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# Visiting Scientist Program

Laboratory for Applications of Remote Sensing
Purdue University
West Lafayette, Indiana USA

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# THE LARS VISITING SCIENTIST PROGRAM

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# THE LARS VISITING SCIENTIST PROGRAM

Abstract

The LARS Visiting Scientist Program is described and illustrated by means of a number of example programs and a description of the types of services provided. Participant's qualifications and instructions for applying to the program are given, necessary financial arrangements are explained and advanced planning requirements are given. Appendices provide the reader with an advance planning check list, application form, guidelines for estimating costs and a listing of current visiting scientist rates.

# The LARS Visiting Scientist Program

## Introduction

The Laboratory for Applications of Remote Sensing (LARS) is a research laboratory within Purdue University focusing the University's unique resources on the development of improved techniques for analyzing earth resource information. A multi-disciplinary staff from various departments within the schools of agriculture, engineering and science compose the LARS team. During the Laboratory's eleven year history, this team has been responsible for many of the developments in remote sensing technology. LARS has become one of the world's leading research centers in the areas of computer assisted processing, analysis and interpretation of remotely collected data.

The remote sensing concept began to develop in the mid-1960's. A group of scientists noted that aerial surveillance data from multispectral scanners could be used to discriminate among a wide range of earth cover types. Although it was still fairly early in the Space Age, they recognized the potential for using multispectral scanners aboard earth-orbiting satellites to gather earth resources data. They also recognized that the volume and rate of acquisition of data collected by such systems would be staggering--as would be the job of analyzing it! To produce the most useful results, the analysis process would have to be quantitative, operating on numerical data and producing numerical descriptions of the area surveyed. Clearly, this was a job requiring the data handling and computational abilities of computers.

Thus, in 1966, the Laboratory for Applications of Remote Sensing (LARS) was organized at Purdue University with the goal of applying modern computer technology to the quantitative analysis of multispectral earth resources data. Two significant factors were recognized early in this effort: (1) that an emerging data analysis technique known as "pattern recognition" represented a powerful methodology for accomodating the multivariate nature of the data, and (2) that for the foreseeable future, man was an indispensable part of the overall analysis process, which would therefore be better described as "computer assisted" rather than "automatic". The LARS research philosophy is basically: The optimal synthesis of man and computer, using the complimentary capabilities of each to rapidly produce the quantitative and accurate analysis results needed in a wide range of earth resources applications.

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.

* Training people to use quantitative remote sensing analysis systems.

* Increasing the ability of the computer to assist the analyst in remote sensing analysis.

* Applying the newly developed analysis systems to specific earth resources problems.

LARS is in an exceptionally favorable position to serve as a training center as well as a research center by virtue of:

* Its position as an integral part of a broad-based, top-level university.

* Its truly interdisciplinary organizational structure and approach.

* Its breadth and depth of experience in remote sensing research and applications.

Being closely integrated in the structure of a high-quality university, the Laboratory is able to attract outstanding scientists to its program in relevant disciplines. The Laboratory's organizational structure encourages communication between disciplines.

Laboratory personnel consists of academic university staff assigned to the Laboratory, usually on a part-time basis (who also maintain their customary role as staff members of academic departments), and professional staff members who are also assigned to department staffs but whose full effort is devoted to remote sensing research (with no university teaching responsibilities). These staffing arrangements have made possible the grouping of teams of scientists from many disciplines in an interdisciplinary research program. Personnel from 20 Purdue departments are currently engaged in research projects at LARS.

LARS is organized into six major program areas:

* Crop Inventory Systems Research

* Data Processing and Analysis Research

* Measurements Research

* Earth Sciences

* Ecosystems Research

* Technology Transfer

Each program area has specific responsibilities for conducting research within its area while cooperating with and supporting each other.

The Technology Transfer program area is responsible for developing and utilizing educational and training materials which aid the process of transferring newly developed remote sensing technology from the research to the applications arena. The Visiting Scientist Program is one of the activities coordinated by the Technology Transfer program area.

The Visiting Scientist Program was developed in response to requests by individuals desiring to spend time at LARS to become acquainted with remote sensing technology, especially computer assisted analysis of multispectral data. The program is intended for individuals or small groups of scientists interested in learning and gaining experience with the fundamental principles, capabilities and limitations of remote sensing technology. Visiting scientists have come to LARS from the academic community (professors on sabattical from other universities), government organizations (both foreign and domestic, state and national), and private industry (agri-business, forest industry).

Remote sensing techniques can be used in a wide variety of applications and the technology itself is based on a broad set of principles representing many of the traditional disciplines. For these reasons there is not a rigid set of qualifications for participation in the program. Persons with a bachelors degree in the following areas are typical participants.

| | |
|---|---|
| agriculture | geography |
| biology | geology |
| civil engineering | physics |
| electrical engineering | meteorology |
| forestry | computer sciences |
| mechanical engineering | statistics |

Most participants also have a minimum of 3 to 5 years work experience and many have advanced academic degrees. Proficiency in the English language is essential.

When an organization wishes to have a small group of scientists participate in the program we recommend that a variety of disciplines be represented. An attempt should be made to include individuals with backgrounds in the life sciences, earth sciences, engineering and computer science.

Upon application, the backgrounds and objectives of potential visiting scientists are circulated to key LARS staff members. Acceptance into the program is contingent upon identifying a LARS staff member who will serve as technical sponsor to the visiting scientist (or group of scientists).

The LARS technical sponsor plays an important role in the Visiting Scientist Program. He provides guidance on technical matters and monitors the visiting scientist's progress toward achieving the technical objectives of the visit. The visiting scientist - technical sponsor relationship is similar to that between graduate student and his major professor. The technical sponsor provides guidance and support but visiting scientists are expected to be self motivated and capable of working independently.

It is LARS' policy to expect the visiting scientist to work jointly with his LARS technical sponsor in preparing a final written report describing his work and accomplishments while at LARS.

Example Programs

The Visiting Scientist Program is very flexible both in terms of duration, number of participants and technical objectives. Programs are designed in a manner so as to best match the background and objectives of each applicant (or group of applicants). Programs range in duration from a few days to more than a year. Scientists participate singly or in small groups - four to six scientists is not unusual. Technical objectives range from a desire to achieve an overview of the technology to engaging in fundamental research. Shorter duration programs tend to be of one of two types:

A) an overview of the technology or of some aspect of the technology,such as computer aided analysis techniques. These programs make use of remote sensing education and training materials developed at LARS.

B) an intensive study of a particular problem. This type of program is usually undertaken by individuals having considerable experience in remote sensing or desiring to work jointly with a particular LARS staff member.

Longer duration programs for individual scientists are often similar to internships or on-the-job training programs. The first four to six weeks are usually spent learning the foundations of remote sensing and computer analysis of remote sensing data. The schedule for this portion of the program is tailored to match the background and objectives of the visiting scientist. During the remaining portion of the program the visiting scientist gains additional first hand experience in analysis techniques by working with LARS staff members and graduate students on on-going research programs. Every effort is made to select a project matching the visiting scientists background, area of interest and objectives, but of course this is highly dependent upon the number and nature of the projects underway at the time of the visit. Visiting scientists often desire to extend an on-going project (either technically or geographically) to match their personal interests even closer.

Programs involving groups of scientists may include the analysis of a data set of particular interest to them and the making of preliminary plans for establishing a remote sensing capability within their own organization or country.

Four example programs are described in detail below. They are intended to give insight into the kinds of objectives that can be met in a given period of time, typical visiting scientist qualifications, advanced planning requirements and an indication of the amount of computer and personnel resources required to accomplish specific goals.

**Example 1** Short Visit, Specific analysis objective.

Length of Visit: 4 days

Background of Visiting Scientist: Computer programmer, some experience with statistical and unsupervised classification programs, attended LARS 1 week Short Course 18 months prior to visit.

Objective of Visit: Analyze a specific portion (1000 lines, 800 columns) of a LANDSAT frame. Interested in 4 or 5 information classes, 8 to 10 spectral classes.

Special Advanced Planning: LANDSAT data tape sent to LARS for reformatting two weeks prior to arrival.

Resources Required:

| | |
|---|---|
| Basic Visiting Scientist Rate | 4 man-days |
| Analyst Consultant | 28 hours |
| Digital Display Technician | 5 hours |
| Computer Services | |
| 1 LANDSAT Reformatting | |
| 3 hours CPU time* | |
| 6 hours Digital Display | |
| 2 packs color film | |
| 1 pack P-N film | |

Accomplishments: After initial orientation to the computer system the visiting scientist worked with a LARS analyst on the analysis of his data set. A pilot analysis (200 columns by 200 lines) was done first to gain familiarity with the entire analysis process with a minimum of computer expense (20 minutes CPU time). The training statistics from this analysis were then used to classify the entire area of interest (1000 lines by 800 columns). A second classification of this larger area was done using a new set of training statistics. Line printer classification maps and color slides of the classification results from the digital display were obtained for each analysis.

Comments: This visiting scientist's familiarity with computer systems and remote sensing allowed him to become comfortable with our computation center procedures and analysis software very rapidly. Assigning an analyst to work with him essentially full-time allowed him to complete his goals in a four-day period. Advanced planning was required to assure the scientist that the data set he wished to analyze was available upon his arrival.

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*CPU = Central processing unit of computer.

Example 2 Long visit, internship and analysis of home country data set.

Length of Visit: 1 year

Background of Visiting Scientist: Formal training in mathematics and statistics. More than 10 years experience in agricultural statistics.

Objectives of Visit: To study remote sensing technology and its application to the area of agricultural statistics. To work with LARS staff on an on-going project related to crop inventoring. To use computer assisted pattern recognition techniques to classify LANDSAT data of an agricultural area of his native country.

Special Advanced Planning: None

Resources Required:

| | |
|---|---|
| Basic Visiting Scientist Rate | 260 man-days |
| Analyst consultant | 1 man-month |
| Computer Services | |

- Order LANDSAT CCT's and color composite prints
- 2 LANDSAT Reformatting
- 6 hours CPU time
- 4 hours digital display
- 2 packs color film

Accomplishments: The first two months of the program were largely devoted to a study of the fundamentals of remote sensing technology and the use of pattern recognition and computer aided analysis techniques to the analysis of multispectral scanner data. The next four months were spent working in close association with an on-going research project dealing with crop identification and acreage estimation using LANDSAT multispectral scanner data. During this phase of the program experience was gained in applying digital analysis procedures in a production mode. The last six months of the program were devoted to analyzing LANDSAT data sets from the scientists home country. Parts of two frames covering the same area but collected during different times of the growing season were analyzed. Results were compared to those obtained from agricultural forecasts.

Comments: The specific application worked on during months 3 through 6 was particularly valuable because it matched the professional interests of the visiting scientist. Because of this internship experience the visiting scientist was able to carry on the last six months of his study largely on his own. His experiences ranged from specifying analysis objectives, selecting and obtaining data, carrying out the analysis and evaluating the results. While the scientist was able to carry out the analysis of data sets from his own country the lack of reference data (maps and aerial photography of the area) prevented him from evaluating the results of his work to the degree that would have been possible had reference data been available. A greater amount of advanced planning would have circumvented this problem.

**Example 3** Short duration, overview of the technology.

Length of Visit: 3 days

Background of group: Three officials representing the ministries of agriculture and natural resources from a developing nation. Two of the visitors had advanced degrees in agronomy and forestry and were currently administering governmental programs. The third visitor was a computer systems programmer.

Objectives of Visit: To learn the underlying principles of classifying LANDSAT data using pattern recognition techniques; to assess the applicability of the technology to resource management within their own country; and to formulate preliminary plans on how to work towards the implementation of the technology within their organizations.

Special Advanced Planning: The visitors were scheduled to visit a number of remote sensing centers in the United States. Phone calls were placed to these organizations so that these experiences were more coordinated, non-redundant and complementary. Details of the visit were finalized 30 days in advance.

Resources Required:

| | |
|---|---|
| Basic Visiting Scientist Rate | 9 man-days |
| Printed materials | |
| Computer-- | |
| .5 hours CPU time | |
| 1 hour digital display | |
| 1 pack color film | |

Accomplishments: All three visitors went through training packages dealing with an introduction to remote sensing, the physical basis of remote sensing and pattern recognition as applied to remote sensing. This experience provided a basic understanding of the technology. Two two-hour seminar discussions were held with key researchers in agriculture and forestry to discuss past research results and applications studies as well as to discuss current research efforts and trends. Two two-hour computer demonstrations were conducted to illustrate computer analysis procedures. Additional training packages in agricultural and forestry applications and pattern recognition and analysis procedures were used to reinforce the seminar discussions and computer demonstrations. These experiences provided a basis for assessing the possible use of the technology in their own country. A working conference with LARS technology transfer staff members was held during which alternative approaches to implementing remote sensing operations within their country were explored. This provided the visitors with a better understanding of the time, man-power and equipment resources required to implement a viable program within their organizations.

Comments: Coordination of the visit with other remote sensing organizations allowed each to emphasize those characteristics or capabilities unique to them.

Example 4 — Medium Duration Visit, Specific Analysis Objective

Length of Visit: 3 Months

Background of Visiting Scientists: Two visiting scientists participated in the program. One scientist's formal training was in the area of agronomy, the other geography. Both had some photo interpretation experience and professional work in their respective fields but no extensive background in computers or numerical analysis.

Objectives of Visit: To train two visiting scientists in computer techniques for the analysis and interpretation of multispectral scanner data; to investigate the feasibility of delineating major ground cover types in LANDSAT data and inventorying natural resources in a tropical environment.

Special Advanced Planning: Selection of site to be analyzed, ordering LANDSAT data tapes and gathering available reference data (maps, aerial photography, technical reports on areas soils, etc.). In addition, ground observations and low altitude observation flights were made of the area of interest prior to coming to LARS.

Resources Required:

| | |
|---|---|
| Basic Visiting Scientist Rate | 120 man-days |
| Analyst Consultant | 1.5 man-months |
| LARS Short Course | 2.0 registration fees |
| Computer Services | |
| 2 LANDSAT Reformatting | |
| CPU Time | 11 hours |
| Digital Display | 12 hours |
| 6 packs color film | |

Accomplishments: The visiting scientists began their work by participating in the short course on remote sensing technology and applications offered by LARS each month. This provided them with an opportunity to learn many of the underlying principles and general approach to computer analysis of multispectral scanner data. By means of case study materials and the use of mini-course educational packages the scientists were able to deepen their understanding of the technology to the point where they could undertake the analysis of a data set from their home country. With this background and some assistance from a LARS analyst consultant the scientists analyzed a 5000 $km^2$ tropical agricultural area. Extensive reference data consisting of maps, aerial photographs and on-site visits assisted the scientists in carrying out the analysis and, perhaps more importantly, to assess the suitability and value of the technology for inventoring natural resources in a tropical environment.

Comments: The ability of the scientists to critically evaluate the technology, and their skills at analyzing multispectral scanner data were both greatly enhanced by the fact that they came prepared with a great deat of reference data and personal experience in the area to be analyzed.

Description of Services

There are several types of services provided in conjunction with the Visiting Scientist Program. These services are described so that the prospective visiting scientist or his sponsoring organization can gain an understanding of what to expect from the program.

I. Basic Program - In many respects the Visiting Scientist Program is similar to professional consultation services. The chief difference is that in most consulting situations an individual or small group of individuals provides professional services to a large organization whereas in the Visiting Scientist Program the LARS organization is making its services available to individual or small groups of visiting scientists. In keeping with this analogy a visiting scientist will find that during the first few days of his program (first few weeks for long duration programs) a considerable amount of effort is devoted to familiarizing him with LARS, its people, the computer facility, providing office space, etc. He will work very closely with the LARS Education and Training Coordinator and his technical sponsor during this period. Careful planning and coordination goes into this phase of the program. As visiting scientists begin to work on their own and learn how to use the facilities and services of the laboratory their work days will be less structured and a greater portion of their time will be spent working toward their personal technical objectives.

Charges for the basic program are based on the number of man-days of participation. The cost per day decreases as the length of the program increases. This reflects the fact that the visiting scientists work more independently as time goes on. In addition to providing a carefully planned and coordinated initial program and arranging for a technical sponsor the basic portion of the Visiting Scientist Program provides access to a variety of educational opportunities and the LARS computer facility.

II. Educational Materials and Programs - Since 1972 LARS has been active in developing educational materials and conducting symposia and short courses. These materials and programs are available to visiting scientists. It is during the first phase of a Visiting Scientist Program that the most use is made of the educational materials available at LARS. Because of the modular design of these materials, the initial training period can be matched to the visiting scientist's background and objectives. Appropriate modules from the LARS FOCUS series, minicourses, simulation exercises and case studies can be used by the visiting scientist. The LARSYS Educational Package, designed to train people to analyze remotely sensed multispectral data using the LARS softwary system (LARSYS), has proven to be very effective. An intensive short course on remote sensing technology and its applications is held the first full work week of each month. Visiting scientists frequently schedule their time at LARS to take advantage of this offering.

Less formal in nature is the LARS technical seminar series. This series of presentations by LARS staff members and visitors deals with current topics in remote sensing. Visiting scientists are invited to participate in this series both as members of the audience and as speakers. LARS also maintains a library of technical literature related to remote sensing.

A question frequently asked is whether or not LARS offers any regular university credit courses. LARS is an interdisciplinary research laboratory and, as such, is not an academic department. Regular credit courses in remote sensing are offered by several academic departments (agronomy, civil engineering, electrical engineering, geosciences, forestry and natural resources) of the University. These courses are often taught by faculty associated with LARS. Visiting scientists may audit or enroll in these courses. Visiting scholars who have attained doctoral status or the equivalent may attend classes as visitors without payment of fees upon approval of the head of the department offering the course and the dean of the Graduate School. Persons wishing to receive graduate credit must register as graduate students and pay appropriate fees and tuition.

III. <u>Computer Services</u> - Services of the LARS computer facility are available to visiting scientists on a cost reimbursement basis. This section describes some of the more commonly used computer services, gives formulas for estimating the cost of classifying a set of multispectral data and illustrates the use of these formulas by means of several examples. These examples and Appendix B are designed to assist the prospective visiting scientist in estimating the amount of computer resources required for various types of visiting scientist programs.

A. <u>Landsat Reformatting</u>. Landsat multispectral scanner data is available on computer compatable tapes. The format of these data tapes is efficient for the purposes of receiving the data from the satellite and storing it, but it is not the most efficient format for analysis using LARSYS algorithms. To reduce the overall cost of analysis, the data must be reformatted so that it can be accessed and manipulated more efficiently. This process, known as Landsat reformatting is the first step in the analysis of a Landsat data set. When a Landsat tape is reformatted the entire 185 km X 185 km frame of data is reformatted. Once reformatted any portion of the frame can be analyzed. LARS has a substantial library of reformatted Landsat frames. Unless the visiting scientist is interested in a specific Landsat scene not in the LARS library reformatting is not needed. When reformatting is required a fixed priceis charged for each Landsat data set that is reformatted.*

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*See Appendix C for a list of computer service rates.

B. Geometric Correction. Due to orbit inclination and the earth's rotation Landsat data is not orientated in a North-South direction. In addition, the vertical and horizontal scales are different. These idiosyncracies of data presentation may be removed by a geometric correction process. Working with a reformatted Landsat tape as input any specified portion of a Landsat frame may be geometrically corrected. The image is rotated to North orientation and rescaled for line printer output with a scale of approximately 1 to 24,000. Geometric correction greatly facilitates the analyst's ability to relate to and interact with the data. Geometric correction of the portion of a Landsat frame of interest is usually the second step in the course of an analysis. The charge for producing a geometric correction is based on a fixed charge for each frame or portion of a frame of LARSYS formatted data, plus an additional charge for each million points of data involved in the correction. Again, LARS has a substantial number of geometrically corrected data sets in its data library and in those cases where a visiting scientist is not interested in a specific scene, a scene which has already been geometrically corrected may be available. In those cases it is not necessary to pay for geometric correction services.

C. Computer Service, Priority Service, Local Terminal. This combination of services provides the analyst with direct access to the 18 processing functions which make up the LARSYS software system. In addition, the user of the system can access special programs and write, store and execute programs of his own. LARSYS processing functions are used to display multispectral data, develop training statistics, classify and display analysis results. These services are essentially measured in terms of the amount of CPU (central processing unit) time used. Charges for this service are based on the number of CPU hours used.

D. Special Output Products. The LARSYS classification processing functions produce a magnetic tape computer file known as a classification results file. Other LARSYS processing functions can be called upon to display the classification results in map-like form using a computer line printer or TV-like digital display screen. Black and white and color photographs, polaroid prints and 35 mm slides can be produced from the display screen. Use of the digital display is charged for on an hourly basis.

E. Estimating Cost of Computer Services. The amount of computer services for any particular Visiting Scientist Program is best estimated after the goals and objectives of the visit have been determined. Formulas for estimating routine analysis of Landsat data are presented in Appendix B and illustrated by means of several examples. It is important to recognize that the computer times and costs illustrated there are those associated with doing remote sensing analysis within a research environment and should not be considered as being representative of the costs that would be involved with a more production oriented facility.

IV. <u>Data Analyst Assistance</u> - As described under the basic program on page 9 the visiting scientist can expect to receive a substantial amount of professional assistance during the early portion of his visit. After completion of the initial training period, participants are expected to be able to carry out analysis on their own. This has proven to be effective when the visiting scientist has the opportunity to gain additional practice by working with LARS researchers who are involved with on-going projects. Time or programatic constraints may require additional analyst assistance in order to meet the goals and objectives of the visiting scientist. This occurs more frequently when the visiting scientist wishes to complete a state of the art analysis of a data set of particular interest to him. Then, in order to increase the probability of achieving the best possible analysis results it is recommended that the services of a data analyst be included in the program planning.

Another viewpoint that can be taken is to plan on budgeting an amount equal to not less than 20% of the computer services budget for analyst assistance. This tends to ensure that the computer resources are used most efficiently. Analyst assistance is charged in times of man-hours of effort.

## Financial Arrangements

LARS is dependent upon grants and contracts to support its research and other activities. Thus it is necessary to require that the cost of the Visiting Scientist Program be borne by the visiting scientist, his organization, or a third party funding agency.

Upon receipt, review and acceptance of an application to the program, LARS' Education and Training Coordinator will correspond with the applicant(s) to clarify objectives, determine the dates during which training will occur, prepare a cost estimate and answer other preliminary questions. After these initial negotiations have been completed, Purdue's Office of Contract Administration will prepare a Memorandum of Agreement between Purdue University and the visiting scientist's sponsoring organization. This agreement specifies the names of participating visiting scientists, cost and dates of the training period. It is the University's policy to receive payment to cover the cost of a specific Visiting Scientist Program in advance and applicants should understand that training cannot begin until such payment has been received. A sample Memorandum of Agreement is shown below.

Memorandum of Agreement
between
Purdue University
and

______________________

This Memorandum, made this ______ day of __________, 19____, by and between ____________, ____________________ and Purdue University Witnesseth that:

**The sponsoring agency agrees to provide financial support for the training of the** following personnel:

______________
______________
______________
______________
______________
______________

as a Visiting Scientist(s) at the Laboratory for the Applications of Remote Sensing at Purdue University.

The Laboratory for the Applications of Remote Sensing at Purdue University is willing to undertake the training of the above named trainee(s) under the following conditions:

1. The sponsor agrees to pay the University upon the execution of this agreement the sum of $_______ for the training program in advance of the proposed visit. Payment shall be made in the name of Purdue University and forwarded to the Office of Contract Administration, Hovde Hall, Purdue University, West Lafayette, Indiana 47906, USA. Should this agreement not be signed within 60 days from the date of the memorandum this offer expires.

2. Training is anticipated to be for ______ man days during the period from __________ to __________. Should trainees determine the need to remain for a period longer than herein agreed, additional funds will be required and must be at Purdue University or written sponsor commitment of said funds must be at Purdue University before training will continue, followed by an Amendment to the agreement.

3. The University agrees to:
   a. Provide a qualified staff member to supervise the trainee(s).
   b. Provide the facilities necessary for the training program.
   c. Provide computational services in accordance with the amount estimated not to exceed $________ included in the sum set forth in article 1.

4. The sponsor agrees that the training shall be in the area of Remote Sensing. Said project shall be assigned to the trainee by the University.

5. This agreement may be terminated at any time by the University in which cases any funds not expended or committed shall be returned to the sponsor.

6. The University is not responsible for the travel, housing, or any other personal expenses of the trainee.

7. Any material first produced or any invention first conceived as a result of this agreement shall be promptly reported to the University. Such material or invention shall become the property of the University.

In witness whereof; the parties have executed this memorandum as of the date first above written.

| | |
|---|---|
| ______________ (Date) | ______________ (Sponsor Representative) |
| ______________ (Date) | ______________ (Purdue University Rep.) |
| | Approved: |
| ______________ (Date) | ______________ Director of Laboratory for Applications of Remote Sensing |

In planning the financial arrangements for a visiting scientist, it is important to note that the Memorandum of Agreement does not cover travel, housing, living and personal expenses of visiting scientists. Assistance in locating satisfactory housing will be given by LARS' Education and Training Coordinator but, since the demand for transient housing in Lafayette is high, no guarantees can be made.

The visiting scientist is well advised to arrange through his organization or as an individual for accident and medical insurance coverage. This will help assure prompt and proper medical care in the event of illness or injuries which might occur during the time the visiting scientist is at LARS.

Application and Advanced Planning

Persons interested in applying to the Visiting Scientist Program are encouraged to submit their application and begin planning as soon as possible. Experience has shown that those individuals who begin their planning early have the most successful programs. While not an absolute requirement a suggested guideline is to anticipate a period for planning and advance preparation equal to the duration of the visit at LARS plus 60 days. Completion of the planning process including the execution of the Memorandum of Agreement should be completed at least 30 days prior to the start of the visit. Attempts to shorten this lead time generally affect the quality of the program.

The following steps serve as a guide to persons interested in applying to the program:

1. The prospective visiting scientist should formulate a set of objectives for his visit. Consideration should be given to whether the purpose of the visit is intended to be primarily educational in nature, for assessing the technology or for carrying out the analysis of a particular data set of interest. End products expected upon completion of the visit should be specified. LARS considers a written report summarizing the accomplishments of the visit to be a minimum end product requirement.

2. Based on his objectives and using the example programs previously described the prospective visiting scientist should estimate the time required to meet the objectives of his visit.

3. With the information from steps 1 and 2 available, the visiting scientist is ready to fill out and submit an application form (Appendix D). In addition to a curricular vita, the form asks the applicant to describe his experience/knowledge of remote sensing, and list any related seminars or courses he may have attended. A statement of the objectives of the visit, suggested duration and preferred dates of the visit should be included. In the case of two or more visiting scientists from the same organization Part A of the application form should be completed for each person.

4. While the application is being evaluated at LARS, visiting scientists whose native language is not English should arrange to take the Test of English as a Foreign Language (TOEFL) exam to demonstrate their English proficiency. This exam is available at most U.S. Embassies. Results of the exam should be sent to the Education and Training Coordinator at LARS.

5. After receiving the application LARS will review it assessing the objectives of the visit, qualifications of the applicant(s) and preferred times relative to on-going programs at LARS and staff comittments. A technical sponsor will be identified and planning of the early phase of the program will begin.

6. LARS will then correspond with the applicants and/or their organizations. An assessment of the proposed program will be made, and a preliminary budget developed to show estimate of cash involved. Sometimes alternative objectives may be suggested. Dates proposed in the application will be confirmed or alternate dates proposed.

7. Applicants should respond to the letter mentioned in paragraph 6 above indicating their willingness to accept the cost proposal and dates of training.

8. Upon receipt of the visiting scientist's response, LARS will initiate a Memorandum of Agreement between Purdue University and the visiting scientist's sponsoring organization. (See Section on Financial Arrangements.)

9. The sponsoring organization should forward the completed Memorandum of Agreement along with payment to Purdue. It is Purdue's policy to require the completed Memorandum of Agreement and payment 30 days prior to the start of the training period.

10. If the training objectives call for the analysis of data gathered over a particular geographic region, the visiting scientist should assemble all available material about the region. Reference data such as maps, aerial photography, and information on cultural practices will be especially useful.

11. The housing requirements of the visiting scientist should be sent to LARS. While LARS is not responsible for providing housing, we will do all we can to assist the visiting scientist in locating suitable housing.

12. International visiting scientists should arrange for a U.S. visa. LARS can provide supporting documentation (DSP form 66) as required.

13. Finally, travel arrangements should be completed. If LARS is notified of the visiting scientist's itinery, arrangements will be made to meet him upon arrival in Lafayette.

All correspondence relating to the LARS Visiting Scientist Program should be addressed to:

Mr Douglas B. Morrison
Education and Training Coordinator
Laboratory for Applications of Remote Sensing
Purdue University
1220 Potter Drive
West Lafayette, IN 47906
U. S. A.

## Appendix A

## ADVANCE PLANNING CHECK LIST

This check list is designed to aid the prospective visiting scientist in planning his training program.

_____ Formulate objectives of visit.

_____ Estimate time required to meet objectives. (Use example programs previously described as a guide.)

_____ Submit application (use form in Appendix D).

_____ If your native language is not English, take Test of English as a Foreign Language Exam (TOEFL).

_____ Respond to LARS' acknowledgement of receipt of application, cost proposal and suggested dates of training.

_____ Complete Memorandum of Agreement and forward with payment to Purdue University.

_____ If objectives include the analysis of data from a specific geographic area, gather maps, aerial photographs and other reference data.

_____ Notify LARS of housing requirements.

_____ Obtain Visa if required.

_____ Notify LARS of travel itinerary.

Appendix B

GUIDELINES AND WORKSHEETS FOR ESTIMATING COST OF TRAINING PROGRAMS

These guidelines are intended to enable prospective visiting scientists to compute the approximate cost of a particular visiting scientist program. A cost proposal will be made by LARS based upon an assessment of the program objectives, its duration, number of participants, etc.

I. Basic Costs

a. Duration of proposed visit _____ days
b. Number of participants _____
c. Number of man days (product of a and b) _____
d. Basic Cost (see Appendix C) $_____

II. Computer Services

a. Estimate 2.0 hours of CPU time per participant for learning the analysis programs and working through an analysis case study.
Estimate cost _____ CPU hrs. X CPU rate (Appendix C) $_____

b. Estimate computer services for specific analysis tasks using the following examples as a guide.
Preprocessing Costs PP$ _____
Processing Costs P$ _____
Output Product Cost OP$ _____
Computer cost sub-total$_____

Preprocessing costs can be estimated using the following formula:

PP$ = $200 * NDA + $140 * NLR + ($270 + $120 * MGC) * NGC

where
NDA = the number of Landsat data tapes ordered
NLR = the number of Landsat reformattings required
MGC = the number of geometrically corrected output points expressed in millions of points
NGC = the number of four channel geometric corrections

"Processing" is loosely defined as those functions which are performed jointly by the computer and the analyst such as applying pattern recognition techniques to the preprocessed data to produce the desired output information. The formula for estimating processing costs is:

P$ = $100 * NRT + $6 * MPC * NSC * NC * (NC + 1)

where
NRT = the number of runs (or areas ) to be classified
MPC = the number of points to be classified (expressed in millions of points)
NSC = the number of spectral classes
NC = the number of channels (Landsat has 4 channels)

This estimate is based upon the assumption that the LARSYS per point classifier is to be used. The estimate was arrived at by analyzing the costs of a large number of analysis jobs and assumes an experienced analyst. An inexperienced analyst may incur 25% to 75% higher processing costs.

The cost of the output products which can be produced with the standard LARSYS processing functions (lineprinter maps, classification tables, digital display photos) is included in the cost of processing estimate. Special output products as described on page 11 cost about $400 per .35m X .55m print. The number of prints required depends upon the scale desired. It is recommended that specialized output products be considered only after consultation with LARS staff.

Examples -

1. Analysis of a 40 by 40 kilometer area (25 by 25 miles) at a resolution of 89 meters, using Landsat data and producing a 1:24,000 scale color coded classification map.

Preprocessing cost estimate is
PP$ = $200·1 + $140·1 + ($270 + 120·.2)·1
= $200 + $140 + $294
= $634

Processing cost estimate is
P$ = $100·1 + $6 (.2) · 16 · 4 · 5
= $484

Output product cost estimate
OP$ = $405
Total estimate = $634 + $484 + 405 = $1523

This estimate assumes that 16 spectral classes were used in the analysis.

2. Analysis of an entire Landsat frame, 185 by 185 kilometers (approximately 100 nautical miles by 100 nautical miles and 8 million data points) at a resolution of 355 meters and the production of a color classification map at a scale of 1:500,000 is estimated as follows:

Preprocessing costs
PP$ = $200·  + $140·1 + ($270 + $120 8)· 1
= $1570

Processing costs
P$ = $100 + $6(1/2) · 16 · 4 · 5
= $960

Output products
OP$ = $405
Total estimate = $1570 + $960 + $405 = $2935

Since the required resolution is 355 meters only every fourth line and column of data needs to be classified or approximately 1/2 million data points. Again 16 spectral classes was assumed.

3. Analysis of a full Landsat frame at an 89 meter resolution would require classification of 8 million data points. The costs in this case would be:

Preprocessing costs
$PP\$ = \$200\cdot 1 + \$140\cdot 1 + (\$270 + \$120\cdot 8) \cdot 1$
$= \$1570$

Processing costs
$P\$ = \$100\cdot 10 + \$6(8) \cdot 16 \cdot 4 \cdot 5$
$= \$16,360$

Output products
$OP\$ = \$405$
Total estimate = \$1570 + \$16,360 + \$405 = \$18,335

The third example points out the relatively expensive processing costs associated with analyzing an entire frame at full resolution. It should be pointed out that these cost estimates are based on using the LARS experimental computer system and are not representative of a system designed for production operation. Also, when analyzing an area as large as a Landsat frame one usually does not require 89 meter resolution. Thus the estimate of example 2 is more typical of full frame analysis costs on the LARS system.

The formulas and examples given in this section are intended to give the prospective visiting scientist data upon which to compute an estimate of the computer costs associated with a specific analysis objective. In general we discourage visiting scientists and their sponsoring organizations from putting a high priority on carrying out a specific analysis. Rather we emphasize a fundamental understanding of the principles underlying the analysis process thereby enabling the visiting scientist to assess both the capabilities and the limitations of current remote sensing technology.

## III. Staff Support

Data analyst support is highly recommended when the objectives of the visit include a state of the art analysis of a specific data set.

Estimate 20% of Computer cost          Sub total $______

## Total Cost Estimate

| | | |
|---|---|---|
| I | Basic Costs | ______ |
| II | Computer Services | ______ |
| III | Staff Support | ______ |
| | Total | ______ |

## Appendix C

## LARS VISITING SCIENTIST RATE SCHEDULE*

### Basic Daily Rate

| Man-Days** | Cost Per Man-Day | Cumulative Cost |
|---|---|---|
| days 1 and | $250/day | $ 500 2 man-days |
| days 3, 4 and 5 | 200/day | 1100 5 man-days |
| days 6 thru 10 | 150/day | 1850 10 man-days |
| days 11 thru 15 | 100/day | 2350 15 man-days |
| days 16 thru 20 | 60/day | 2650 20 man-days |
| days 21 thru 25 | 30/day | 2800 25 man-days |
| days 26 and over | 20/day | 2800 + 20 (number of man-days in excess of 25) |

### Computer Facility Charges

| Item | Unit | Rate/Unit |
|---|---|---|
| Computer Service (Includes 1 hour of CPU, priority service and 10 hours of terminal connect time) | 1 CPU hr. | $400.00 |
| Digital Display | 1 hour | 25.00 |
| Landsat Reformatting | 1 run | 135.00 |
| Geometric Correction Run | 1 run | 270.00 |
| Geometric Correction Data Points | 1 million points | 120.00 |
| Mead Photo Processing (3 copies) | 1 run | 405.00 |

### Staff Support (Computer Programmer or Data Analyst)

| | |
|---|---|
| Professional Assistant (includes salary, fringe benefits and University overhead) | $ 25.00/hr. |

---

* Rates as of July 1, 1977. Subject to change without notice.

** Defined as one person for 1 day.
Examples:
a) One person for 4 days would be 1 X 4 = 4 man-days.
b) Two persons for 2 days would be 2 X 2 = 4 man-days.
c) Three persons for 3 months would be 195 man-days.

## Appendix D

## LARS VISITING SCIENTIST PROGRAM

Part A: Professional Background of Participants

Note: Complete Part A for each participant.

Name ____________________

Company or Organization ____________________

Address ____________________

____________________

____________________

____________________

Phone or Cable Address ____________________

Educational Background:

List Earned Degree(s)

| School | Degree | Date Awarded | Field or area of specialization |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

Specialized seminar or short courses related to remote sensing (Describe name of each seminar/course, duration, dates, institution or organization offering the course.)

____________________

____________________

____________________

____________________

Work Experience:

Current Job Title ____________________

Description of Responsibilities ____________________

____________________

Previous Work Experience

Dates | Job Description

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

Describe Previous Experience in Remote Sensing (if any)

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

Personal Data:

Age _____, Citizenship_______________, Native Language*_____________

Do you plan to being your spouse? ___Yes ___No

Are any children accompanying you? If so, how many? ______

*Applicants whose native language is not English are required to demonstrate proficiency in English. This may be done by taking the Test of English as a Foreign Language (TOEFL) exam, which is administered by most U.S. Embassies; or, offering similar evidence (such as a degree earned in an English speaking country).

Application Form

LARS VISITING SCIENTIST PROGRAM

Part B: Information about Program

Proposed Duration of Program ______________________________

Preferred Dates 1st choice ______________________________

2nd choice ______________________________

3rd choice ______________________________

Sponsoring Organization and Address (Give contact person if different from visiting scientist(s).)

______________________________

______________________________

______________________________

To whom should correspondence be sent? ______________________________

______________________________

______________________________

______________________________

Number of visiting scientist applying ______________________________

Objectives (include desired technical and educational objectives, applicant's area of interest, skills to be learned, type of report covering training activities, etc.)

(Use reverse side if necessary)

Mail completed application to:

Mr. Douglas B. Morrison
Laboratory for Applications of Remote Sensing
1220 Potter Drive
West Lafayette, IN 47906
U.S.A.