123174

123174

SECOND QUARTERLY REPORT - 1974-75

Reporting Period: October 1, 1974 - December 31, 1974
Contract Number: NAS9-14016
Title of Investigation:

Research in Remote Sensing of Agriculture,
Earth Resources, and Man's Environment

Principal Investigator:

D. A. Landgrebe
Laboratory for Applications of Remote Sensing
Purdue University
West Lafayette, Indiana 47906

Submitted to:

NASA Lyndon B. Johnson Space Center
Applied Physics Branch
Attn: A. E. Potter, Mail Code TF3
Houston, Texas 77058
Mark for: Contract NAS9-14016

TABLE OF CONTENTS

INTRODUCTION

Following is a summary of the major activity and technical problems encountered in each of the task areas of Contract NAS9-14016 for the period October 1, 1974 through December 31, 1974.

I. LACIE Crop Identification

Major Activity. During the second quarter multitemporal classifications of the CITARS Fayette Co., Illinois segment were performed. The use of feature selection and the interpretation of clustering of multitemporal data were emphasize. The results will be reported with other CITARS results.

Technical Problems Encountered. No ERTS data from major wheat production areas was received until mid-November. Ground truth data did not accompany the ERTS data.

Future Activity. At the request of NASA/EOD this project was terminated October 31, 1974. The research planned on identification of wheat without *in situ* ground observations for training will not be conducted. Portions of the planned work on multitemporal classifications of wheat and stratification of ERTS scenes will be carried out under the re-defined spectral class definition project.

II. LACIE Crop Acreage Estimation

Major Activity. No major activity to report this quarter on this project. At the request of NASA/EOD, this project's resources were utilized in defining a field measurements research for remote sensing of wheat project.

Future Activity. This project was cancelled as of October 31, 1974 and the resources transferred to the newly defined Field Measurements project.

III. LACIE Yield Prediction

Major Activity. The major activities during this quarter were the completion of the Field Measurements project plan and collection of spectral and agronomic data at Garden City, Kansas on October 18-19 and November 5 and 7 with the Exotech field spectroradiometer system. The data collection missions were

highly successful (high quality data over a range of wheat and other targets was collected) and the data is being readied for analysis.

In addition, several other field and laboratory studies were performed. A large area collimated illuminator and related detector for making laboratory measurements on microscale canopy models has been completed. The equipment for constructing the microscale models has also been completed. Field spectral data on wheat canopies as a function of several agronomic variables related to yield has been acquired. Supporting measurement necessary to obtain parametric information for several canopy models has been obtained and reduced.

The optical depth of a corn canopy as a function of maturity was also measured using a specially developed technique. After the method is evaluated it will, if successful, be applied to wheat. The measurement was made on corn first since the method was developed after the Indiana wheat harvest. The data have been readied for processing and will be processed after appropriate software is completed.

Various models are being studied to determine relative ease of use and accuracy in spectral-temporal measurement of wheat yield. Ultimately one or two models will be selected for a detailed numerical evaluation using field and laboratory data acquired to date.

The data collected with the field spectroratiometer system during the past two summers on corn and soybeans is being analyzed. Data analysis procedures to be used for the Field Measurements project.

IV. LACIE CITARS

Major Activity. The major activity during the October-December quarter has been to summarize and interpret the classification results obtained during the previous quarter. Several possible causes for the rather low classification performance have been identified and we are attempting to quantify the effects of these factors. The limitations in performance are tentatively believed to be a result of a combination of the following factors: (1) lack of training data, (2) training procedure, (3) method of evaluation, (4) registration and geometric correction, and (5) ERTS data characteristics. The results of this analysis will be reported in our final report.

In addition, statistical analysis of the results is being conducted in cooperation with EOD and ERIM. Barbara Davis spent November 18-22 at JSC pursuing this task. Documentation of ERTS data preparation--reformatting, geometric correction, registration, and field boundary location is being completed.

It is anticipated that CITARS will be completed by December 31, 1974.

V. LACIE Spectral Class Definition

Major Activity. This quarter saw a thorough reassessment of project goals in this area commensurate with the evolving nature and needs of LACIE. A revised work statement was generated reflecting the newly defined emphasis on determining the extendability of training sets. The general approach shall continue to be through the application of cluster analysis to quantify scene variability, establish spectral strata, and define training classes.

A major requirement of this effort is the analytical definition and determination of "cluster distinctness". To this end, we have reviewed some techniques developed elsewhere for the purpose of automatically establishing the number of distinct clusters in a set of multispectral data, comparing these techniques with experimental methods developed at LARS. A decision is pending as to which specific technique to pursue further. In addition, the transformed divergence has been implemented as a cluster distinctness criterion in the LARSYS Cluster processor in order to evaluate its use in this manner. This criterion is likely to be more compatible with the Gaussian maximum likelihood criterion implemented in the LARSYS classifier than is the currently implemented "Swain-Fu distance".

Technical Problems Encountered and Proposed Solutions. The only serious problem encountered during this period was the lack of ERTS and ground truth data from LACIE test sites. ERTS data was received for Kansas in mid-November, but no ground truth data. This project will be hampered unless NASA supplies the ground truth as agreed.

VI. LACIE Image Registration

1. LACIE Registration - During the first quarter the major activity was implementation of an algorithm developed by Baudet of the Computer Sciences Corp. selected by NASA/Goddard for registration of the ERTS LACIE Wheat Site data. In the current quarter the algorithm was applied to ERTS MSS data from Hill Co., Montana for six ERTS times. Standard product correlation as used by LARS was applied to the same data and the results compared with the CSC results. The results agreed closely for these two methods. The location of the correlation peak was the same in 84% of the trails for the Montana data from May through August, 1973. This data demonstrated relatively high correlation (correlation coefficient above .5) for all time pairs except for May 5 versus July 16, which had a correlation coefficient of .47, which is still quite high. It is believed that any correlation scheme will work relatively well for image pairs having above 50% correlation. The basic concern of image registration research at LARS has been correlation of relatively dissimilar images, i.e. images for which the correlation coefficient is less than .5. This case has plagued image registration activities from the beginning of interest in registration. A preliminary conclusion on the CSC algorithm is that it will work satisfactorily for wheat site data having temporal correlation coefficients above .5, but its performance is unknown for cases for which correlation is less than .5.

Image preprocessing algorithms which are being implemented for comparative evaluation in addition to the CSC algorithms are: clustering, binary image transformation, and a boundary enhancement scheme using classified data. The goal of these studies is to find enhancement and correlation techniques which will work on blocks having lower correlation than .5 and which will provide greater accuracy for all levels of correlation.

Also, in the current period another test site was studied using product correlation of temporal data. The area is northwest Tippecanoe County, Indiana for four ERTS dates. This area offers a distinctly different scene type than Montana for comparative evaluation of the algorithms. Product correlation of channel and time pairs was completed. CSC and other correlation approaches will be applied to the site in the next quarter. The correlations found between three of the Tippecanoe County dates typically ranged from .66 between September 30, 1972 and October 19, 1972 to .28 between September 30 and November 24, 1972 data. This data demonstrates much lower temporal correlation than the Montana data and will pose better tests for registration algorithms under study.

The Information Note referred to in the last report, "Image Registration Error Variance as a Measure of Overlay Quality" by C. D. McGillem and M. Swedlow, Note 090274, is complete and submitted under separate cover. This theoretical derivation gives the lower bound on registration accuracy. An experimental verification of these results is planned.

2. Data Base Registration - The Data Base Registration project is divided into two tasks: A) Registration of ERTS LACIE data to an earth coordinate system, and B) Aggregation of ERTS data and ground truth data.

a. Registration to Earth Coordinates - This task is being pursued along the lines of optimum function specification for describing the relationship between ERTS image geometry and the earth coordinate system. The projective, four parameter, and biquadratic functions were compared for control points from a quarter frame size area and results indicate that the biquadratic gives better performance than the simpler functions, thus indicating the presence of higher order distortions in the ERTS MSS subframe. Work also continued by Mr. Anuta on a two-dimensional cubic spline approximation algorithm which is expected to be useful for accurately describing distortions over an entire frame. This work is expected to be completed and a report generated in the next quarter. The question of correlation of an ERTS image with a data base reference image to determine the initial 2 to 5 mile uncertainty in frame position has not yet been addressed.

b. Aggregation of ERTS and Ground Truth Data - The data type studied for interface was topographic data supplied by the Defense Mapping Agency. Digitized Topo. data from the Durango 1:750000 scale U.S.G.S. map was digitally registered using a modified LARS registration technique. The cell size of the topo data is 210 feet and the ERTS cell is approximately 260 feet, thus some duplication of elevation data is required under the newest neighbor rule which is used in this system. Elevation data is represented by 8 bit words as channel 5 on an ERTS data tape. Elevations range from 5224 feet to 14,250 feet, thus the quantization level of the data is 8326/255 = 32.5 feet. Since the contour interval was only 200 feet it is assumed that this level of quantization is reasonable. The resulting tape will offer researchers four spectral values plus topographic data to aid in analysis of the ERTS data. One application approach would be to use the layered classifier to classify ERTS data based on certain attributes such as an elevation interval or a range of slopes. This work will be terminated as part of the LACIE effort as of the end of the current quarter as directed by JSC.

VII. Forestry Applications Project

Work in this project is associated with two separate sites, the Hoosier National Forest and the Sam Houston National Forest.

A. Hoosier National Forest

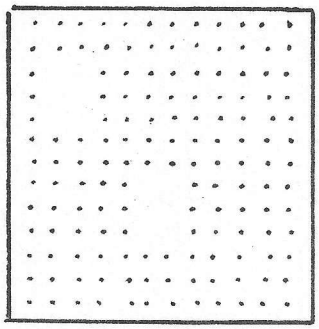
Major Activity. Work during the second quarter has been conducted in the following primary areas:

- Statistical evaluation of classification performance; and
- Preparation and evaluation of data sets.

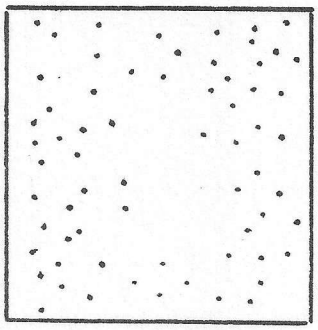
The four basic sampling procedures being tested for classification evaluation are portrayed in Figure 1. Dots represent the 4 x 4 pixel sampling units discussed in the previous quarterly report, and blank areas such as observed in Method I indicate that training areas have been eliminated from consideration as test fields. The advantages of equal sample size include the potential for analyses-of-variances and determination of confidence intervals around the means, as well as the increased likelihood for obtaining a representative sample of cover types which approximates the ratios of their areal extent. Following determination of the optimal sampling technique ("optimal" includes a consideration of the ease of implementation for the corresponding methods), the chosen technique will be used to quantitatively evaluate and contrast the subsequent classifications executed during this contract. This effort will be completed during the following quarter.

Regarding preparation of data sets, several dates of ERTS-1 data have been temporally-overlaid and geometrically corrected for the HNF (Hoosier National Forest) analysis. Provision of support data to aid the forthcoming analysis tasks included flying both HNF sites at 10,000 feet to obtain color infrared and color 70mm imagery. The photography is being indexed on 7.5-minute USGS quadrangle maps in preparation for selection of test and training areas, and other characteristics of the test sites (e.g., geology, plant community distribution, and timber yield) are being studied to facilitate analysis and interpretation of the ERTS data.

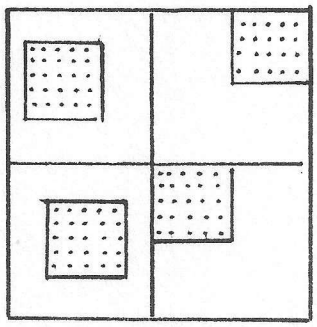
Technical Problems Encountered. Analysis of the four statistical sampling methods has been hampered by the nonnormality of the data in addition to heterogenity of variances between the various classes (cover types) to be compared. Thus, more commonly used analyses-of-variance may not be applied to the test field results in their present form.



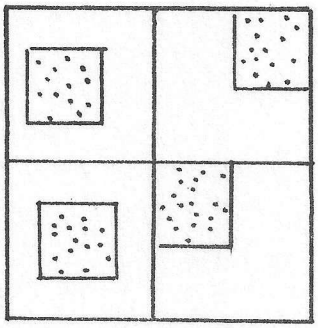
I



II



III



IV

Figure 1. Various statistical evaluation procedures: I = systematic, entire test site; II = random, entire test site; III = systematic, sixteenth subsamples from four blocks; and IV = random, sixteenth subsamples from four blocks.

Proposed Solutions to Problems. The test field results have been converted using an arcsin transformation which was suggested by Dr. Virgil Anderson of the Statistics Department of Purdue University. It is anticipated that this transformation will result in a data set that can be analyzed, using a two-way, unequal sample size ANOVA to define the optimal sampling method.

Solutions to Problems Encountered During Previous Period. No problems were encountered during the previous period.

B. Sam Houston National Forest

Major Activity.

Data Available for Analysis

Aircraft Multispectral Scanner

Eight data sets selected and preprocessed by JSC were entered in the LARS data storage tape file on July 23, 1974. The JSC Edit number and corresponding LARS Run number are as follows:

Edit	Run	Edit	Run
3	74021300	14	74021303
6	74021301	18	74021304
9	74021302	53	74021306
12	74021305	54	74021307

In addition, a forest type map and a semi-controlled infrared photo mosaic (1:125,000) each showing the location of the eight areas corresponding to the data was received.

ERTS

Imagery (1:1,000,000) for two dates has been received. Delivery of ERTS data tapes was promised but not received during this period so none of the planned ERTS analysis activities could be initiated. The aircraft scanner data was converted to LARS format and reviewed for quality. Initial clustering analysis has started.

Technical Problems Encountered. During the data quality review, several data irregularities were found.

1. A vertical banding appears in several channels. This banding occurs most frequently in channels in the blue portion of the spectrum but can be seen faintly in some infrared channels. The bands do not appear in the same channels in all sets nor do they always appear in adjacent channels within a data set. The width of the bands varies within and between channels. An example from channel 1(0.38-0.40μm) is shown in Figure 2.

2. Reversal of directions was found in four of the eight data sets provided.

3. Bad data lines (data drop out) is severe in two data sets.

4. Sun angle/scanner angle effects are pronounced in all sets.

Proposed Solutions to Problems.

1. The vertical banding does affect clustering analysis, but since it appears infrequently it can be avoided by deleting those channels from the analysis. If the banding was introduced during preprocessing, the original data could be used to generate new data sets. At present the cause of the banding is unknown.

2. Data sets with direction reversal is being corrected with LARS software.

3. Bad data lines are not believed to be severe enough to affect tabular results but will appear in imagery.

4. Sun angle/scanner angle can be corrected with LARS software.

Solutions to Previous Problems. No problems were encountered during previous period.

VIII. Regional Application Project

Major Activity. The major activity during this reporting period consisted of reformatting the following ERTS frames:

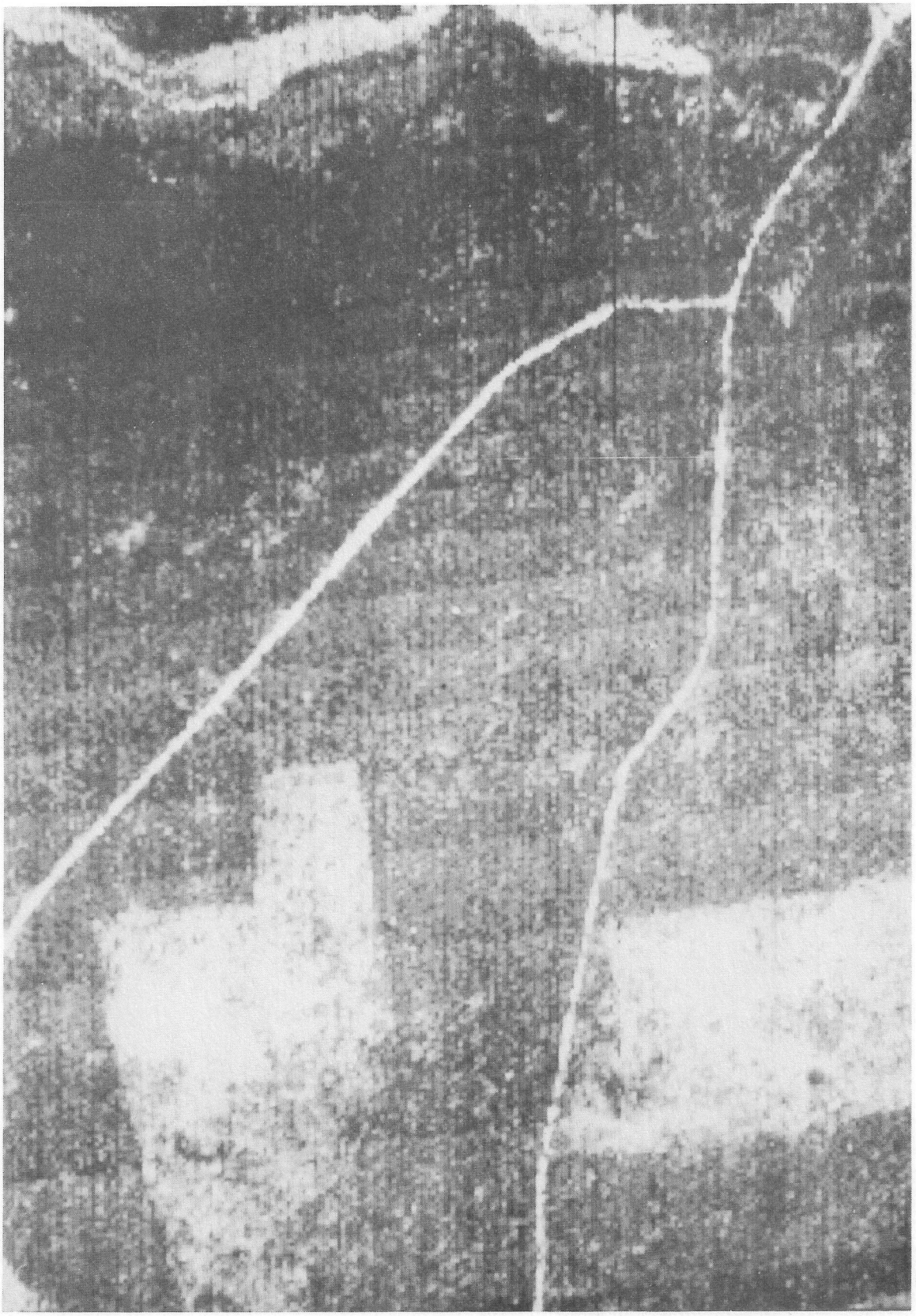


Fig. 2. Banding in Channel 1 (0.38-0.40 μm) Edit 12, Run 74021305.

Scene	Date	Quality
1127-16260	Nov. 27, 1972	Test site split, second bulk tape was a copy of the first. Noise level was unacceptable in four bands.
1146-16134	Dec. 16, 1972	Noise level unacceptable in four bands. Change detection would be difficult since only 18 days separate the first two frames.
1289-16261	May 8, 1973	Quality of first three bands is good. Band four is unacceptable.

A tentative project plan was completed by E. A. Weisblatt/ JSC and S. G. Luther/LARS.

A study of change detection has commenced. This study will be finished in the fourth quarter.

Technical Problems Encountered. No acceptable ERTS data has been received from JSC to date. No underflight photography or B.E.G. maps have been sent to LARS from JSC to date.

According to the project plan the milestone for receiving this material was October 1, 1974. As a result of not receiving the data this milestone, upon which the remaining tasks depend, will be moved back to January 1, 1974 or until all acceptable data is received.

Proposed Solutions to Problems. Data sets of acceptable quality should be sent from JSC to LARS as soon as possible. Acceptable results of the Classification, Change Detection and Performance Evaluation tasks are dependent on these data sets.

The major difficulty encountered during the first quarter was the absence of a project plan. A plan has been submitted to E. A. Weisblatt for R.A.P. Management approval.

IX. Remote Terminal and Technology Transfer

The remote terminal and technology transfer project conducted activities in several major areas. These include the completion of the support for the remote terminal project, preparation for the final report on the remote terminal project, technology transfer, and the new terminal development project. A brief summary of these activity areas are included in the following paragraphs.

The Houston, Goddard, and Wallops terminals continued to be supported for their evaluation of the Purdue system. This support for the remote terminal project is completed as of December 31, 1974. A final remote terminal project committee meeting was held in October, 1974, at Purdue. During this

meeting, the outline for the final report for the project was completed and assignments were made to complete the writing of this report. It should be noted that all three of these terminal sites have made arrangements to continue their remote terminals past December 31, 1974.

During the second quarter, the remote terminal at JSC was again used in conjunction with the training course for LACIE data analysis administered and conducted by LARS personnel. Twenty-four trainee analysts went through the LARSYS Education Package and learned to use the remote terminal system and LARSYS processing functions during the period September 23, 1974 - October 29, 1974.

The revision in format of the first two units of the LARSYS Education Package that are being made were described to the remote terminal steering committee at their October 24, 1974, meeting. The first unit, "An Introduction to Quantitative Remote Sensing," has undergone extensive internal review and editing and is ready for final typing and reproduction. The second unit, "The LARSYS Software System - An Overview," has undergone an initial review, reviewers comments have been taken into consideration, and, at the time of this writing, the unit is being reviewed prior to final typing.

Comments from the remote terminal steering committee stressed the need for including an ERTS case study in the LARSYS education materials. As reported last time, an ERTS case study is in preparation. Progress on the ERTS case study was interrupted for six weeks because of the necessity to assign technology transfer personnel to LACIE training activities at JSC. With the completion of the training course we have once again resumed work on the case study.

As a result of the loan of videotape recording equipment from JSC, we have had an opportunity to experiment with closed-circuit television as a medium for technology transfer. The equipment has been used to record LARS seminars, and to provide for the convenient viewing of videotapes prepared by LARS staff under University sponsorship. Continued experimentation and evaluation is planned during the next few months.

As a result of activities in the new terminal development area and of changes in direction with respect to the LACIE project, products initially expected to be produced during this quarter are expected to be delayed. The paragraphs below explain this delay.

In preparation for the writing of the functional specifications for a more cost-effective remote terminal, many users of the current system have been contacted with a questionnaire. The results of this study show that it is more appropriate to consider a family of remote terminals with various levels of effectiveness and cost. A decision was then made to write the functional specifications for the family of remote terminals instead of a single, more cost-effective terminal. This decision has led to a request for information to industry on the availability of different types of hardware. The decision has also led to an expansion of the functional specifications originally conceived and hopefully a more valuable and useful document.

A second factor which has caused these products to be delayed is the inadequate functioning of Princeton 801 terminal ordered at the end of FY74. The remote terminal development concept originally centered around this device, and some experiments with the device were carried out after its late delivery. The primary result of these experiments has been to find the equipment defective. The equipment has been returned to Princeton for repair.

A third reason for the delay in these products is that some of the personnel assigned to the new terminal development project have been reassigned to work on the LACIE field measurements software system. Thus, the level of effort for this subtask has been decreased.

At the present time, the functional specifications for a family of remote terminals is expected to be produced by March 1, 1975. The system design document will continue to be delayed depending on the results of improving the Princeton terminal, the results of the RFI, the status of the field experiment, and the results of further tests and user response to the experiment. Although this project is considered to be very important at Purdue, we have given it a priority less than LACIE and other SR&T tasks.

X. Preprocessing Algorithms

The final report on the Optimal Scanner field of view correction by Terry Riemer is in press and should be available in the next period. Work was completed on lineament enhancement using Gradient and Laplacian operators by student Bijan Mobasseri under the direction of Mr. Anuta. A report is being prepared on this work. Mobasseri implemented an interpolation and filtering algorithm using Riemer's results under Prof. McGillem's direction

and applied it to ERTS data during the period. A new EE graduate student, Nim Chu, joined the group and is applying interpolation algorithms developed by Prof. McGillem to ERTS data. The initial goal of these efforts is to improve the visual quality of ERTS images. The longer term goal is to improve classification accuracy obtainable. Mr. Riemer terminated graduate employment in the group on September 30.

XI. Effective Utilization of Data Dimensionality

Major Activity--Layered Classifiers. During this quarter, effort was directed toward test and evaluation of the heuristic decision tree design program and conversion of all related research software to CMS to enhance its availability for general usage and compatibility with LARSYS.

The layered classifier project has been brought to the following status. A program is available which will accept the specifications for any multi-level decision logic and associated class statistics and will classify multispectral data accordingly. Three alternative approaches for designing the decision logic are being evaluated. The simplest of these is design by manual methods, which is useful only for relatively simple problems requiring elementary decision logic. The second approach is the "binary tree" approach which is most useful when optimal classifier accuracy is sought and some classifier speed can be sacrificed. The third approach, heuristic search optimization, is the most general and potentially most powerful, in that it considers all possible decision trees for a given problem in order to search for the optimal tree. The optimality criterion used in this approach requires a trade-off to be defined between classifier accuracy and the speed with which the classification is accomplished.

All three design approaches have now been shown capable of producing results which are superior to the results obtainable from the conventional single-layer classifier. The manual design method has been applied successfully in a selection of applications, and a special version of the layered classifier has been made available for use in thermal mapping of water. The binary tree method has been found most useful where the "dimensionality problem" is responsible for degradation of classification results. (The dimensionality problem occurs when the number of training samples is severely limited and thereby restricts the number of features to be used in classification. The binary tree method allows a small but optimal subset of features to be used for discriminating each individual class from all others.)

The heuristic search optimization program is still the subject of research. Decision logic design using this program requires specification of a number of parameters, one of the most important being the parameter which defines the trade-off between classification speed and accuracy. Variation of these parameters can produce decision trees which are radically different in both form and performance. It is not yet well understood how the parameter values should be selected for a given problem to produce the most desirable results.

Goals have been formulated for the balance of FY75 as follows:

Complete and document experimental evaluation of the present heuristic search evaluation program--March 15, 1975.

Complete and document experimental evaluation of the manual design and binary tree methods--May 31, 1975.

Technical Problems Encountered. It was discovered during this quarter that certain restrictions inherent in the original research programming would not permit utilization of this programming for several candidate applications to be used in the evaluation process. These restrictions were primarily related to storage limitations, and are being removed by reprogramming using dynamic storage allocation.

Major Activity--Integration and Evaluation of New Algorithms. It has been determined that two capabilities developed elsewhere could have a significant impact on LARSYS-type remote sensing data processing. They are the table look-up classifier and the linear combination feature extraction algorithm. In order to assess this impact and to make these methods available for applications research, it is planned that they be implemented and evaluated on the LARS system. Copies of the software have been obtained from the originating organizations.

Goals for this activity are as follows:
Table look-up software conversion completed, ready for test and debugging--January 17, 1975.

Table look-up software operational--February 14, 1975.

Implement capability to generate image tapes using optimal linear combination features--March 31, 1975.

Complete tests to determine utility of linear combination features, decide whether to add this capability to LARSYS--May 31, 1975.

XII. Extraction and Analysis of Spatial Information

Major Activity--Sample Classification and Boundary Finding. Additional tests data sets were defined during this quarter and efforts are proceeding toward conclusion of this phase of the research (evaluation of currently defined procedures and algorithms). Compilation of results and documentation are well under way.

Currently defined goals are as follows:
Complete first draft of thesis/technical report--February 1, 1975.

Complete all tests and documentation--March 1, 1975.

Evaluate potential application to LACIE-type survey problem--May 31, 1975 (contingent on successful hiring of replacement staff).

Major Activity--Use of Fourier Transforms. Software has been previously developed at LARS for computing spatial (two-dimensional) Fourier transforms. Therefore an effort is now under way to assess the potential utility of this software for generating a characterization of spatial information in remote sensing data. It is to be determined whether this is a feasible approach to generating spatial features which can be used in conjunction with spectral features.

Currently defined goals in this area are:
Complete study of literature and existing software, decide feasibility question, and estimate time required for software adaptation--January 31, 1975.

XIII. Soil Moisture Measurements

As previously reported a method of Slichter was suggested as a means of measuring permittivity profile in a soil containing moisture. The permittivity can then be interpreted in terms of available soil moisture profile based on data obtained on a large variety of soil samples. The problem encountered previously with the application of the Slichter method was that certain criteria for convergence of functions used in the analysis could not be established. During the quarter being reported, criteria for convergence were described which permitted rigorous establishment of convergence of functions used in the analysis which would apply over expected conditions of soil moisture profile. Additionally, a restriction on depth (3 meters) was applied to the analysis of EM waves (wavelength $\cong$ 1 meter) used in the method. A report describing the method in detail along with supporting data and examples will be issued near the end of

CY 1974. Current activity on the project deals with the definition of instrument parameters necessary to implement the method.

XIV. Soil Inventory

Major activities have continued for White County and Hidalgo County data. Results of computer analysis and field checks in Barton County indicated that June 17 data were less than optimum for soil survey work, so August and October data were ordered. Computer-compatible tapes were received early in December, and will be reformatted, geometrically corrected, and analyzed. Initial screening indicated the October data shows the best soil patterns, and it will be analyzed first. A briefing on the status of the project, which will be given to Kansas State University personnel at Manhattan, Kansas on December 19.

For precise location of soil mapping units as mapped in the operational survey, all of the road intersections in White County were digitized from the 1:24,000 scale topographic maps and will be input into the 1:20,000 scale ERTS data set. This procedure has been very time consuming, but will yield a much more valuable data set, both for analysis and for evaluation purposes.

As a result of field evaluations of ERTS data in White County, the Indiana State Soil Scientist, Ray Sinclair has become more familiar with ERTS data and has proposed two further projects utilizing ERTS data in the soil survey. Both projects involve increased participation by the State Soil Scientist and personnel on his staff. He is finding out from first-hand experience that ERTS data is contributing new soil information to the field survey. Soil Conservation Service personnel are now heavily involved with LARS in operational soil survey efforts using ERTS data, which marks a very important milestone.

One significant discovery in White County during this reporting period was that the better drained soils from glacial till and outwash were indistinguishable on false color images but had slightly different signatures when plotted in four bands. False color ERTS images are useful in soil survey field work, but in this case did not give as much capability for discrimination of similar soils as did the computer classification.

XV. Langley Remote Terminal Support

Purdue continues to support the Langley Remote Terminal as outlined in the Statement of Work. The only problem associated with this support has been the completion of a contract addendum with JSC for funding this support. During this quarter the addendum has been completed and forwarded to Purdue.

XVI. EROS Data Center Remote Terminal

On December 9, 10, 1974, a verbal report of the status of all activities funded by the EROS Data Center was made. The four major areas of the work statement: remote terminal installation, remote terminal support, demonstration package development, and LARSYS Version 3 conversion to EDC computer were addressed. A summary of this verbal report follows.

The installation of the remote terminal at the EROS Data Center was completed in early October. Attention is now being given by LARS personnel to supporting this terminal.

During the December meeting, a presentation of a rough draft demonstration package was made by John Lindenlaub. A critique of the rough draft and many inputs were provided by the Data Center personnel. Agreement with respect to the final demonstration package was made.

A major source of discussion during the December meeting was in respect to the LARSYS Version 3 conversion to the EDC computer. Difficulties with this conversion centered around the delay in the EDC computer selection and the uncertainty as to the magnitude of the conversion until a computer is selected. LARS personnel prepared for discussion a proposal for EDC and LARS personnel activities for the remainder of FY75. Both groups agreed to proceed with this plan with specific dates of completion for particular activities through March 1, 1975. Specifics with respect to the remainder of the plan will be delayed until the EDC personnel participate in a LARSYS course at Purdue scheduled for the last two weeks in February, 1975.