of the classification results for the Sudan Project. These are ten color plates representing a twenty class results output. Six plates cover an area of 48 X 57 kilometers at 1:50,000 scale. The other two plates cover an area of 122 X 155 kilometers at 1:250,000 scale. Both include MARION BAUMGARDNER S famous wadis and granite dam, as well as numerous wind patterns in the sand. You may see them in DAVE FREEMAN's office in Flex Lab II.



## SUMMARY OF 360/67 USE FOR OCTOBER, 1976

\* Usage of the 360/67 continued very light during the month of October -- this marks the third consecutive month of nearly record low level of usage.

We present here the usual digest of possibly interesting statistics:

<u>Overall Usage</u> - Basic Rate CPU time used	13.96 hours (11%)
Priority Rate CPU time used	112.74 hours (89%)
Total CPU time used	126.70 hours (100%)
Terminal Sessions	3630
Batch Jobs	860

<u>Batch Machines</u> - <u>Batch Machine</u>	<u>Jobs Run</u>	<u>Avg. Clock Time</u>	<u>Avg. CPU Time</u>
BATQUICK	191	1.1 min.	.2 min.
BATSHORT	378	7.0 min.	.8 min.
BATMED	134	23.1 min.	2.5 min.
BATLONG	37	29.4 min.	10.4 min.

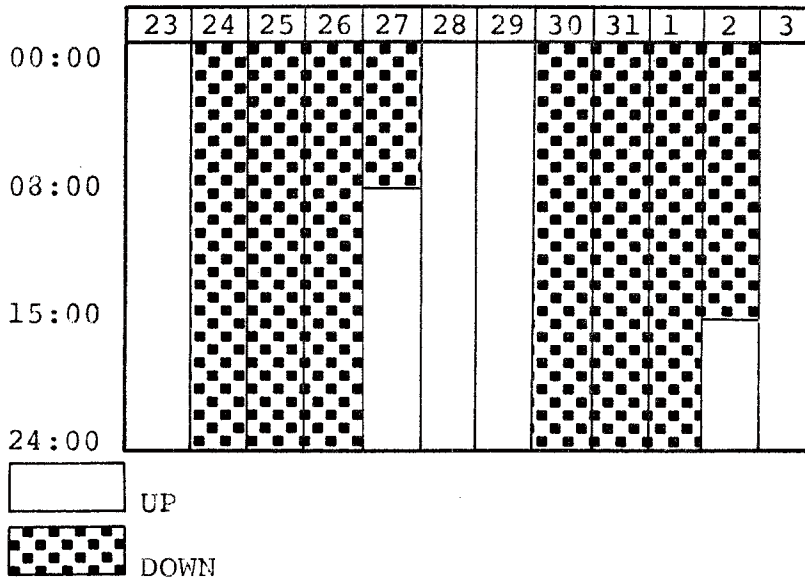
<u>Local &amp; Remote Terminals</u> - <u>Location</u>			
	<u>Cards Read</u>	<u>Lines Printed</u>	<u>Cards Punched</u>
FLEXLAB 1	35742 (9%)	362102 (89%)	6826 (2%)
FLEXLAB 2	4384 (1%)	487478 (98%)	4699 (1%)
Houston	44944 (24%)	138524 (73%)	7128 (4%)
ISU	8752 (4%)	205221 (96%)	492 (0%)
EDC	394 (36%)	349 (32%)	356 (32%)
Wallops	0	0	0

<u>Terminal Use</u> - <u>Location</u>	<u>Port</u>	<u>Terminal Type</u>	<u>Logins</u>	<u>Total Time</u> <u>In Use</u>	<u>Avg. Time</u> <u>Per Session</u>
Comp. Rm	78	2741	167	73 hrs.	.44 hrs.
Flex 2	7B	Hazeltine 1200	225	157 hrs.	.70 hrs.
Flex 2	7C	Hazeltine 2000	217	140 hrs.	.65 hrs.
Flex 2	7D	2741	126	94 hrs.	.74 hrs.
Flex 2	7E	Infoton GTX	332	253 hrs.	.76 hrs.
Flex 2	7F	Hazeltine 1200	289	220 hrs.	.76 hrs.
Flex 1	80	Infoton GTX	375	216 hrs.	.57 hrs.
Flex 1	81	Hazeltine 1200	307	182 hrs.	.59 hrs.
Flex 1	85	2741	197	101 hrs.	.51 hrs.
Flex 1	86	2741	192	120 hrs.	.63 hrs.
Dial-Up	8D	First in use	45	75 hrs.	1.66 hrs.
Dial-Up	8E	Second in use	10	10 hrs.	1.02 hrs.
Houston	91,92,93	-----	279	393 hrs.	1.41 hrs.
ISU	99	2741	212	97 hrs.	.46 hrs.
EDC	95	2741	1	.1 hrs.	.1 hrs.
Wallops	94	2741	0	0	0



# SEASONS GREETINGS

## COMPUTER FACILITY HOLIDAY SCHEDULE



\* There is a possibility of the system being up on December 30th and 31st, but the Computer Facility will not know until December 28th.

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*Prepared by the Laboratory for Applications of Remote Sensing for distribution at Purdue. Contact Susan Ferringer, SCAN LINES editor, to be placed on the mailing list (749-2052, ext. 273).*

## PERSONNEL CHANGES

- \* Three computer operators are graduating in December and may be leaving our staff. LARRY KOMAREK expects to leave December 23rd and RON FASSNACHT expects to leave about January 9th. TELL GATES also graduates; however, he plans to enroll for a few extra credits this spring and expects to stay on this semester.

We welcome PAT WOOD to the Operations Staff. Pat is a Freshman in Mechanical Engineering. He has a great interest in writing programs and acquired some programming experience while attending Jefferson High School last year.

- \* PAM ROBERTS, Administrative Assistant for the past 3½ years to DAVID LANDGREBE, Director, is changing addresses to follow her husband to his new job. Randy will be working for the National Steel Company in Granite City, Illinois, and they will be living in St. Louis County, Missouri. Pam's last day will be December 23. We all wish Pam and her family well.

It has been announced that MARLENE HODGE has been promoted and will fill the vacancy left by Pam's departure. Marlene, currently secretary to TERRY PHILLIPS, Deputy Director, started spending part days in training at Flex I on December 16, and will move to the Director's Office permanently in early January 1977. She will be assisting the Director in all administrative management of the laboratory, as well as compiling and editing reports, performing statistical and secretarial functions.

In addition to a new face in the position of Assistant to the Director, a new division of the work load in the Director's Office resulted in new responsibilities for SHARON WHITLOCK. As of December 16, Sharon is clerical supervisor of Flex I. In addition to her office manager duties, she continues as secretary to JOHN PETERSON, Associate Director.

## TRAVEL: SEMINARS & ADDRESSES

- \* At the 1976 annual meetings of the American Society of Agronomy, held in Houston, Texas from November 28-December 3, JOHN PETERSON presented an invitational paper and was honored with an Award of Honorary Membership in the society. Other members of LARS attending included: MARV BAUER, CRAIG DAUGHTRY, DICK WEISMILLER, STEVE KRISTOF, and JOHN AHLRICHS. The following papers were also presented (\* refers to author presenting the paper):

Soil Inventory Prepared from Satellite and Topographic Data, R. WEISMILLER\*, I. PERSINGER, O. MONTGOMERY.

An Investigation of the Relationship Between Spectral Reflectance and the Chemical, Physical and Genetic Characteristics of Soils, O. MONTGOMERY\*, M. BAUMGARDNER, R. WEISMILLER.

Mapping Land and Vegetation Resources in North Jordan by Digital Analysis of LANDSAT Data, S. KRISTOF\*, M. BAUMGARDNER.

In Vitro Disappearance of Tall Fescue and Orchardgrass Hemicellulose, C. DAUGHTRY\*, D. HOFT, V. LECHTENBERG, D. DIKEMAN.

- \* STEVE KRISTOF presented a paper entitled Inventory of Small Nature Preserve Areas in Lake County, Indiana Using Satellite Multispectral Scanner Data at the joint 92nd Annual Meeting of the Indiana Academy of Science and the 44th Annual Meeting of the Junior Academy of Science held at Valparaiso, Indiana from November 4-5. Other authors contributing to this paper included FRANK KIRSCHNER, DICK WEISMILLER, and STEVE KAMINSKY.
  
- \* PAUL ANUTA was in Gaithersburg, Maryland on November 16, to discuss with NASA/Wallops Island the establishment of a capability at LARS for registering airborne radar and LANDSAT imagery.  
  
Dr. Anuta again discussed the tasks for the radar registration system study on December 17 at Wallops Island, Virginia.
  
- \* DAVID LANDGREBE travelled on December 17 to NASA/Goddard to give a general presentation and review on the LARS SR&T Tasks.
  
- \* MARION BAUMGARDNER travelled to Washington D. C. in a culmination of the initial work between LARS and the Inter-American Development Bank/Costa Rica Visiting Scientist program. Dr. Baumgardner, PIERRE-MARIE ADRIEN, ALEXIS VASQUEZ MORERA, and CARLOS L. ELIZONDO SOLIS made a presentation of their results to IDB and representatives of the Costa Rican government on December 15. CARLOS BROCHMAN also contributed a report on the continuing Bolivian projects.
  
- \* A meeting was held in Indianapolis on December 14, hosted by the Indiana Department of Natural Resources, Division of Reclamation, in which DICK WEISMILLER and DICK MROCYNSKI participated in a discussion of the strip mine inventory proposal.  
  
HUGH SPENCER was also the guest of Dr. Weismiller on December 17 to talk on strip mine acid waste.
  
- \* A field Measurements Project meeting was held at NASA/JSC on December 6-8 with MARV BAUER, LARRY BEIHL, BARRETT ROBINSON, and BILL SIMMONS attending.

- \* A joint meeting of the Soil Conservation Service, Missouri, Washington D. C., and Indiana; Purdue University Department of Agronomy, and LARS was held at Flex II on December 16 to review the LARS soils research programs. Besides staff members from Purdue, participants included: IVAL PERSINGER, RICHARD GILBERT, RAY SINCLAIR, AL ZACHARY, DON FRANZMCIER, CHARLES MCKEE, and STEVE QUACKENBUSH.

## PUBLISHED WORKS

- \* C. TARNOCAI and STEVE KRISTOF recently had the following article published in *Arctic and Alpine Research*, Vol. 8, No. 2, 1976: Computer-Aided Classification of Land and Water Bodies Using LANDSAT Data, Mackenzie Delta Area, N.W.R., Canada.

Terrestrial and aquatic environment on Richards Island (Mackenzie Delta) were classified by a computer-implemented pattern recognition technique using LANDSAT data. A clustering sampling procedure applied to a portion of the area divided the data into groups of sample points of similar spectral characteristics. These cluster groups were used as reference or training samples in the classification of each data point on Richards Island into one of 22 spectral classes (14 terrestrial and 8 aquatic). The description of the cluster classes and the evaluation of the classification accuracy were based on data collected at the ground truth sites.

- \* *National Society for Performance and Instruction*, Vol. XV, No. 8, October 1976 published as its cover story the following article by JAMES RUSSELL: Systematically Disseminating Technological Information to Potential Users.

Reprints are available at Flex II Courtesy Corner.

## RECENT ACQUISITIONS IN THE LIBRARY

- \* Proceedings of the 3rd International Joint Conference on Pattern Recognition  
Coronado, California  
November 1976

This volume is shelved in PHIL SWAIN's office, Flex I.  
If interested, contact him.

- \* NEW FOCUS TITLE: Reformatting LANDSAT Data

This and all other titles in the Focus series are available in the Flex I and Flex II Courtesy Corners.

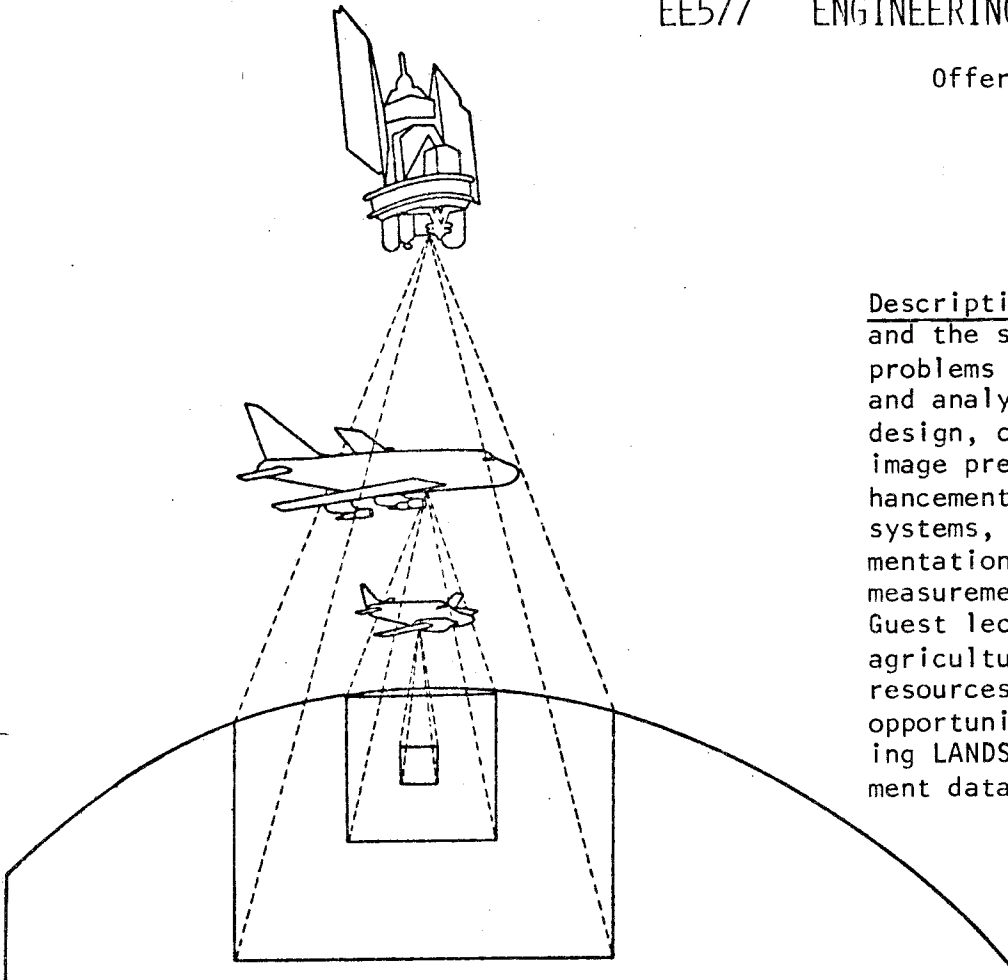
# COMING ATTRACTIONS

## EE577 ENGINEERING ASPECTS OF REMOTE SENSING

Offered Spring Semester 1977

Class 3, Cr. 3

Tue-Thurs 2:30-3:45



Description: Remote sensing is defined and the scope of engineering related problems are discussed. Data handling and analysis topics include software design, classification algorithms, image preprocessing, overlay and enhancement. Multispectral scanner systems, detectors and field instrumentation are discussed in the physical measurements portion of the course. Guest lectures on applications in agriculture, forestry, geology and water resources. Students will have an opportunity to gain experience analyzing LANDSAT Satellite and field measurement data.

Objectives: To introduce senior electrical engineering and graduate students from all areas to the interdisciplinary area of remote sensing. Topics covered in the course are based on the areas in which electrical engineers are presently interfacing with remote sensing activities. Upon finishing the course students will know the capabilities and limitations of current remote sensing instrumentation systems and data analysis programs. The course will prepare students for work in research or operational aspects of remote sensing.

Prerequisites: EE301, 302, 402 or graduate standing

### Outline

	Topics	Weeks
I.	OVERVIEW OF REMOTE SENSING	1
II.	DATA HANDLING AND ANALYSIS	4
III.	PHYSICAL MEASUREMENTS IN REMOTE SENSING	4
IV.	MEASUREMENT LIMITATIONS, DATA CALIBRATION	4
V.	APPLICATIONS (special lectures)	1

For further information contact Professor Lindenlaub

EE 348C                      Ext. 39467  
LARS                              Ext. 2052



INFORMATION NOTES

070676

Determining Land Use Patterns Through Man-Machine Analysis of LANDSAT Data . . . A Tutorial Simulation  
by S. J. Kristof, J. D. Russell, T. K. Cary,  
B. M. Lube, and R. A. Weismiller.

The tutorial simulation is a detailed step-by-step description of the typical steps in the analysis of remotely-sensed data for determining land use patterns. The simulation uses numerically-oriented pattern recognition techniques and emphasizes the respective roles of the analyst and the computer in the analysis process. The decisions made by an analyst and their rationale are described. The various computer processing functions are also explained. The steps are documented with illustrations and an example analysis from the Texas Coastal Zone. The reader can check his mastery of the concepts after each section through self-check evaluations.

The research reported in this paper was sponsored by NASA under NASA Contract No. NAS9-14016.

110976

An Empirical Study of Scanner System Parameters by  
D. A. Landgrebe, W. Simmons, and L. Biehl.

The selection of the correct combination of parametric values (instantaneous field of view, number and location of spectral bands, signal to noise ratio, etc.) of a multispectral scanner is a complex problem due to the strong inter-relationship these parameters have with one another. In this paper the results of an empirical study using the proposed Thematic Mapper parameters are presented. The results obtained shows that as the IFOV is decreased, classification accuracy declines slightly but mensuration accuracy improves, among other conclusions.

The research reported in this paper was sponsored by NASA under NASA Contract No. NAS9-14016.



111076

Systematically Disseminating Technological  
Information to Potential Users by J. D. Russell.

The article describes the activities of the Technology Transfer program area at LARS. The Matrix of Instructional Materials is presented and each of the types of instructional materials used is described briefly. The instructional development sequence for educational materials is also presented.

The research reported in this paper was sponsored by NASA under Contract No. NAS9-14016.

# SYSTEM SERVICES

December 22, 1976

## INFORMATION EXCHANGE SESSION

- \* HOWARD GRAMS and BILL SIMMONS conducted the third in their continuing series of informal information exchange sessions on November 18. The session was quite brief since the turnout was limited to just six people. In response to questions, we had a discussion about the current status of the Varian plotter, the table digitizer, and the PDP-11. (See the LITER section below for an up-to-date summary.) We also had a brief discussion of \*IMAGEDISPLAY and the experimental version of it.

Being the undaunted souls we are, we are assuming that the poor turnout for the November session was due to poor advance notice and to factors beyond everyone's control (such as pressing deadlines for other work), and we are still planning the next such session for late January. Watch for an announcement in the January "Scan Lines".

## FLEXLAB2 HARDWARE CHANGES

- \* On or about January 10, computer users at Flexlab2 will notice that the 2501 card reader located near the digital display will be removed. In addition, we are also returning one of the two 1403 printers and its control unit to IBM. These changes are the culmination of the planned group of changes that saw the two Data-100 machines installed some months ago, since the Data-100 at Flexlab2 was intended to functionally replace the extra card reader and printer. Completing these planned changes will stem the current flow of red ink by approximately \$1500 per month.

## LITER DEVELOPMENT STATUS

- \* We continue to make progress in our work on the development of Phase I of the LARS Intelligent Terminal for Earth Resources. The major progress during the past month has been that the Version 0 software for the table digitizer has been completed and is ready for initial use by intrepid users, and that the Varian printer/plotter hardware has at long last been rendered useable for program testing and development work

(although it cannot yet operate in its most efficient mode).

First, concerning the table digitizer: Its current software support is immediately useful to persons who have time and inclination to write some software of their own on either the 360 or the PDP-11 to process the digitized data. If you are interested in that kind of possible use of the system, you are encouraged to talk to HOWARD GRAMS. As work on LITER progresses, we will be building on our current software to come up with various software that is more user-oriented instead of programmer-oriented. We already have some ideas and suggestions - if you have any more, they are quite welcome. (As a minor matter of interest, we have encountered some digitizer hardware problems - dead spots - that should be taken care of by the time this is published. The manufacturer is familiar with the problem, and is sending appropriate parts.)

Concerning the printer/plotter: The machine is completely operational as a line printer for the PDP-11 (one of our milestones), and can of course print files passed from the 360 if needed in a particular case. The hardware is not operating in its most effective mode for plotting, but this is not hindering our software development any longer. Test programs for the line and vector plotting routines are now running; work continues on overlaying them and further refining them to make them available to LARS programmers. We are equally hard at work on our gray-scale plotting software. However, this much more involved work has not yet progressed to the "visible example of progress" stage.

## DIGITAL DISPLAY

- \* The problem of unevenly developed color Polaroid photographs has been traced to weak film holder rollers. Rollers have been replaced in one Polaroid film holder. This holder is marked "For Color Film". Rollers for the other holders are on order. Black and white Polaroid film does not seem to be affected by worn rollers. Also we have found that excess film developer on the film holder rollers tends to adversely affect subsequent Polaroid color photographs. Therefore, it is highly recommended that users wipe rollers clean with a damp paper towel before loading each Polaroid film pack.

A procedure check list for operating the cameras has been posted on the Digital Display bulletin board. The check list will be helpful if the photocopy unit is new to you or if it has been some time since you have used it.

## SUMMARY OF 360/67 COMPUTER USE FOR NOVEMBER 1976

\* Usage of the computer system during November was up by 12% from October, but it was down by 12% from the use during November a year ago.

We present the usual summary of possibly interesting statistics:

<u>Overall Usage</u> - Basic Rate CPU time used	14.22 hrs. (10%)
Priority Rate CPU time used	128.10 hrs. (90%)
Total CPU time used	142.33 hrs. (100%)
Terminal Sessions	3353
Batch Jobs	980

<u>Batch Machines</u> - <u>Batch Machine</u>	<u>Jobs Run</u>	<u>Avg. Clock Time</u>	<u>Avg. CPU Time</u>
BATQUICK	180	1.9 min.	0.1 min.
BATSHORT	437	7.8 min.	0.8 min.
BATMED	181	26.8 min.	5.3 min.
BATLONG	182	21.0 min.	4.7 min.

<u>Local &amp; Remote Terminals</u> - <u>Location</u>	<u>Cards Read</u>	<u>Lines Printed</u>	<u>Cards Punched</u>
FLEXLAB2	5448 (1%)	427436 (98%)	2692 (1%)
FLEXLAB1	46637 (10%)	391676 (86%)	18543 (4%)
Houston	21427 (13%)	138541 (83%)	7680 (5%)
ISU	45362 (22%)	152180 (75%)	4542 (2%)
Wallops	223 (6%)	3730 (93%)	39 (1%)

<u>Keyboard Terminals</u> - <u>Location</u>	<u>Port</u>	<u>Terminal Type</u>	<u>Logins</u>	<u>Total Time in Use</u>	<u>Avg. Time Per Session</u>
Comp. Room	78	2741	164	66 hrs.	0.40 hrs.
Flexlab2	7B	Hazeltine 1200	242	183 hrs.	.76 hrs.
Flexlab2	7C	Hazeltine 2000	258	196 hrs.	.76 hrs.
Flexlab2	7D	2741	178	104 hrs.	.58 hrs.
Flexlab2	7E	Infoton GTX	376	226 hrs.	.60 hrs.
Flexlab2	7F	Hazeltine 1200	264	181 hrs.	.69 hrs.
Flexlab1	80	Infoton GTX	268	196 hrs.	.73 hrs.
Flexlab1	81	Hazeltine 1200	216	167 hrs.	.77 hrs.
Flexlab1	85	2741	191	104 hrs.	.54 hrs.
Flexlab1	86	2741	193	139 hrs.	.72 hrs.
Dial-Up	8D	First in Use	33	38 hrs.	1.15 hrs.
Dial-Up	8E	Second in Use	5	3 hrs.	.57 hrs.
Houston	91,92,93	(various)	246	394 hrs.	1.60 hrs.
Wallops	94	2741	1	0.2 hrs.	.17 hrs.
ISU	99	2741	268	143 hrs.	.53 hrs.