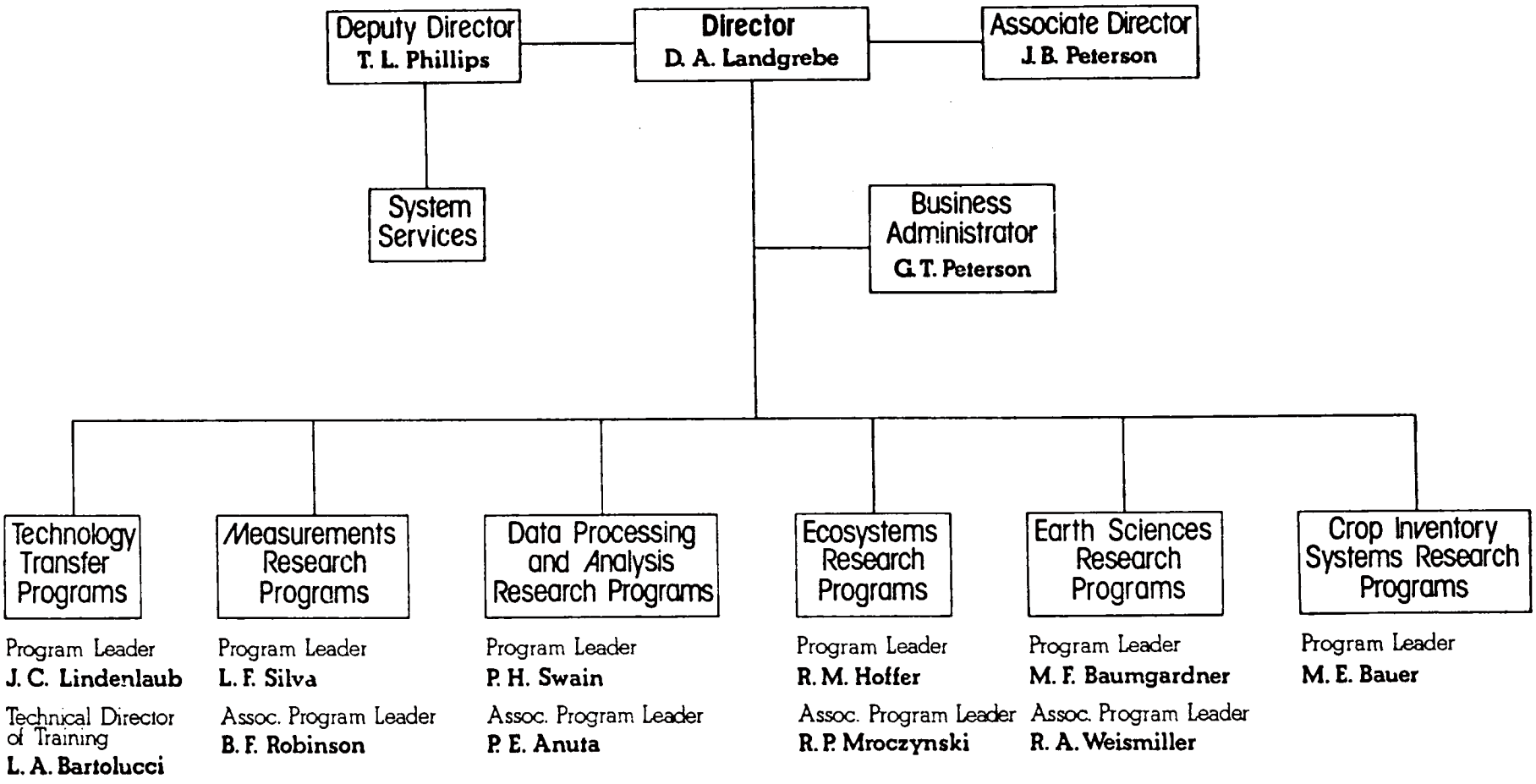
LARS Publication 042779

Purdue/LARS Organization



Organization of the Laboratory for Applications of Remote Sensing

The Laboratory for Applications of Remote Sensing

The Laboratory for Applications of Remote Sensing (LARS) is a research laboratory within Purdue University focusing the University's resources on development of improved techniques for analyzing earth resource information. An interdisciplinary staff from various departments within the schools of agriculture, engineering, and science compose the LARS team. Over the Laboratory's thirteen year history, this team has been responsible for many of the developments in remote sensing technology.

Purdue/LARS' activities include conducting research, developing technology, and training people in the use of quantitative remote sensing systems. Such systems utilize the tremendous data volumes now available from instruments aboard high flying aircraft and earth-orbiting satellites.

Research interests at LARS center on the development of remote sensing technology and its applications including: expanding understanding of earth surface features and their spectral properties; developing quantitative remote sensing analysis systems, increasing the ability of computers to assist the analyst in remote sensing analysis; and applying newly developed analysis systems to specific earth resource problems.

LARS is in an exceptionally favorable position to serve as a training center as well as a research institution by virtue of: its position as an integral part of a broad-based, top-level university; its organizational structure; its interdisciplinary approach; and its breadth and depth of experience in remote sensing research and applications. Being closely integrated into the university structure, the Laboratory is able to attract outstanding scientists to its program.

LARS Organization

A key to the interdisciplinary research efforts at LARS is the Laboratory's organizational structure shown on the cover page. The six major program areas have specific responsibilities for conducting research within their area while coordinating with and supporting each other. This design provides much greater opportunity for flexibility in programming and forming compatible teams to research specific problems than is usually possible in the normal university organizational structure. The Program Leaders, led by the Directors plan and coordinate all technical activities at LARS.

Technology Transfer programs have an overall aim of transferring remote sensing technology from the research laboratory to the technology's potential users. Emphasis is placed on conveying an understanding of both the principles and fundamental concepts supporting the technology and the methodologies developed for using it. Educational and training programs have been developed to achieve these aims, and educational materials have been created in their support. Many of these materials are used in other remote sensing educational programs in this country and abroad.

Work carried out by this program area has contributed significantly to the broader understanding of remote sensing technology. Some of the most significant contributions include:

* Development of a one-week short course on Remote Sensing Technology and Applications offered monthly. Since 1972, more than 400 people representing over 200 organizations have attended.

* Development of a one-week short course on Advanced Topics in the Analysis of Remote Sensing data; offered annually in recent years.

* Development of a Visiting Scientist Program serving individuals or groups of scientists who visit LARS for extended periods of time to learn and evaluate digital analysis. Since 1973, over 86 visiting scientists from 28 countries have benefited from this program.

* Evolution, maintenance, and educational support of a remote terminal system that allows subscribers direct access to LARS' Earth Resources Data Processing System and data library. Approximately 1000 individuals have received training and applications experience through this system.

* Development of 19 multi-media educational modules on the Fundamentals of Remote Sensing. Since their availability in July 1976, over 50 complete sets and 550 individual modules have been distributed.

* Development of printed educational materials ranging from single-concept introductory brochures, through simulation and case study exercises.

Current program interests include:

* Extending analysis capabilities to additional users at costs and levels commensurate with their needs and resources.

* Research in the processes and effects of technology transfer concentrating on how to best achieve educational goals and on the social, political and economic implications inherent in the technology transfer process.

* Increased refinement and extension of existing educational programs to reach more potential users more effectively.

* Extending the effectiveness of the educational materials through evaluation of their current usefulness and addition to the existing body of materials as needs become evident.

The mission of Measurements Research is to investigate the relationship of the measureable radiation characteristics of crops, soils, and other earth surface features to their biological, physical and chemical properties and to interpret and organize data for remote sensing research.

The major accomplishments of Purdue's measurements research activities have been:

* The development and implementation of a high resolution spectral data acquisition system (.4 - 14 μm) for field research in remote sensing. This system has gathered high quality data for nine years of successful field research (1970 - present).

* The technical direction of the spectral data acquisition activities of the NASA Large Area Crop Inventory Experiment (LACIE). This responsibility included coordinating the acquisition of calibrated spectral data for spectrometers mounted on trucks and helicopters, and for airborne multispectral scanner data. The experiment was conducted from 1974 to 1978 at sites in Kansas, North Dakota and South Dakota which typified the wheat producing areas of the Great Plains of the United States.

* The development of a data access facility which enables researchers to analyze the relationships between the spectral characteristics of thousands of high-resolution spectra and extensive concurrent agronomic data gathered during the LACIE Field Measurements Project. The data analysis software designed for this data bank enables researchers to obtain and analyze data and present results with significant efficiency. This analysis capability and the organized storage of calibrated and registered data with accurate descriptive agronomic characterization is a major milestone in field research for remote sensing.

Major areas of interest for measurements research activity include:

* Acquiring spectral and ancillary data in support of programs of remote sensing research.

* Conducting research on sensory related problems and accessing their impact on data quality and multispectral data processing.

* Conducting research on improved methods of data acquisition including data verification, data calibration, data correlation, and development of new and improved instrumentation.

* Conducting research on the application of remote sensing technology to situations outside the earth resources arena, such as biomedical applications.

* Conducting research on the basic characteristics of remotely sensed data and developing analytical procedures for data from new sources.

Data Processing and Analysis Research programs focus on research in the development and application of computer processing techniques for remote sensing data. Of interest are preprocessing methods which improve the radiometric and geometric quality of the data; analytical processes which extract information

from the raw or preprocessed data; and methods for storage and retrieval of both data and analysis results to facilitate their effective utilization.

Data processing research conducted at LARS has produced significant advancements of the quantitative remote sensing technology. Some of these include:

* Application of pattern recognition and related techniques for the analysis or multispectral data.

* Evolution of the LARSYS software system for effectively interfacing the user with the remote sensing data and computer-implemented analysis tools.

* Development of techniques for precision geometric correction and registration of multisensor and multitemporal data.

* Development of multiclass feature selection techniques for determining most effective subsets of available scene measurements.

* Modeling of sensor system response characteristics and use of these models for resolution enhancement.

* Application of clustering methods for unsupervised classification.

* Development of a system for scene segmentation and maximum likelihood "object" classification.

* Application of sampling techniques in remote sensing to produce precise and unbiased estimates of areal coverage by crop types.

Current research interests of this program area include:

* Scene and sensor modeling for system performance prediction and design.

* Data base design for the digitization, integration, storage and retrieval of multitype remote sensing and ancillary data.

* Image processing techniques for data compression and image enhancement.

* Advanced pattern classification/recognition methods for extraction of spectral, spatial and temporal information from remote sensing data.

* Development of special system configurations and architectures for increasing the effectiveness and efficiency of both interactive and automated image processing techniques.

Ecosystems Research programs involve both research and application activities directed toward the utilization of remote sensing technology for natural resource inventories. Emphasis is placed upon development of capabilities to identify, map, tabulate, and characterize selected land use (non-urban), forest, wild land, and water resource information. Much research is directed at testing and refining various computer-aided analysis techniques. The interpretation of data derived supplemental sources, such as color infrared photography or measurements obtained in the field, is stressed in order to better understand the scene characteristics and to define more effective man-machine interactions for analysis of remotely sensed data.

Major accomplishments of the ecosystems research group include:

* Demonstration of the utility of machine implemented analysis of satellite data for forest and wild land resource inventories.

* Development of the capability to produce traditional line maps (as opposed to pictures or type maps) for representing results of digital classifications.

* Development of a means for a statistical evaluation of classification accuracy in wild lands analyses.

* Augmentation of digital data with slope, aspect and elevation information for machine analysis of forest, snow cover, and wild land resources.

* Development of a three dimensional thermal mixing model for water which may be used in conjunction with remotely sensed data.

* Development of a topographic model incorporating slope, aspect, elevation and satellite data for forestry inventory research.

* Multitemporal classification and change detection techniques applied to satellite data for forestry, wild land, snow cover and water resource analysis problems.

Ecosystems research interests continue to center on the use of remote sensing technology to aid in the identification and management of natural resources:

* Development of new and improved methods for incorporating ancillary information such as slope, aspect, elevation, water shed, etc., into the decision criteria for analyzing forest, wild land, and water resources.

* Identifying and demonstrating the usefulness of remote sensing technology for monitoring certain ecological habitats and their conditions.

* Improving the ability of natural resource managers to use the results of remote sensing technology by developing means to

present those results in a traditional, already understood manner and by integrating the technology into already existing information systems.

* Applying the technology to various natural resource problems under varying conditions to demonstrate its usefulness to specific natural resource problems.

* To help resource managers learn and evaluate the benefits of remote sensing technology.

Earth Sciences Research programs include studies of the multispectral characteristics of soils and geologic features and the application of spectral information in surveying earth resources and in monitoring sequential changes in the quantity and quality of these resources. The long range objective is to develop techniques in which digital analysis of multispectral data may be used as a basic tool for soil survey, identification and assessment of soil degradation, land use capability mapping, potential soil productivity mapping, mineral resources investigations, geologic mapping, and land cover mapping.

Accomplishments in the earth sciences research programs include:

* Spectral delineation of soil boundaries from aircraft scanner data.

* Demonstration of relationship between quantitative reflectance measurements and the organic matter content of surface soils.

* Initial field measurement of spectral properties of soils.

* Land use inventory of 34 million hectares in the U.S. portion of Great Lakes Watershed by digital analysis of Landsat data.

* General soils map of White County, Indiana produced by visual analysis of Landsat simulated infrared color composite.

* Established middle infrared as superior to other reflective wavelengths for delineating soil differences.

* Successful geologic mapping at scales of 1:250,000 to 1:100,000 of the Bagdad and Zagros Mountain regions in Iraq and the Desaguadero Area in Bolivia using digital analysis of Landsat Data.

* First use of multisource data, Landsat spectral measurement and geophysical data to enhance anomolies associated with mineralization.

* First use of ancillary data with Landsat data for stratification and delineation of soil differences.

* First county survey (Jasper County, Indiana) of detailed soil differences (1:15,840) using digital analysis of Landsat MSS data.

Current areas of interest include:

* Implementing the use of spectral delineation of soil differences in operational soil surveys.

* Establishing the relationships between spectral map units and soil/plant community differences.

* Determination of the spectral and physical/chemical properties of soil.

* Use of multitemporal Landsat analysis to monitor land degradation (desertification, salinization, water erosion, laterization, accelerated leaching, etc.).

* Use of multidata sources to study geologic mineralization.

* Development of innovative methods of using Landsat multispectral scanner and appropriate ancillary data to create land cover maps.

The overall objective of the Crop Inventory Research at Purdue/LARS is to research, develop and test procedures for obtaining crop production information using remotely sensed spectral measurements, together with meteorological, soils, and ancillary data. The specific objectives are to:

* Determine relation of fundamental crop parameters (maturity stage, leaf area, biomass, moisture status, stress effects, canopy geometry, and grain yield) to reflectance and radiant temperatures of crops.

* Understand and quantify the effect of cultural and environmental factors on the spectral-temporal characteristics of crops.

* Develop methods to assess crop condition and predict crop yield using spectral, meteorological soils and ancillary data.

* Develop and test procedures, including sampling, stratification, training, and classification, for using satellite data to estimate the area of crops.

Significant research accomplishments during the past decade at LARS which have contributed to the capability to inventory crop production using remotely sensed data include:

* Apollo IX Experiment: Demonstrated feasibility of crop identification from space data.

* Corn Blight Watch Experiment: Prototype crop information system based on remote sensing which provided an integrated test of all system components.

* Landsat Investigations: Development of methodology, including sampling, stratification, and training procedures, for using Landsat MSS data to make accurate and precise crop area estimates.

* LACIE Field Measurements: A comprehensive set of multidate, multisensor spectral, agronomic, and meteorological data was acquired and processed.

* Crop Spectra Analysis: Relation of key agronomic variables, including growth stage, leaf area index, biomass, and plant water, to the reflectance of wheat canopies quantified.

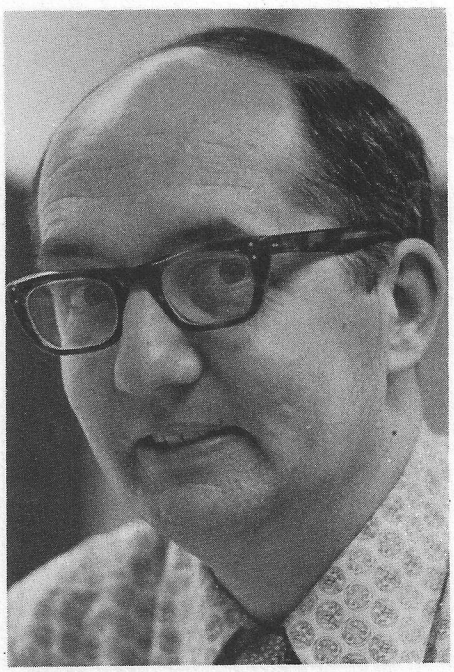
Current areas of research interests include:

* The crop inventory and measurements program areas in cooperation with NASA and USDA, are acquiring and processing fully annotated and calibrated multitemporal sets of spectral measurements augmented with agronomic and meteorological data. This data base is being used to quantify and model the temporal-spectral characteristics of crops, defining future sensor systems, and developing advanced data processing and analysis techniques.

* Development of crop condition and yield prediction models which utilize spectral data, together with meteorology and soils data.

* Development of stratification, sampling, and training techniques for crop production forecasts based on classifications of satellite data.

* Definition of sensor systems requirements and information extraction procedures for identification and assessment of crops.



David A. Landgrebe

Director of LARS and Professor
of Electrical Engineering

B.S., M.S., and Ph.D. Electrical Engineering, Purdue University. He has held positions at Bell Telephone Laboratories, Interstate Electronics Corporation and Douglas Aircraft Company. He is engaged in research in data representation and analysis and teaches advanced courses in Electrical Engineering. He has been active in the field of remote sensing since 1965. Dr. Landgrebe served on the 1967-1968 National Academy of Sciences Space Applications Study, and the Academy's Committee on Remote Sensing Programs for the Earth Resources Survey (CORSPERS).

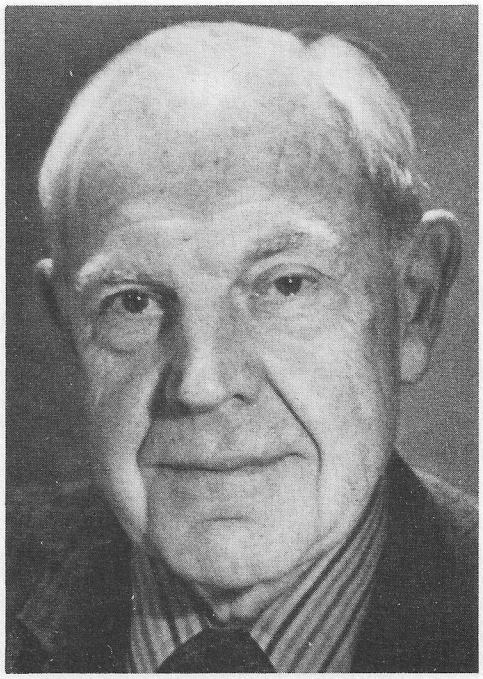
In 1975 he served as Chairman of the NASA Working Group to define the system parameters for Thematic Mapper, a satellite multispectral scanner for the 1980's.

In 1973 he was awarded NASA's Exceptional Scientific Achievement Medal for "his outstanding contributions to the space program." He is a member of Tau Betta Pi, Eta Kappa Nu, Sigma Xi honoraries, the American Association for the Advancement of Science and the American Society for Engineering Education and a fellow of the Institute of Electrical and Electronic Engineers. He is also a member of the Editorial Board and Associate Editor of the journal, Remote Sensing of Environment, and a member of the Administrative Committee of the IEEE Geoscience Electronics Society.

As Director of LARS, Dr. Landgrebe is responsible for the overall management of the Laboratory and its relations with all academic units. He is the Principal Investigator of several of the Laboratory's grants and contracts. His research activities are with regard to the relation of sensor system parameters to the information extractive (data analysis) process.

John B. Peterson

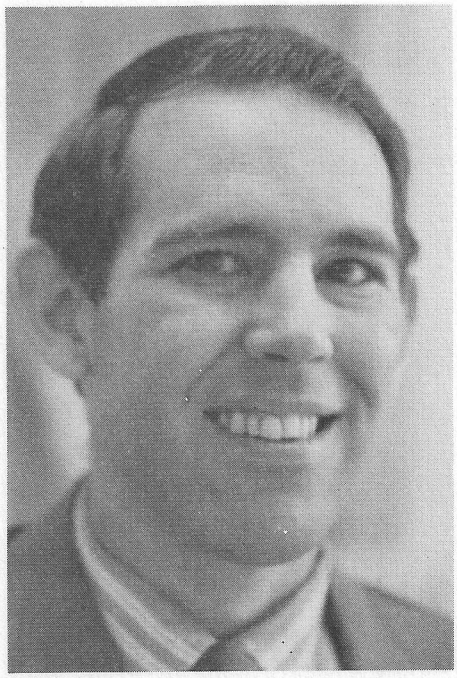
Associate Director for
Administration of LARS



B.S., Oregon State University, M.S. and Ph.D., Soil Science, Iowa State University; National Research Foundation post-doctoral fellowship in geology at the University of California, Berkeley. He received the American Society of Agronomy's Soil Science research award in 1948 and Service Award in 1978 and was president of that society in 1958. From 1948 to 1971, Dr. Peterson was Head of the Purdue University Agronomy Department, directing plant and soil science, meteorology and land use. He has served as a consultant on administrative problems in research and education for the FAO, the Rockefeller Foundation, the Ford Foundation and the InterAmerican Development Bank in Latin America, for the Greek Government and for the United States/Saudi Arabian Joint Commission for Economic Cooperation in Saudi Arabia. His major research interest is the estimation of the moisture tensions of soils from their spectral data. He is a member of the Soil Science Society of America, American Society of Agronomy, Western Society of Soil Science, the Soil Conservation Society of America and Sigma Xi.

Dr. Peterson assists the Director in the management of LARS, particularly in the supporting services and applications areas. He also conducts research in the use of remote sensing in studying problems of soil mapping and land use.

Terry L. Phillips



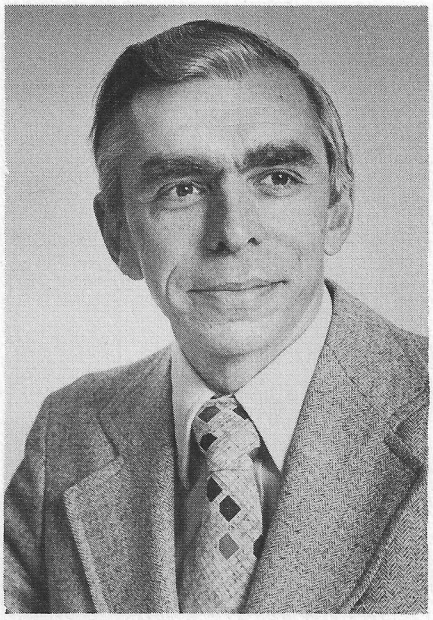
Deputy Director of LARS

B.S., M.S., Electrical Engineering, Purdue University. He has held positions at Purdue University in the Electrical Engineering Department, National Cash Register Company and the U.S. Navy. He has been a consultant to the Computer Science Corporation, U.S. Geological Survey, Iowa Geological Survey and the Colorado Intergovernmental ADP Council. He is engaged in the development of data handling and processing systems. He has been active in the applications of these systems for Remote Sensing since 1966. In 1976 he was recognized by NASA for the creative development of technology. He is a Senior Member of the Institute of Electrical and Electronics Engineers, and a member of the Association for Computing Machinery, Tau Beta Pi and Eta Kappa Nu societies.

EARTH RESOURCES DATA PROCESSING SYSTEM

Mr. Phillips' major contribution at LARS has been toward the development of the Earth Resources Data Processing System which serves Purdue as well as a number of remote terminal sites. Mr. Phillips designed the hardware, software, and data bank concepts for this system. His leadership is responsible for the LARSYS software documentation which has received world-wide recognition from the remote sensing community. As Deputy Director of LARS, Mr. Phillips is responsible for technical and administrative direction for the Laboratory. He is principal investigator of several of the Laboratory's contracts and contributes to many others primarily in the area of system design.

John C. Lindenlaub



Program Leader for Technology Transfer
at LARS and Professor of Electrical
Engineering

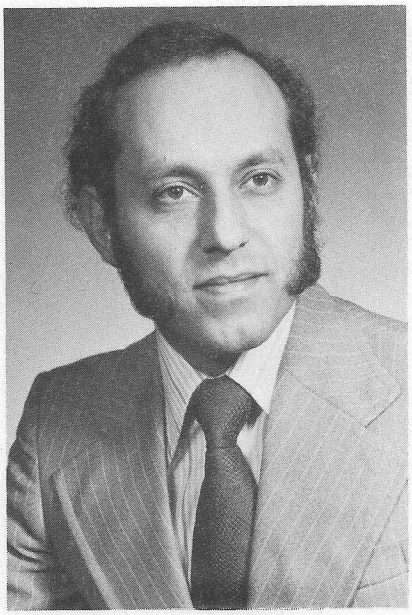
Dr. Lindenlaub joined the LARS staff in 1969. Prior to that time, his research interests were in the area of statistical communication theory. Dr. Lindenlaub worked in the data handling and analysis area at LARS until June 1974 when the Technology Transfer program area was formed. He is active professionally having held offices in the Education Research and Methods Division of the American Soicety of Engineering Education and the Education Group of the Institute of Electrical and Electronics Engineers.

TECHNOLOGY TRANSFER

The Technology Transfer program area at LARS has general responsibility for the development of education and training materials and conducting training programs to further remote sensing research and aid in the transfer of the technology from the research arena to the applications arena. Materials development programs include development of the Focus Series, minicourses on the fundamentals of remote sensing, specialized educational packages, such as the LARSYS Educational Package, and case studies. Operational programs include intensive short courses, symposia and the Visiting Scientist program.

Luis A. Bartolucci

Technical Director
Training Programs



B.S., M.S., and Ph.D. in Geophysics from Purdue University. Dr. Bartolucci has been involved in Remote Sensing research since 1969. He has played an active role in the development of remote sensing technology for applications in the area of water resources and has also made outstanding contributions in the field of thermal infrared radiation for remote sensing applications. In addition, Dr. Bartolucci has served as consultant to the U.S. Information Agency, the U.S. Agency for International Development, the Inter-american Development Bank and to several Latin American development agencies. He has been Principal Investigator and Project Director of several domestic and international research and training programs involving computer-aided processing and analysis of remotely sensed data for earth resources inventories.

Dr. Bartolucci is responsible for the LARS educational and training programs. His primary research interest involves the application of remote sensing techniques for water quality assessment and snow cover mapping, spectral signature mixing problems, topographic influence on the spectral response of ground cover types, calibration of Landsat MSS data, and the design of integrated information systems for developing countries.

LeRoy F. Silva

Program Leader for Measurements Research at LARS and Professor of Electrical Engineering

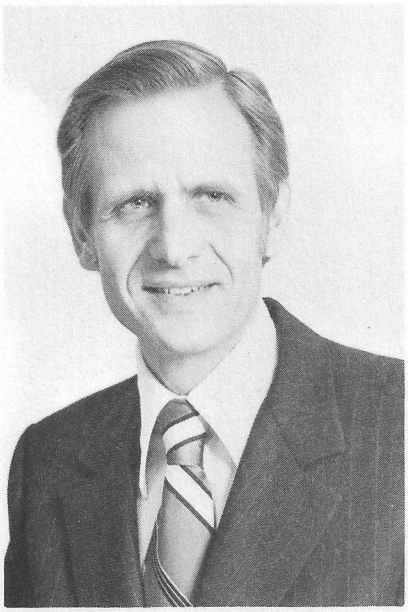
B.S.E.E., Purdue University; M.S.E.E., Massachusetts Institute of Technology; Ph.D., Purdue University. He has been employed by Lincoln Laboratories; Ballistic Research Lab, Aberdeen Proving Ground, Maryland; and C P Electronics, Inc., Columbus, Indiana. He has also been a consultant in electronics and magnetics to several companies. Dr. Silva has been associated with LARS since 1969, and has published in the areas of electronics, magnetics, optics, bioengineering and remote sensing. He is a member of Eta Kappa Nu and Sigma Xi honoraries, and of the Institute of Electrical and Electronic Engineers (Senior Member) and the National Society of Professional Engineers and the American Association for the Advancement of Science. He is a Registered Professional Engineer, State of Indiana.

MEASUREMENTS RESEARCH IN REMOTE SENSING

Measurements research is concerned with the physics and optics of natural materials and their effects on the spectral, spatial and temporal variability of remotely sensed data, as well as with the details of remotely sensed data acquisition. LARS has developed sophisticated field and laboratory instrumentation systems for remote sensing research and has helped broaden the fundamental understanding of the spectral properties of natural meterials. Dr. Silva has been involved in both the theoretical and laboratory/field aspects of this research.

Barrett F. Robinson

Associate Program Leader of
Measurements Program Area



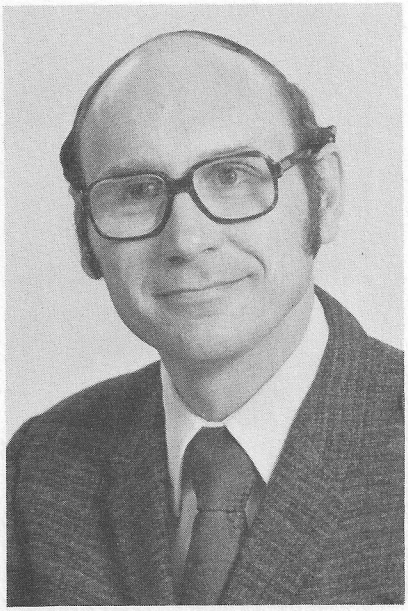
B.S. in Electrical Engineering and M.S. in Mathematics from Purdue University. He is a senior research engineer in the School of Electrical Engineering at Purdue where he serves as coordinator of the undergraduate laboratory program and teaches electronics and systems laboratory courses. His university experience includes an NSF Fellowship and three years as a graduate research assistant in electrical engineering at Purdue. He is a member of the Institute of Electrical and Electronics Engineers and serves as a consultant in electronics and electro-optics.

A FAST SCAN WIDE RANGE FIELD SPECTRORADIOMETER

Mr. Robinson participated in the design and directed the implementation of a field spectroradiometer system featuring the ability to produce and process calibrated digital data obtained from subjects insitu in agricultural fields, thus achieving the long time goal of LARS researchers. His other activities include the development of instruments for radiometric field calibration and directing the acquisition of radiometric ground truth data for LARS projects and experiments. He served as aircraft coordinator for the Skylab Wabash River Basin Test Site during 1974. He has had a key role in the LACIE Field Measurements Project in defining and directing the spectral data acquisition by Purdue and NASA/JSC.

Philip H. Swain

Program Leader for Data Processing and Analysis Research at LARS; Assistant Professor of Electrical Engineering



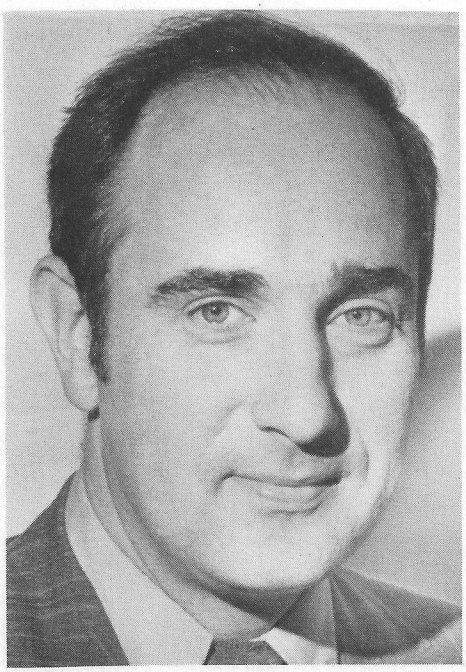
Philip H. Swain (B.S.E.E., Lehigh University, 1963; M.S.E.E., Purdue University, 1964; Ph.D., Purdue University, 1970) is Assistant Professor of Electrical Engineering at Purdue University and Program Leader for Data Processing and Analysis Research at Purdue's Laboratory for Applications of Remote Sensing (LARS). He has been employed by Philco-Ford Corporation and Burroughs Corporation and served as a data processing consultant to Allison Division of General Motors, Bendix Corporation, Midwest Applied Sciences, the National Aeronautics and Space Administration (NASA), and the Universities Space Research Association.

Dr. Swain has been associated with LARS since 1966. His research interests are in the areas of pattern recognition theory and applications as well as the application of advanced computer processing techniques to multispectral remote sensing data. He is coauthor and coeditor of the textbook Remote Sensing: The Quantitative Approach, McGraw-Hill, 1978. Dr. Swain is a member of Phi Beta Kappa, Tau Beta Pi, Sigma Xi and Eta Kappa Nu honoraries, the Institute for Electrical and Electronics Engineers, the Pattern Recognition Society, and the American Society of Photogrammetry.

PATTERN RECOGNITION AS A BASIS FOR REMOTE SENSING DATA ANALYSIS

Pattern recognition is well suited for processing large quantities of data with minimal human involvement, which makes it an ideal approach to the analysis of multispectral remote sensing data. Since its inception, LARS has developed its computer-based data analysis system, LARSYS, with pattern recognition techniques as the central focus. Over the years, Dr. Swain has made significant contributions to both the theory and practical application of pattern recognition and has played a major role in the evolution of LARSYS.

Paul E. Anuta



Associate Program Leader for
Data Handling Research

B.S., Electrical Engineering, Purdue University; M.S.E.E., University of Connecticut; M.S., Computer Science, Purdue University. As an employee of the IBM Federal Systems Division he investigated hybrid computer applications and conducted guidance and control systems analysis and software design activities for missile and spacecraft computers. Mr. Anuta joined the LARS staff in 1967, and has designed data handling systems for a multispectral aircraft scanner system, interferometer spectrometer and other sensors. He is a member of the Institute of Electrical and Electronic Engineers, American Society of Photogrammetry, and of Tau Beta Pi and Eta Kappa Nu honoraries.

DATA PREPROCESSING

Mr. Anuta is responsible for research and evaluation of remote sensor data preprocessing techniques. Current key data handling research areas are image registration, geometric correction and resolution enhancement of satellite multispectral imagery. The goal of data handling research is to improve the form of the remote sensor data so as to enhance its utility for analysis and information extraction.

Roger M. Hoffer

Program Leader of the Ecosystems Research Programs, LARS, and Professor of Forestry, Department of Forestry and Natural Resources, Purdue University

B.S. in Forestry from Michigan State University, M.S. and Ph.D. in Watershed Management from Colorado State University. Dr. Hoffer has been involved full-time in remote sensing research and teaching since 1964, and was a co-founder of LARS in 1966. He teaches three different courses on Remote Sensing of Natural Resources, and has served as a principal investigator on Landsat, SKYLAB, and several other major remote sensing projects.

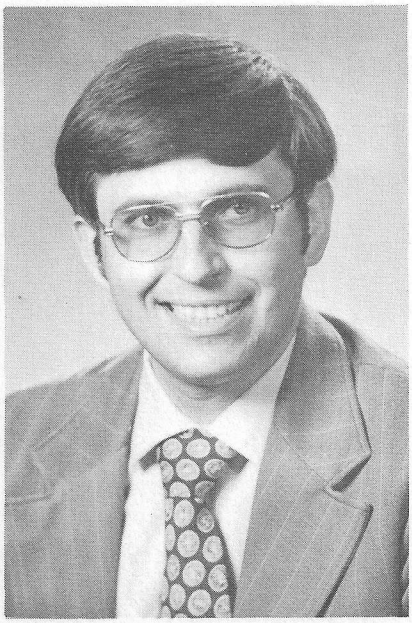
Over 100 scientific publications and papers on remote sensing have been authored or co-authored by Professor Hoffer, including invitational papers at international meetings in Austria, Brazil, Canada, Columbia, Japan, Norway, and the U.S. He has also spent several weeks as a remote sensing specialist in Brazil, Thailand, Afganistan, and Bolivia, in addition to talks and lectures on remote sensing in many other countries throughout South America, Southeast Asia, and Europe. He is a member of the Society of American Foresters, American Society of Photogrammetry (where he has served as the Associate Editor of "Photogrammetric Engineering and Remote Sensing" and as Director of the Remote Sensing and Interpretation Division), Sigma XI, XI Sigma Pi, and several other professional and honorary societies. He was the recipient of the 1979 Alan Gordon Memorial Award in Recognition of his pioneering work in the field of remote sensing, is a certified Photogrammetrist, is a member of the National Eagle Scout Association, and is listed in American Men and Women in Science.

SPECTRAL ANALYSIS AND MAPPING NATURAL RESOURCES

The focal point of Dr. Hoffer's research activities involves the interpretation and analysis of multispectral scanner data and color infrared photography, with particular emphasis on study of the spectral characteristics of various earth surface features. He has been instrumental in the development and use of computer-aided analysis techniques using multispectral scanner data, particularly for forestry, water resources, and land use applications. He believes that proper understanding and interpretation of the spectral characteristics of the various earth surface features is essential for effective analysis of remotely sensed data (in other words, "think spectral!").

Richard P. Mroczynski

Associate Program Leader for
Ecosystem Research Program

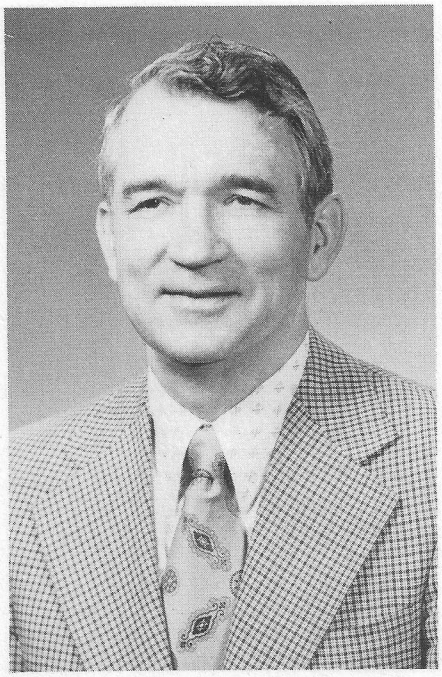


B.S.F. in Forest Production and M.S., Forestry, University of Illinois. He joined LARS in 1969 and has been involved with photo-interpretation and Landsat Analysis. He is a member of the Society of American Foresters, active in that organization's Working Group on Photogrammetry and Remote Sensing. In addition, he has served in various capacities with the American Society of Photogrammetry, and is a member of the American Forestry Association and American Management Association.

REMOTE SENSING AND NATURAL RESOURCES

Mr. Mroczynski is currently involved with projects dealing with the application of computer-assisted analysis techniques to resource inventory. His special interest is in identifying techniques to improve the flow of forest inventory information.

Marion F. Baumgardner



Professor of Agronomy and Program Leader
Earth Sciences Research Programs
Laboratory for Applications of Remote Sensing

B.S., Texas Tech University; M.S., Ph.D., Purdue University. The author of numerous scientific papers, Prof. Baumgardner serves frequently as a consultant to several international development agencies with assignments in Africa, Asia, Latin America, and Europe. He is a Danforth Associate and a Fellow of the American Society of Agronomy, the Soil Science Society of America and Indiana Academy of Sciences. Having traveled and lectured in more than 50 countries, Professor Baumgardner is active in a dozen national and international scientific societies. As a participant in the 1974 Summer Study of the National Academy of Engineering's Space Applications Board, he helped to define applications of space technology for the 1980's and 1990's. During his 1974-75 sabbatical year in Europe he was a visiting scientist and guest lecturer in many countries. He served on the National Academy of Sciences' Committee on Remote Sensing for International Development, is currently Chairman of the Agricultural Research Institute's Study Panel on Remote Sensing, and serves on the executive committee of the Working Group on Remote Sensing and Soil Survey of the International Soil Science Society.

A GLOBAL INFORMATION SYSTEM FOR MAPPING AND MONITORING EARTH RESOURCES

Professor Baumgardner's primary research interest lies in the relationships between the spectral characteristics and the physical/chemical properties of soils. In the practical applications of these relationships he is investigating the use of computer-implemented analysis of multispectral data to discover more rapid and better methods for assessing soil productivity and land use capabilities and for preparing soil surveys and land use inventories. He is greatly interested in and encouraged by the potential applications of a global information system in the developing nations for providing heretofore unavailable inventories of land, vegetation, water, and mineral resources. Since 1974 Prof. Baumgardner has been particularly active in using digital analysis of Landsat multispectral scanner data to map and monitor natural resources in arid and semiarid lands.

Richard A. Weismiller

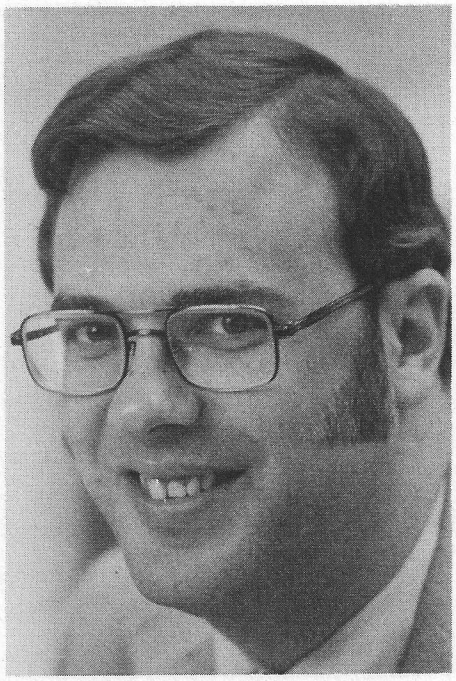
Associate Program Leader for
Earth Sciences Research Program

B.S., Agronomy, with Highest Distinction, Purdue University; M.S., Soil Mineralogy, Purdue University; Ph.D., Soil Chemistry-Clay Mineralogy, Michigan State University. He joined LARS in 1973 after four years as a Captain in the USAF, serving as a research scientist, Civil Engineering Research Division, Air Force Weapons Laboratory, Kirtland AFB, New Mexico. During August 1974-July 1975 Dr. Weismiller served as Acting Program Leader for Earth Sciences Research. He is a member of Phi Eta Sigma, Alpha Zeta, and Sigma Xi honoraries, the Soil Science Society of America, the American Society of Agronomy, the Clay Minerals Society, and the Soil Conservation Society of America. He is also listed in American Men and Women in Science. His publications are in the areas of remote sensing as related to soils and land use and infrared spectroscopy studies of clay minerals.

APPLICATIONS OF REMOTE SENSING TO SOILS AND LAND USE STUDIES

Among Dr. Weismiller's primary research interests are the relation of the spectral reflectance of soils to their physical and chemical properties and the application of remote sensing technology to soils mapping, land use inventories and change detection as related to land use. He is currently the principal investigator of a grant to cooperate with governmental agencies within the State of Indiana in the application of remote sensing technology to the solution of problems in resource management. Also Dr. Weismiller managed the Great Lakes Project which entailed computer-aided analysis of Landsat-1 multispectral data to prepare a current land use inventory of the 34,500,000 hectares within the U.S. portion of the Great Lakes watershed.

Marvin E. Bauer



Program Leader of Crop Inventory
Systems Research

With B.S.A. and M.S. degrees from Purdue University in Agricultural Economics and Agronomy and a Ph.D. from the University of Illinois in Crop Physiology, Dr. Bauer joined the LARS staff in 1970. He is a member of the American Society of Agronomy, Crop Science Society of America, American Society of Photogrammetry and several honorary societies. He is the author of 20 publications on the spectral characteristics of crops and the application of remote sensing technology to crop identification, area estimation and yield prediction.

He has had key roles in the design, implementation, and analysis of results of several major remote sensing projects including the 1971 Corn Blight Watch Experiment and the Crop Identification Technology Assessment for Remote Sensing Project. He has been the principal investigator of a recent LANDSAT investigation for crop identification and area estimation. Currently, he is the technical leader of field research being conducted to quantify and model the radiation characteristics of agricultural crops in relation to their agronomic properties.

CROP PRODUCTION INVENTORIES

At LARS, research projects are being conducted on the application of remote sensing to crop production surveys. One area of emphasis is the development and testing of computer-aided techniques for training, classification, and sampling LANDSAT multispectral scanner data for crop area estimation. A second area of emphasis is the development of an approach to crop yield prediction which utilizes remotely sensed multispectral measurements, as well as meteorological and soil productivity data. The investigations in both areas are supported by studies of the relationship of crop, soil, and meteorological variables to the spectral reflectance-emittance of crops using calibrated, multitemporal measurements from high resolution spectrometers.