Perspective on Education in Photogrammetry and Remote Sensing

An introduction to courses, programs, and innovations in education on the North American continent.

This issue of our Journal provides an updated overview of the widely dispersed and diversified programs which offer educational opportunities in the United States, Mexico, and Central America, and reflects the role and scope of photogrammetry and remote sensing. Few other fields of study are interrelated with such a diversified group of academic disciplines and departments or research institutions; and few other fields have contributed so actively to the instrumented discovery of both scientific realities and data for applied environmental management both on earth and in space.

The extensive collateral training activities carried on by governmental agencies and private enterprises actively involved in photogrammetry and remote sensing may be suggested by some of the data in the surveys reported here, but no attempt has been made to survey these very significant contributions to the advancement of photogrammetric skills. Nor can this group of presentations do other than illustrate, as one article demonstrates, the value of the short and "mini" courses, symposiums, and summer institutes—often supported by the National Science Foundation—that have been of outstanding value in expediting the transfer of knowledge and new technology and the potential of its application. These programs which often have been scheduled in association with the time and place of national meetings by various disciplines have been particularly successful in dispersing awareness of remote sensing capabilities. Some professional associations have established their own committees or commissions on remote sensing to encourage communication, and some, such as the Association of American Geographers' Committee on Remote Sensing, have established periodical publications which vary from newsletter to pamphlet size and emphasize educational activities and methods. Two articles of this issue demonstrate the development of innovative instructional techniques, a frequent occurrence in remote sensing education and photogrammetry.

Since other authors in this issue have referenced previous articles in this Journal concerning education, they are not discussed here, but those interested in pursuing the historical perspective will note the great expansion of education related to the use of imagery. The advance of detecting and recording systems, the improvement in reproduction methods, and the advance of interpretation techniques and measurement methods have stimulated the growth in courses, programs, and career majors. However, growth in education has been so rapid that many significant dimensions are not yet well developed. The increasing importance of certification, as recognized by the Society, seems to suggest a greater attention to such tasks as defining the core requirements for a professional photogrammetrist and remote sensing practitioner. This also requires an improved structure of continuing education to maintain and update professional skills in a dynamic field. Many teachers of remote sensing are delighted with the recent publication of the Manual of Remote Sensing, but still regret the need for a text that organizes learning experiences for students entering the field. Specialized texts relating to particular disciplines are developing, but the cost of color printing often inhibits their ef-

* Chairman, Committee on Education, American Society of Photogrammetry.

fectiveness when serving limited markets. Teaching aids which can introduce students to automatic measurement and interpretation systems are needed, because only a few students have access to the high-capability electronics of elaborate laboratories. Simplified interpretation systems which can relate to computer terminal access now found in almost all educational centers would advance educational development and could also encourage smaller agencies, such as county planning groups, to integrate imagery data in their information systems.

The Society is appreciative of the considerable service of L. David Nealey, who organized the most extensive survey of our educational programs yet achieved—and to Dario Rodriguez-Bejarano who has reported on Mexico and Central America. Much of the momentum for these studies was initiated by the Remote Sensing Division’s Committee on Education, Chaired by Ralph W. Kiefer. We regret any omissions that may occur, and look forward to meeting the need for continuing reporting on education in photogrammetry and remote sensing.

ASP’s 1977 President Cartwright

Vern Cartwright has been active in the field of photogrammetry and aerial photography for over 30 years and more recently has entered the fields of operational remote sensing and computer cartography. He is registered in the State of California as an Industrial Engineer, Professional Engineer, and as a Photogrammetric Surveyor. He was instrumental in obtaining recognition and licensing of photogrammetrists in California.

Vern is a Past President of the National Legislative Council for Photogrammetry, Past President of the Northern California Region American Society of Photogrammetry, and has served as the 1st and 2nd Vice President of the National Society. He served for two years on the Board of Directors of the Northern California Chapter of the American Congress of Surveying and Mapping, is a member of the American Public Works Association, the American Society of Military Engineers, Legislative Council of Photogrammetry, American Society of Civil Engineers, and Society of Photo-Optical Instrumentation Engineers. He has authored many articles on remote sensing, photogrammetry, and computer cartography and is a visiting lecturer on these subjects at a number of universities.

In 1967 Governor Ronald Reagan appointed him to the California State Board of Control on which he served for eight years as the Public Member. This Board administers a program to aid victims of violent crimes and holds hearings to decide all money claims against the State of California. Also in 1967, he was appointed by Governor Reagan to the Engineers Advisory Council to review and make recommendations on legislation pertaining to engineers. In 1968 he served on a Task Force Committee for Aerospace Education under the direction of Congressman Donald Clausen.

He is the President and sole owner of four firms: Cartwright Aerial Surveys, Inc., Datamap Systems, Inc., Cartwright Blueprint Company, and Cartwright Research.

In 1966 he founded the International Remote Sensing Institute, a non-profit organization dedicated to the advancement of the science of remote sensing. During the past four years he has been active in the development of data handling systems and techniques.

Vern Cartwright was born in Medford, Oregon, attended schools at Medford and Portland, Oregon, and served in the navy as an aerial photographer for three years during World War II.

His hobbies are building computers and running political campaigns. He and his wife Miriam reside in Sacramento, California.
Remote Sensing/Photogrammetry Education in the United States and Canada

A listing of courses, programs, projects, and textbooks.

INTRODUCTION

Remote sensing/photogrammetry is a critical tool in present-day research, one that can reduce field reconnaissance in a remote area of Alaska from a few months to a few days; tell a HUD planner where to site for greatest soil and rock competence; watch related programs at 125 universities in the United States. In 1972, Eitel published a list of 80 remote sensing courses, and Bidwell (1975) and Morain (1975) recently researched colleges and universities for courses and programs in this field. The data presented here were obtained between May

ABSTRACT: Remote sensing and photogrammetry are an integral part of many programs at colleges and universities in the United States and Canada. In 1975, there were at least 470 courses in the United States and 64 in Canada that stressed remote sensing/photogrammetry. Thirty-eight universities in the United States and six in Canada have or plan to initiate majors, minors, or areas of specialization in remote sensing/photogrammetry. Many of the courses include field trips and several are offered in the evening. At least 63 books (listed) have been adopted as textbooks and reference books. The American Society for Engineering Education reported at least 110 basic engineering research projects underway at 31 member institutions in 1974 and 1975 (list included).

wheat in the United States, USSR, and the Peoples Republic of China; reveal the crop pattern of pre-historic Sinagua farming in Arizona; and make possible mapping for the search for life on Mars.

The status of remote sensing and photogrammetry in college and university curricula has been the subject of several works in the past few years. Stanton (1971) discussed photogrammetry and photogrammetry-

† Revised from the paper presented at the 42nd Annual Meeting, American Society of Photogrammetry, Washington, D. C., February 22-28, 1976, to include information on courses and programs in Canada.

1 Used in the general sense of the term, the courses cover the electromagnetic spectrum from the ultraviolet through the radio range and include non-photographic sensor systems.

2 Courses mainly concerned with aerial photography and camera systems.
troseology, 96 in photogrammetry, 18 in image processing, and 59 in other related subjects in the United States (List A). Of these, 23 are programmed for evening classes and 113 include trips. Courses are taught in 178 institutions in 24 academic areas.

Canadian programs in 1975 included at least 27 remote sensing courses, 10 photointerpretation courses, 25 photogrammetry courses, and two other related courses (List B), taught at 13 institutions in seven academic areas. At least one of them is offered in the evening and 13 include trips.

About 75 percent of the remote sensing/photogrammetry courses in the United States are taught by departments of geography (22 percent), geology (19 percent), civil engineering (20 percent), and forestry (13 percent) (Table 1). Another four percent of the courses are in the curriculum of civil engineering departments if the Ohio State University's Department of Geodetic Science can be included in the category of civil engineering. Approximately one-third of all remote sensing courses are taught by geography departments, and 72 percent of all photogrammetry courses are taught by civil engineering departments (Ohio State included). The majority of the image processing courses are taught in electrical engineering departments, which reflects the infancy of computer applications to remote sensing. In the future, image processing courses are expected to increase in number and to be introduced to applications-oriented departments, i.e., geology, forestry, and geography.

The number of students enrolled in remote sensing/photogrammetry courses could not be accurately determined from the information received in response to the questionnaire. Many responses were received that did not include enrollment figures, and

<p>| TABLE 1. RELATION OF TYPES OF COURSES TO DEPARTMENTS IN WHICH THEY ARE OFFERED (U.S.). |
|----------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|</p>
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<th>PIr</th>
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many of these were from large universities having fairly comprehensive programs in remote sensing and photogrammetry. A tally of the responses shows that at least 4000 students are enrolled annually in a remote sensing/photogrammetry course, but there is no way to determine from this information how many of them enroll in two or more such courses. It is thought that the number of students enrolled in remote sensing/photogrammetry courses annually is as high as 6000.

Trips taken as an integral part of at least 113 courses include visits to local aerial survey firms or government agencies. Field trips provide the students with practice in ground-truth verification, occasionally in actual data acquisition from remote-sensing platforms.

Thirty-eight universities in the United States (List C) and six in Canada (List D) have or plan to initiate majors, minors, or areas of specialization in remote sensing, photogrammetry, or astrogeology (planetary geology). Several universities that offer more than one course in remote sensing/photogrammetry do not provide degree programs in these areas. Colorado State University, for instance, has at least 13 undergraduate and graduate courses in remote sensing and photogrammetry but does not offer a degree in either field, whereas the University of Miami, with only one remote sensing course, offers a minor and Ph. D. in remote sensing.

An example of the curriculum required for a Masters degree in photogrammetry is included as List E, taken from the pamphlet Curriculum Information, the Department of Geodetic Science, The Ohio State University.

There are no known programs in the United States or Canada similar to the South Australian Institute of Technology's graduate diploma in remote sensing, a two-year part-time graduate program that teaches remote sensing to professionals within the framework of their discipline. The program contains six courses: remote sensing I & II, applied interpretation I & II, and field assessment A & B. The first year of the program is concerned with the physical, environmental, and human factors of remote sensing data acquisition and interpretation and the interpretation of visual imagery. The second year covers non-photographic remote sensing techniques and the analysis of digital data. A good place for programs of this kind is the junior college, an excellent facility for training remote sensing and photogrammetric technicians.

Two American universities have developed innovative teaching techniques. Colorado State University videotapes its photogrammetry classes. The tapes are used by nonresident students at 21 cooperating institutions and seven county libraries in Colorado and Wyoming. Oregon State University's School of Forestry has developed a self-instruction approach to aerial photointerpretation instruction. This course is "self-paced and is built around the unit mastery concept." The student must obtain a "B" (80 percent) in each unit and may retake an exam twice. In addition to the unit exams, two midterms, a final, a photo-mission report, and a landform map report are included in the grading scheme. The faculty at the University believes that this approach produces:

(1) An increased mastery and longer retention of material over the lecture-lab approach;
(2) A higher percentage of A's, B's, and I's, and fewer D's and F's;
(3) More highly motivated students and greater student satisfaction, and;
(4) More material covered in the same amount of time.

Classroom lectures of the various institutions are reinforced and supplemented by the use of readings in at least 64 textbooks (List F). The most widely used remote sensing/photointerpretation text is T. Eugene Avery's Interpretation of Aerial Photographs (1968) (List G). When included in the category of remote sensing, it is used in 39 percent of the courses. As a text on photointerpretation, it is used for 50 percent of the courses. The next most used text on photointerpretation is U. S. Geological Survey Professional Paper No. 373 by Richard G. Ray (1960), Aerial photographs in geologic interpretation and mapping. The photogrammetry text most widely used is Paul Wolf's Elements of Photogrammetry (1974).

Many instructors find no single text satisfactory for all their needs and consequently employ two required texts. Several instructors utilize only readings in various journals such as Photogrammetric Engineering and Remote Sensing, symposia proceedings, and textbooks.

The Manual of Remote Sensing (American Society of Photogrammetry, 1975) has been used at several institutions. The cost ($32.50 to students), size (two volumes), and complexity of this work will probably preclude its becoming the leading remote-sensing text.
in the United States, but it will continue to be used extensively as a reference book and for additional reading assignments for its excellent technical papers by leading researchers.

Several remote-sensing texts are being prepared for publication. They include works by Floyd Sabins, Chevron Oil Research; David Simonett, University of California at Santa Barbara; and Alan Gillespie and Barry S. Siegal, Jet Propulsion Laboratory. Sabin's text will include a workbook that has interpretation exercises keyed to the text. The workbook will contain unannotated images not included in the text. This is a needed instructional aid at present, especially at institutions where the instructors are new to remote sensing and are unaware of the many sources of data.

Visual aids are available in formats that provide the instructor with selected 35-mm slides of satellite, aircraft, ground, and microscope data of various areas from several sensors and involving many scientific problems. Facilities where slides can be obtained without permission of the author or the U.S. Geological Survey include: Pilot Rock Inc., Arcata, California; the EROS Data Center USGS, Sioux Falls, South Dakota; the Technology Applications Center, University of New Mexico, Albuquerque, New Mexico; John Wiley & Sons (slides by Norman Gillmeister and Barry Siegal); McGraw-Hill (slides by John S. Shelton); and Purdue University, Laboratory for the Applications of Remote Sensing, West Lafayette, Indiana.

A wide range of remote sensing and photogrammetry equipment, from pocket stereoscopes to analytical stereoplotters, is available to students at institutions in the United States and Canada, and a few schools utilize their own aircraft to acquire specialized data. In addition to internal resources, several institutions maintain a close working relation with federal, state, and commercial agencies. Only one formal internship was found in the survey, an arrangement of South Dakota State University with the U.S. Geological Survey EROS Data Facility, Sioux Falls, South Dakota.

The American Society for Engineering Education (ASEE) annually publishes a summary and analysis of engineering research and graduate study activities of the 195 ASEE member institutions in its journal, Engineering Education. The list does not represent all engineering research projects, since all institutions are not members, and all of those surveyed do not subdivide their projects into specific disciplines such as remote sensing and photogrammetry. Many of the subdivisions have peripheral applications to remote sensing. Readers interested in specialized areas are referred to the journal of the American Society of Engineering Education and to the various engineering departments.

The ASEE indicated that Remote Sensing/Photogrammetry engineering research projects are underway at at least 27 institutions in the 1973-1974 school year (Engineering Education, 1974) and 31 institutions in the 1974-1975 school year (Engineering Education, 1974) and 31 institutions in the 1974-1975 school year (Engineering Education, 1975) (List H). There were more than 122 research projects in the 1973-1974 time period and 110 in the 1974-1975 time period.

The author wishes to thank Mrs. Carolyn Waller and Mrs. Velma Jean Reed for their help in the preparation of this paper. The cooperation of the institutions and individuals who made this paper possible is greatly appreciated, especially Dr. Philip J. Howarth, who helped with the gathering of information on Canadian programs.

REFERENCES


The Department of Geodetic Science, The Ohio State University Curriculum Information, April 1975.

Note: Research projects of an applications nature are not included in this paper; only basic engineering research projects are listed.
REMOTE SENSING/PHOTOGRAMMETRY EDUCATION IN THE U.S. & CANADA

NOTE: Asterisk (*) denotes the discipline credited with courses listed under departments having multiple disciplines. Universities are listed alphabetically by state.

**LEGEND**
- RS—Remote Sensing
- RSr—Remote Sensing related
- PI—Photo-Interpretation
- PIr—Photo-Interpretation related
- PG—Photogrammetry
- PGr—Photogrammetry related
- MPI—Map & Photo-Interpretation
- PGe—Photogeology
- AG—Astrogeology
- SD—Systems Design
- IP—Image Processing
- OP—Optics

**ALABAMA**

*Univ. of Alabama*
- Dept. of Geography
  - #420 Air Photo Interp. (PI)
  - #417 Photogrammetry (PG)
    - 5 Qtr. hrs. UGrad/Grad
  - #617 Remote Sensing (RS)
    - 3 Qtr. hrs.
  - #691 Directed Study (PI, RS)
    - 1-5 Qtr. hrs.

*Dept. of Civil Eng.*
- #408 Advanced Surveying and Mapping (PGr)
  - 5 Qtr. hrs. UGrad

*Dept. of Elec. Eng.*
- #646 Pattern Recognition (SD)
  - 3 Qtr. hrs. Grad

*Univ. of South Alabama*
- Dept. of Geography
  - #331 Methods of Geographic Research (PIr)
    - 5 Qtr. hrs.

**ALASKA**

*Univ. of Alaska-Fairbanks*
- Dept. of Civil Eng.
  - #412 of Elements of Photogrammetry (PG)
    - 3 Sem. hrs. UGrad

*Dept. of Geology*
- #408 Photogeology (PGe)
  - 3 Sem. hrs.
- #494 Geoscience Applications of Remote Sensing (RS)
  - 3 Sem. hrs. UGrad/Grad
- Evening

**ARIZONA**

*Univ. of Arizona*
- Dept. of Civil Eng.
  - #254 Photogrammetry (PG)
    - 3 Sem. hrs. UGrad/Grad

*Dept. of Geography and Area Development*
- #298 Geographical Applications of Remote Sensing (RS)

*Dept. of Geosciences*
- #207 Photogeology (PGe)
  - 3 Sem. hrs. UGrad/Grad
- #207 Applied Multispectral Imagery (RS)
  - 2 Sem. hrs. Grad

*Arizona State Univ.*
- Dept. of Geography
  - #575 Geographic Applications of Remote Sensing (RS)
    - 3 Sem. hrs.

*Northern Arizona Univ.*
- Dept. of Engineering
  - #330 Photogrammetry (PG)
    - 3 Sem. hrs.
Dept. of Geography
#418 Remote Sensing Techniques (RS)
4 Sem. hrs.
#419 Remote Sensing Techniques (RS)
#420 Remote Sensing Techniques-Methology (RS)
2 Sem. hrs. Trips
Dept. of Forestry
#524 Airphoto Interp (PI)
3 Sem. hrs. Grad
Phoenix College
Dept. of Engr. Science
#242 Topographical Surveying (PG)
3 Sem. hrs.
Dept. of Civil Technology
#205 Introduction to Photogrammetry (PG)
3 Sem. hrs.
#248 Geodetic Surveying (PGr)
3 Sem. hrs.
Central Arizona College—Coolidge
Dept. of Civil Technology
#220 Photogrammetry (PG)
3 Hrs. UGrad
Arizona College of Technology
Dept. of Civil Eng. Tech.
#202 Surveying II (PGr)
4 Sem. hrs.

Arkansas
University of Arkansas—Monticello
Dept. of Forestry
#4653 Photogrammetry and Photointerpretation (RS)
3 Sem. hrs. UGrad Trips

California
Allan Hancock College—Santa Maria
Dept. of Engineering
#718 Surveying (PG)
3 Units Trips
California State Univ. at Chico
Dept. of Geological* and Physical Science
#301 Remote Sensing (RS)
California State Univ. at Fresno
Dept. of Civil Eng.
Photogrammetric Instrumentation (PG)
Dept. of Geography
Advanced Air Photo Interp. and Remote Sensing (RS)
3 Hrs. UGrad/Grad Trips
Dept. of Geology
Map and Photo Interp. (MPI)
4 Sem. hrs. UGrad/Grad
California State Univ. at Northridge
Dept. of Geosciences
#331 Photogeology (PG)
1 Sem. hr. UGrad Trips
California State Univ. at Sacramento
Dept. of Elec. Eng. of School of Engineering
#187 Environment Remotely-Sensed Using Satellites-Aircraft (RS)
3 Sem. hrs. UGrad Trips
City College of San Francisco
Dept. of Engineering
#196 Photogrammetry (PG)
UGrad Trips Evening
Columbia Jr. College—Columbia
Dept. of Natural Resources Technology Aerial Photography and Map Interp. (MPI)
3 Qtr. hrs. UGrad Trips
Feather River College—Quincy
Dept. of Timber Technician-Forestry
#57 Maps and Aerial Photo Interp. (MPI)
3 Sem. hrs.
Foothill College—Los Altos Hills
Dept. of Geology
#14 Map Reading and Aerial Photo Interp. (MP)
2 Qtr. hrs.
Planetary Geology (AG)
3 Qtr. hrs. UGrad Trips
Fullerton College
Dept. of Civil Engineering Technology
#2 Aerial Photo Interp. (PI)
3 Sem. hrs.
Dept. of Earth Sciences
Planetary Geology (AG)
3 Sem. hrs.
Humboldt State Univ.—Arcata
Dept. of Forestry
#106 Aerial Photogrammetry (RS)
4 Qtr. hrs. UGrad Trips
Dept. of Geography
#196 Remote Sensing (RS)
4 Qtr. hrs. UGrad/Grad Trips
Pasadena City College
Dept. of Eng. & Tech.
#170 Photogrammetry (PG)
6 Sem. hrs. UGrad Trips Evening
#170A Photogrammetry (PG)
3 Sem. hrs. UGrad Trips
#170B Photogrammetry (PG)
3 Sem. hrs. UGrad
#170C Photogrammetry (PG)
4 Sem. hrs. UGrad
#170D Photogrammetry (PG)
Pomona College
Dept. of Geology
Planetary Geology (AG)
4 Sem. hrs. UGrad Trips
San Diego State Univ.
Dept. of Geography
#587 Remote Sensing of the Environment (RS)
3 Sem. hrs. UGrad/Grad
#588 Adv. Remote Sensing of the Environment (RS)
3 Sem. hrs. UGrad/Grad
#687 Seminar in Remote Sensing of the Environment (RS)
3 Sem. hrs. Grad
Dept. of Geology
#505 Photogeology (PG)
3 Sem. hrs. UGrad/Grad Trips
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<td>Group Studies in Photogrammetry and Surveying</td>
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<td>4 qtr. hrs.</td>
<td>#102 Forest Photogrammetry and Photo Interp.</td>
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<td>Fundamentals of Remote Sensing of the Environment</td>
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<td>#722 Atmospheric Radiation and Energetics</td>
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<td>#737 Satellite Observation of the Atmosphere and Earth</td>
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<td>Interdepartmental Remote Sensing Program</td>
<td>#323 A Survey of Remote Sensing and Photogrammetry</td>
<td>3 Sem. hrs. UGrad</td>
<td>(RS, PG)</td>
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<td>#310 Interpretation of Maps and Remote Sensing</td>
<td>3 Qtr. hrs.</td>
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<td>United States Air Force Academy</td>
<td>Dept. of Economics, Geography* and Management</td>
<td>#383 Geographic Application of Imagery Analyses</td>
<td>3 Qtr. hrs.</td>
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<td>Univ. of Denver</td>
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<td>Yale Univ.</td>
<td>Dept. of Forest Mensuration and Operations Analysis Interp. of Aerial Photographs</td>
<td>#317a Terrestrial Photogrammetry and Remote Sensing</td>
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<td>College of Marine Studies</td>
<td>#672 Remote Sensing of Earth Resources</td>
<td>UGrad/Grad Trips Evening</td>
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<td>#681 Remote Sensing of Environment</td>
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<td>3 Sem. hrs. UGrad/Grad Trips Evening</td>
<td>Special Problems in Remote Sensing</td>
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<td>Dept. of Biology</td>
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<td>UGrad/Grad</td>
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<td>Washington Tech. Institute</td>
<td>Dept. of Geoscience</td>
<td>Remote Sensing</td>
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<td>#470 Remote Sensing of Environment</td>
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<td>#420/620 Use and Interp. of Aerial Photographs</td>
<td>5 Qtr. hrs. UGrad/Grad Trips</td>
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<td>#422/622 Advanced Photogrammetry</td>
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<td>#825/826/827 Problems in Remote Sensing of Environment</td>
<td>3 Qtr. hrs. Grad</td>
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<td>Hawaii</td>
<td>Univ. of Hawaii-Manoa</td>
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<td>#470 Remote Sensing</td>
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<td>#750 Seminar in Remote Sensing</td>
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<td>Idaho</td>
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<td>Dept. of Civil Eng.</td>
<td>Photogrammetry and Photo Interp.</td>
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<td>Dept. of Forest Resources</td>
<td>#390 Forest Resource Measurements</td>
<td>1 Sem. hr. UGrad Trips Evening</td>
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<td>#375-575 Aerial Photo Interp. of Renewable Natural Resources</td>
<td>2 Sem. hrs. UGrad/Grad</td>
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REMOTE SENSING/PHOTOGRAMMETRY EDUCATION IN THE U.S. & CANADA  267

IOWA

Iowa State Univ.

Dept. of Aerospace Eng.
Remote Sensing: Measurements from Space
3 Qtr. hrs. Grad

Dept. of Civil Eng.
#315 General Photogrammetry and Photo-Interp.
3 Qtr. hrs. UGrad/Grad

#414 General Photogrammetry and Photo-Interp.
3 Qtr. hrs. Grad

#418 Stereo-Photogrammetry (PG)
3 Qtr. hrs. UGrad/Grad

#419X—Remote Sensing (RS)

#510 Analytical Photogrammetry
#516 Advanced Topics in Photogrammetry and Photointerp.

#519 Remote Sensing of the Environment and Earth resources (RS)

#562 Airphoto Interp. of Engineering Soils (PI)

Dept. of Electrical Eng.
#533 Modern Eng. Optics (OP)
3 Qtr. hrs. Grad

Dept. of Forestry
#445 Forest Photogrammetry and Photo-Interp.
#590C Forest Mensuration and Photogrammetry
2-5 Qtr. hrs. Grad

Dept. of Geology
#407 Geologic Interp. of Aerial Photographs (PGe)

Univ. of Iowa

Dept. of Geography
Environmental Impact Studies
3 Sem. hrs. UGrad/Grad

Dept. of Geology
Geologic Remote Sensing
3 Sem. hrs. UGrad/Grad

#12: 106 Photogeology and Geologic Map Interp.

Univ. of Illinois

Dept. of Geology
Remote Sensing: Measurements from Space
3 Sem. hrs. Grad

Dept. of Civil Eng.

#306 Dynamics of Soil Development (RSr)
3 Sem. hrs. UGrad/Grad Trips

#309 Advanced Remote Sensing of the Environment
3 Sem. hrs. UGrad/Grad Trips

Remote Sensing of the Environment (RS)
3 Sem. hrs. UGrad Trips

Dept. of Electrical Eng.
	
Dept. of Forestry

#557 Aerial Photo Interp. (PI)
3 Sem. hrs. Grad

#558 Remote Sensing of Natural Resources (RS)
3 Sem. hrs. Grad

#579 Remote Sensing Seminar (RS)
0 or 1 Sem. hr. Grad

Univ. of Kansas

Dept. of Geology, * Geography and Elec.
Eng. Remote Sensing (RS)
3 Sem. hrs. UGrad/Grad

Wichita State Univ.

Dept. of Geography
Map and Air Photo Interp. (MPI)
3 Sem. hrs. UGrad Trips

Wichita State Univ.

Dept. of Geology
Map and Air Photo Interp. (MPI)
3 Sem. hrs. UGrad Trips

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(RS)

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(PG)

(PG)

(PGe)
**KENTUCKY**

**Univ. of Kentucky**
Dept. of Civil Eng.
- #523 Photogrammetry (PG)
- UGrad/Grad Trips (PG)
- #621 Terrain Analysis (PIr)
- Grad

**Western Kentucky Univ.**
Dept. of Geography* and Geology
Airphoto Interp.
- UGrad/Grad Trips Evening (RS)
- Remote Sensing of Environment (RS)

**LOUISIANA**

**Louisiana State Univ.-Baton Rouge**
Dept. of Civil Eng.
Geodetic and Photogrammetric Surveying
- 3 Sem. hrs. UGrad (PG)
- Dept. of Geography* and Anthropology
  #4019 Air Photo Interp.: Cultural Features (PG)
  - 3 Cr. hrs. UGrad/Grad Trips (PG)
  #4020 Air Photo Interp.: Physical Features (PG)
  - 3 Cr. hrs. Trips (PG)
  #4015 Environmental Remote Sensing (PG)
  - 3 Cr. hrs. UGrad/Grad Trips (PG)

**Louisiana Tech Univ.**
Dept. of Civil Eng.
- #304 Remote Sensing (RS)
  - 2 Sem. hrs. UGrad (RS)

**Tulane Univ.**
Dept. of Earth Sciences Astrogeology (AG)
- 3 Sem. hrs. UGrad/Grad (AG)

**MAINE**

**Univ. of Maine**
Dept. of Forest Resources
- #6 Photogrammetry and Remote Sensing of Natural Resources (RS)
  - UGrad/Grad Trips (RS)
  - #106 Photogrammetry (PG)
  - UGrad/Grad Trips Evening (PG)

**MARYLAND**

**Univ. of Maryland**
Dept. of Geography
Air Photo and Topographic Map Interp.
- (MPI)

**Massachusetts**

**Harvard Univ.**
Dept. of Landscape Architecture
- #4-2a Air Photo Interp. (PI)
  - 2 Sem. hrs. Grad Trips (PI)
- #4-2b Remote Sensing (RS)
  - 2 Sem. hrs. Grad Trips (RS)

**Massachusetts Inst. of Tech.**
Dept. of Earth and Planetary Sciences
Remote Sensing of the Earth (RS)
- 23 Sem. hrs. UGrad/Grad (RS)

**Southern Massachusetts Univ.**
Dept. of Elec. Eng.
- #573 Pattern Recognition (IP)
  - 3 Sem. hrs. UGrad/Grad (IP)
- #574 Topics in Digital Signal Processing (IP)
  - 3 Sem. hrs. UGrad/Grad (IP)
- #578 Picture Processing by Computers (IP)
  - 3 Sem. hrs. UGrad/Grad (IP)

**MICHIGAN**

**Eastern Michigan Univ.**
Dept. of Geography* - Geology
- #505 Aerial Photo Interp.-Remote Sensing (RS)
  - 2 Sem. hrs. Grad Trips Evening (RS)

**Grand Valley State College-Allendale**
Dept. of Geography
Remote Sensing (RS)
- UGrad (RS)

**Michigan State Univ.**
Dept. of Geography
- #224 Remote Sensing: Airphoto Interp. PI (PI)
  - UGrad/Grad (PI)
- #424 Remote Sensing (RS)
  - UGrad/Grad Trips Evening (RS)
- #818 Readings in Geography: Convert, Passive and Synthetic Aperture Sensors (RS)
  - Grad (RS)
- #818 Readings in Geography: Computer Interp. of Remote Sensors and Pattern Articulation Analysis (IP)
  - (IP)
- #818 Radings in Geography: Multispectral Remote Sensing (RS)

**Michigan Technological Univ.**
Dept. of Forestry
- #455 Aerial Photography Interp. in Forestry (PI)
  - UGrad/Grad (PI)

**Univ. of Michigan-Ann Arbor**
Dept. of Civil Eng.
- #560 Photogrammetry (PG)
  - 2 Sem. hrs. UGrad/Grad (PG)

Dept. of Electrical* and Computer Eng.
- #476 Noncoherent Optical Technology (OP)
  - 3 Sem. hrs. UGrad/Grad (OP)
- #477 Coherent Optics Lab (OP)
  - 2 Sem. hrs. (OP)
- #478 Environmental Remote Sensing Systems (RS)
  - 3 Sem. hrs. UGrad/Grad (RS)

Dept. of Natural Resources
- #441 Remote Sensing of Environment (RS)
  - 3 Sem. hrs. (RS)
- #541 Principles of Radiation for Remote Sensing (RS)
  - 3 Sem. hrs. (RS)

**Univ. of Michigan**
Dept. of Natural Resources
- #441 Remote Sensing of Environment (RS)
  - 4 Sem. hrs. (RS)
- #541 Principles of Radiation for Remote Sensing (RS)
  - 3 Sem. hrs. (RS)
- #542 Optical Sensors and Instrumentation (RS)
  - 3 Sem. hrs. (RS)
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<td>Univ. of Michigan—Flint</td>
<td>Dept. of Physical Geography: Remote Sensing in Environmental Analysis (RS)</td>
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<td>Carleton College—Northfield</td>
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<td>Dept. of Forestry: Research Problems: Photogrammetry, Remote Sensing (RS, PG)</td>
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<td>Univ. of Nebraska—Lincoln</td>
<td>Conservation and Survey Div.: Remote Sensing of the Environment (RS)</td>
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<td>Dartmouth College</td>
<td>Dept. of Geography: Remote Sensing: Seminar (RS)</td>
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MISSOURI

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<td>Dept. of Geology: Photogeology (PGe)</td>
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Dept. of Geology
#455L Air Photogrammetry and Photogeology (PGe)
3 Sem. hrs.

SUNY-Albany
Dept. of Geography
#285 Introduction to Remote Sensing of Environment (RS)
UGrad Trips
#485/585 Advanced Remote Sensing (RS)
UGrad/Grad
#685 Seminar in Remote Sensing (RS)
Grad Trips Evening

SUNY College-Cortland
Dept. of Geology
#590 Photogeology (PGe)
3 Sem. hrs. UGrad

SUNY College-Geneseo
Dept. of Geological Sciences
Geologic and Photogrammetric Interp. of Aerial Photography (PGe)
3 Sem. hrs. UGrad

SUNY College-New Paltz
Dept. of Geology
Air Photo Interp. (PI)
4 Sem. hrs. UGrad Trips

Dept. of Geological Sciences
Photogeology and Remote Sensing (RS)
4 Sem. hrs. Grad

SUNY College-Dineonta
Dept. of Earth Science
Photogeology
3 Sem. hrs.

SUNY-Syracuse
Dept. of Forest Eng.
#352 Introduction to Remote Sensing (RS)
2 Sem. hrs. UGrad
#363 Photogrammetry (PG)
3 Sem. hrs. UGrad
#563 Photogrammetry I
3 Sem. Hrs.
#652 Remote Sensing Interp.
3 Sem. hrs. Grad
#655 Remote Sensing Measurements (RS)
3 Sem. hrs. Grad Theory of Errors and Adjustments (PG)
Grad
Instrumental Photogrammetry I, Grad(PG)
Instrumental Photogrammetry II (PG)
Grad
Analytical Photogrammetry I (PG)
Grad
Analytical Photogrammetry II (PG)
Grad
Terrestrial and Non-Topographic Photogrammetry (PG)
Grad

Lehman College-CUNY
Dept. of Geology* and Geography
Air Photo Interp. (RS)
3 Sem. hrs. UGrad

NYCHE CAROLINA
Duke Univ.
Dept. of Computer Science
#210 Image Processing (IP)
3 Sem. hrs.

#250 Clustering and Classification (IP)
3 Sem. hrs.

NORTH CAROLINA
Duke Univ.
Dept. of Computer Science
#210 Image Processing (IP)
3 Sem. hrs.

#250 Clustering and Classification (IP)
3 Sem. hrs.
North Carolina A&T State Univ.
Dept. of Earth Science
#408 Aerial Photointerp. (PI)
3 Hrs. UGrad

North Carolina State Univ.
Dept. of Civil Eng.
#507 Air Photo Analysis (PI)
3 Sem. hrs. Grad Trips

Dept. of Forestry
#353 Air Photo Interp.
3 Sem. hrs. UGrad

Dept. of Geosciences
Photogeology (PG)
3 Sem. hrs.

Univ. of North Carolina
Dept. of Geography*—Earth Science
Air Photo—Remote Sensing Interp. (RS)
3 Sem. hrs. Trips

Western Carolina Univ.
Dept. of Earth Sciences Remote Sensing (RS)
5 Qtr. hrs. Trips

NORTH DAKOTA

North Dakota State Univ.
Dept. of Civil Eng.
#481 Photogrammetry (PG)
3 Sem. hrs. UGrad/Grad

Univ. of North Dakota
Dept. of General Eng.
#375 Remote Sensing Systems (RS)
2 Sem. hrs. UGrad Trips Evening

Dept. of Geography
#375 Introduction to Remote Sensing (RS)
3 Sem. hrs. UGrad Trips Evening
#475 Remote Sensing Applications and Analysis (RS)
2 Sem. hrs. UGrad/Grad Trips Evening

OHIO

Ashland College—Ashland
Dept. of Earth Sciences
#300 Air Photo Interp. (RS)
UGrad

Kent State Univ.
Dept. of Geography
#49064/59064/79064 Advanced Earth Imagery Interp. (RS)
5 Sem. hrs. UGrad/Grad Trips

Univ. of Akron
Dept. of Geography
#355:488/548 Remote Sensing of the Environment (RS)
3 Qtr. hrs. UGrad/Grad

Dept. of Geology
#337:404/504 Astrogeology (AG)
4 Qtr. hrs. UGrad/Grad

Ohio State Univ.
Dept. of Geodetic Science
#505 Photogrammetry and Photo Interp. (PI)
4 Qtr. hrs. UGrad/Grad
#503 Remote Sensing (RS)
4 Qtr. hrs. UGrad/Grad

#604 Terrain Analysis (PI)
4 Qtr. hrs. UGrad/Grad
#624 Instrumentation in Photogrammetry (PG)
4 Qtr. hrs. UGrad/Grad
#626 Metric Photography (PG)
4 Qtr. hrs. UGrad/Grad
#627 Introduction to Advanced Photogrammetry (PG)
5 Qtr. hrs. UGrad/Grad
#650 Adjustment Computations I (PG)
3 Qtr. hrs. UGrad/Grad
#651 Adjustment Computations II (PG)
3 Qtr. hrs. UGrad/Grad
#660 Geometric Photogrammetry (PG)
3 Qtr. hrs. UGrad/Grad
#688 Field Work in Photogrammetry (PG)
5 Qtr. hrs. UGrad/Grad
#778 Analog Photogrammetry (PG)
5 Qtr. hrs. UGrad/Grad
#779 Computational Photogrammetry (PG)
4 Qtr. hrs. UGrad/Grad
#780 Non-Conventional Photogrammetry (PG)
4 Qtr. hrs. UGrad/Grad
#782 Geodetic Applications of Digital Computers (PGr)
4 Qtr. hrs. UGrad/Grad
#802 Advanced Computational Photogrammetry (PG)
4 Qtr. hrs. Grad
#805 Advanced Stereophotogrammetry (PG)
4 Qtr. hrs. Grad
#822 Photogrammetry in Practice (PG)
4 Qtr. hrs. Grad
#826 Photo-Triangulation (PG)
4 Qtr. hrs. Grad
#872 Selenodesy and Lunar Mapping (PG)
3 Qtr. hrs. Grad

Wittenberg Univ.
Dept. of Geology
Geomorphology and Aerial Photo Interp. (PIr)
UGrad Trips

Wright State Univ.
Dept. of Geography
#261-4 Introduction to Remote Sensing (RS)
UGrad/Grad Trips Evening
#360/660-3 Systematic Geography: Problems in Map and Photo Interp. (MPI)
Trips Evening
#362/662-4 Remote Sensing of the Environment (RS)
UGrad/Grad Trips Evening
1-4 Qtr. hrs. UGrad/Grad
### Oklahoma

**Univ. of Oklahoma**  
Dept. of Geography  
#2913 Cartography—Map and Photograph Analysis  
UGrad  
#5613 Interp. of Aerial Photographs  
UGrad/Grad  

Dept. of Geology and Geophysics  
#5423 Aerogeology and Advanced Geomorphology  
UGrad/Grad  
#5433 Aerial Photographs in Stratigraphic and Structural Study  
UGrad/Grad  
#5443 Photogrammetry in Stratigraphic and Structural Study  
UGrad/Grad  
#5883 Remote-Sensing Exploration  
UGrad/Grad  

Dept. of Meteorology  
#4413 Synoptic Meteorology  
UGrad/Grad  

**Oklahoma State Univ.**  
Dept. of Civil Eng.  
#4623 Photogrammetric Engineering  
UGrad/Grad  
#5623 Aerial Photographic Interp.  
PI  

Dept. of Forestry  
#3880 Aerial Photogrammetry  
UGrad/Grad  

### Oregon

**Oregon State Univ.**  
Dept. of Civil Eng.  
#362 Photogrammetry  
UGrad/Grad  
#462 Photo Interp.  
UGrad/Grad  
#561 Photogrammetry  
UGrad/Grad  
#656 Analytical Photogrammetry  
UGrad/Grad  

Dept. of Forest Mgt - School of Forestry  
Aerial Photo-Interp.  
UGrad/Grad  

### Pennsylvania

**Lehigh Univ.**  
Dept. of Geological Sciences  
#393 Photogeology and Remote Sensing  
1 Sem. hrs. UGrad/Grad  

**Mansfield State College**  
Dept. of Geology  
Aerial Photo Interp.  
UGrad/Grad  

**Pennsylvania State Univ.**  
Dept. of Agronomy  
#415 Soil Morphology, Mapping and Land Use  
UGrad/Grad  

Dept. of Civil Eng.  
#112 Photogrammetry and Photointerp.  
UGrad/Grad  
#316 Photogrammetry and Photointerp.  
UGrad/Grad  
#512 Applied Soil Mechanics  
UGrad/Grad  

**Univ. of Pittsburgh**  
Dept. of Civil Eng.  
Geometronics  
UGrad/Grad  

**Slippery Rock State College**  
Dept. of Geology  
#331 Air Photo Interp.  
UGrad/Grad  

**Inter American Univ. of Puerto Rico**  
Dept. of Geography  
#301 Cartography and Aerial Photography  
UGrad/Grad  

**Univ. of Rhode Island**  
Dept. of Electrical Eng.  
#437 Introduction to Photo-electronic Devices  
UGrad/Grad  
#506 Digital Signal Processing  
UGrad/Grad  
#511 Electromagnetic Fields  
UGrad/Grad  
#520 Fourier Optics  
UGrad/Grad  
#531 Solid State Engineering I  
UGrad/Grad  
#532 Solid State Engineering II  
UGrad/Grad  
#535 Transistor Circuits  
UGrad/Grad  

### Rhode Island

**Univ. of Rhode Island**  
Dept. of Electrical Eng.  
#437 Introduction to Photo-electronic Devices  
UGrad/Grad  
#506 Digital Signal Processing  
UGrad/Grad  
#511 Electromagnetic Fields  
UGrad/Grad  
#520 Fourier Optics  
UGrad/Grad  
#531 Solid State Engineering I  
UGrad/Grad  
#532 Solid State Engineering II  
UGrad/Grad  
#535 Transistor Circuits  
UGrad/Grad  

### Indiana Univ. of Pennsylvania

Dept. of Geography  
#490 Map and Photo Interp.  
UGrad/Grad  

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REMOTE SENSING/PHOTOGRAMMETRY EDUCATION IN THE U.S. & CANADA

SOUTH CAROLINA

Clemson Univ.—Clemson
Dept. of Civil Eng.
#417-617 Air Photo Interp. I
3 Sem. hrs. UGrad/Grad Trips
#419-619 Photogrammetry
3 Sem. hrs. UGrad/Grad Trips
#812 Air Photo Interp. II
3 Sem. hrs. Grad Trips
Dept. of Forestry
#308, 608 Aerial Photographs in Forestry
3 Sem. hrs. UGrad/Grad Trips

Univ. of South Carolina
Dept. of Geography
#105 Maps and Aerial Photographs (MPI)
3 Sem. hrs.

SOUTH DAKOTA

South Dakota State Univ.
Dept. of Geography
#483 Air Photo Interp.
3 Sem. hrs. UGrad
#484 Remote Sensing
3 Sem. hrs.
#780 Seminar—Geographic Techniques: Advanced Remote Sensing
2-3 Sem. hrs. Grad
EROs Data Center Short Course—Remote Sensing
4 Sem. hrs.
Dept. of Elec. Eng.
Automatic Signal Processing Methods (IP)
2 Sem. hrs. Grad

Univ. of South Dakota
Dept. of Earth Sciences*
Physics Internship at the EROS Data Center (RS)

TEXAS

Pan American Univ.—Edinburg
Dept. of Physical Science
#4101, 4102 Advanced Physics Lab
UGrad

Stephan F. Austin State Univ.
Dept. of Forestry
#441 Forest Photogrammetry
3 Sem. hrs. UGrad/Grad
#442 Advanced Photogrammetry
3 Sem. hrs. UGrad/Grad
#651 Forest Photo Mensuration
3 Sem. hrs.
#652 Remote Sensing of Natural Resources
3 Sem. hrs. UGrad/Grad

Texas A&M Univ.
Dept. of Bio-Sciences
#444 Remote Sensing in Renewable Natural Resources
3 Sem. hrs. UGrad

Dept. of Civil Engr.
#470 Aerial Photogrammetry
3 Sem. hrs.

Dept. of Electronic Eng.
#659 Electro-Optical Systems Eng.
3 Sem. hrs.
Depts. of Forest Science  
#485 Photographic Interp. Verification and Mapping (PI)  
1-4 Sem. hrs. UGrad/Grad Trips

Depts. of Forest Science* and Civil Engr.  
#661 Photo Interp. (PI)  
3 Sem. hrs. Grad Trips

Dept. of Geology  
#633 Photogeology (RS)  
3 Sem. hrs. Grad

Dept. of Meteorology  
#616 Remote Sensing of the Atmosphere (RS)  
3 Sem. hrs. Grad  
#674 Radar Meteorology  
3 Sem. hrs. Grad  
Radar Meteorology  
2-3 Sem. hrs.

Texas Tech Univ.  
Dept. of Geosciences  
Remote Sensing Instrumentation (RS)  
1 Sem. hr. UGrad/Grad Trips  
Remote Sensing  
3 Sem. hrs. UGrad/Grad Trips

Univ. of Texas-Austin  
Dept. of Geography  
#362K Remote Sensing of the Environment (RS)  
UGrad Trips  
#383K Research in Remote Sensing (RS)  
Grad Trips

UTAH  
Utah State Univ.  
Dept. of Civil* and Environmental Eng.  
Photogrammetry (PG)  
3 Qtr. hrs. UGrad Trips  
Dept. of Geology  
#564 Photogeology (PG)  
3 Qtr. hrs. UGrad/Grad Trips

Univ. of Utah  
Dept. of Geography  
#543 Advanced Remote Sensing-Remote Sensing of the Environment (RS)  
3 Qtr. hrs. UGrad/Grad Trips Evening  
Remote Sensing (RS)  
3 Qtr. hrs. UGrad/Grad Trips Evening  
Dept. of Civil Eng.  
#501 Photogrammetry (PG)  
3 Qtr. hrs. UGrad Trips

VERMONT  
Middlebury College-Middlebury  
Dept. of Geography  
#302 Techniques of Spatial Analysis: Cartography and Remote Sensing (RS)  
UGrad Trips

Univ. of Vermont  
Dept. of Civil Eng.  
#210 Air Photo Interp. (PI)  
3 Sem. hrs. UGrad/Grad Trips  
Dept. of Geography  
#161 Remote Sensing of Environment (RS)  
#261 Remote Sensing and Environmental Problems (RS)

VIRGINIA  
Emory and Henry College-Emory  
Dept. of Geology  
Cartography and Remote Sensing (PI)  
4 Sem. hrs. Trips

Virginia Military Institute  
Dept. of Civil Eng.  
#450 Photogrammetry (PG)  
2 Sem. hrs. UGrad Trips

WASHINGTON  
Univ. of Washington  
Dept. of Civil Eng.  
#316 Geometrics  
4 Sem. hrs.  
#415 Photogrammetry (PG)  
3 Sem. hrs.  
#515 Stereogrammetry (PG)  
3 Sem. hrs.  
#518 Aerial Triangulation (PG)  
3 Sem. Hrs.  
#530 Adjustment Computations (PG)  
4 Sem. hrs.  
#565 Remote Sensing of Environment (RS)  
3 Sem. hrs. Grad Trips  
Dept. of Geological Sciences  
#414 Photogeology  
3 Hrs. UGrad/Grad  
Dept. of Urban Planning  
#508 Specialized Planning Laboratory in Remote Sensing Applications (RS)  
5 Hrs. Grad Trips

Washington State Univ.  
Dept. of Agronomy and Soils  
#416 Airphoto Interp. (PI)  
UGrad/Grad

WEST VIRGINIA  
West Virginia Univ.  
Dept. of Civil Eng.  
#397 Photogrammetry (PG)  
3 Sem. hrs. UGrad/Grad  
#485 Airphoto Interp. (PI)  
3 Sem. hrs. UGrad/Grad  
Division of Forestry  
#226 Remote Sensing of the Environment (RS)  
2 Sem. hrs. UGrad Trips

WISCONSIN  
Univ. of Wisconsin-Eau Claire  
Dept. of Geography  
Remote Sensing of Environment (RS)

Univ. of Wisconsin-Madison  
Depts. of Civil* and Environmental Eng.  
#355 Adjustment Computations (PG)  
3 Sem. hrs.  
#356 Photogrammetry (PG)  
3 Sem. hrs. Trips
REMOTE SENSING/PHOTOGRAMMETRY EDUCATION IN THE U.S. & CANADA

LIST B
REMOTE SENSING AND PHOTOGRAMMETRY AT CANADIAN UNIVERSITIES

RS—Remote Sensing
RSr—Remote Sensing related
PI—Photo-Interpretation
PIr—Photo-Interpretation related
PG—Photogrammetry
PGr—Photogrammetry related
MPI—Map & Photo-Interpretation
PGe—Photogeology
AG—Astrogeology
SD—Systems Design
IP—Image Processing
OP—Optics

Univ. of Alberta
(Edmonton, Alberta)
Dept. of Geography
#501 Remote Sensing and Photointerp.
Grad Trips

Univ. of British Columbia
(Vancouver, B.C)
Dept. of Civil Eng.
#453 Photogrammetry
3 Sem. hrs. UGrad Trips

Univ. of Guelph
(Guelph, Ontario)
Dept. of Land Resource Science
#46-250 Remote Sensing
3 Sem. hrs. UGrad Trips

Univ. of Wisconsin-Milwaukee
Dept. of Geological Sciences
Remote Sensing of the Environment (RS)
3 Sem. hrs. Grads

Univ. of Wisconsin-Stevens Point
Dept. of Geography*—Geology
#377 Air Photo Interp. (PI)
3 Sem. hrs. UGrad
#379/579 Remote Sensing of Environment (RS)
3 Sem. hrs. UGrad/Grad

Univ. of Wisconsin-Superior
Dept. of Geosciences (Geography)
Remote Sensing of Environment (RS)

Univ. of Wisconsin-Whitewater
Dept. of Geography
#475 Air Photo Interp. (PI)
3 Sem. hrs. UGrad/Grad Trips
#498 Problems in Cartography and Air Photography (PI)
2-3 Sem. hrs.

WYOMING
Univ. of Wyoming
Dept. of Geology
#701D Remote Sensing of Environment (RS)
3 Sem. hrs. UGrad/Grad
#852D Quantitative Techniques in Remote Sensing (RS)
4 Sem. hrs. Grad

Univ. of Guelph
(Guelph, Ontario)
Dept. of Land Resource Science
#46-250 Remote Sensing
3 Sem. hrs. UGrad Trips
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<th>McMaster Univ.</th>
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<td>Dept. of Geography</td>
<td>Dept. of Natural Resources</td>
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<tr>
<td>Remote Sensing and its Geographical</td>
<td>Photogrammetry</td>
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<td>Applications</td>
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<td>#6711 Sensors in Geodesy and Photogrammetry</td>
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### Aerial Triangulation (PG)
- **Credit hrs. Grad:** 9

### Analytical Photogrammetry (PG)
- **Credit hrs. Grad:** 6

### Forestry Photogrammetry (PG)
- **Credit hrs. Grad:** 3

### Photogrammetry Seminars (PG)
- **Credit hrs. Grad:** 4

### Interp. Seminars (RS)
- **Credit hrs. Grad:** 4

### Special Subjects in Photogrammetry (Including Field Work, Automated Photogrammetry and Cartography) (PG)
- **Credit hrs. Grad:** 3-12

### Numerical Treatment of Remote Sensing Data (RS)
- **Credit hrs. Grad:** 9

### Remote Sensing Application in Limnography (RS)
- **Credit hrs. Grad:** 6

### Forest Resources Image Interp. and Cartography (PI)
- **Credit hrs. Grad:** 6

### Remote Sensing Data Acquisition Technologies (RS)
- **Credit hrs. Grad:** 6

### Remote Sensors (RS)
- **Credit hrs. Grad:** 6

### Photogrammetric Project Planning (PG)
- **Credit hrs. Grad:** 9

### Resources Remote Sensing Project Planning (RS)
- **Credit hrs. Grad:** 9

### Non-Topographical Photogrammetry (PG)
- **Credit hrs. Grad:** 3

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### University of Manitoba (Winnipeg, Manitoba)
- **Dept. of Geography**
- **Remote Sensing and Its Geographical Applications (RS)**
- **Hr. UGrad/Grad:** 1

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### List C

**Remote Sensing/Photogrammetry Programs in the United States**

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<th>Number</th>
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<th>State</th>
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<th>Degree(s)</th>
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<td>1</td>
<td>Brown University</td>
<td>Providence, Rhode Island</td>
<td>Dept. of Geology</td>
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<td>Planetary Geology</td>
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<td>in Geography w/emphasis on remote sensing</td>
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<td>Cornell University</td>
<td>Ithaca, New York</td>
<td>School of the Civil and Environmental Eng.</td>
<td>M.S., Ph. D.</td>
<td>in airphoto studies (P.I.) and remote sensing</td>
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<td>Columbia University</td>
<td>New York, New York</td>
<td>Dept. of Geography</td>
<td>M.A., Ph. D.</td>
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<td>University of Delaware</td>
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<td>Dept. of Marine Studies</td>
<td>M.S., Ph. D.</td>
<td>in remote sensing of coastal environments</td>
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<td>University of Miami</td>
<td>Coral Gables, Florida</td>
<td>Dept. of Mechanical Eng.</td>
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<td>State University of New York</td>
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<td>State University of New York</td>
<td>Syracuse, New York</td>
<td>College of Environmental Science and Forestry</td>
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<td>10</td>
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<td>Depts. of Agronomy, Civil Eng.,</td>
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Electrical Eng., Forestry, Geosciences, and Plant Pathology
M.S., Ph. D. in the above disciplines w/emphasis on remote sensing
(11) University of Tennessee Space Institute—Tullahoma, Tennessee
Dept. of Eng. Science
M.S. in remote sensing
Ph. D. in remote sensing planned
Ph. D. in planning w/emphasis on remote sensing
Dept. of Geoscience
Minor in remote sensing planned

Central States
(1) Stephen F. Austin State University—Nacodoehes, Texas
School of Forestry
M.S., D.F. & Ph. D. in remote sensing
M.S., Ph. D. in photogrammetry
(2) Colorado State University—Fort Collins, Colorado
Specialization in remote sensing applied to natural resource, environmental, or engineering problems.
(3) University of Illinois—Urbana—Champaign, Illinois
Dept. of Geography
Minor in remote sensing
Dept. of Civil Eng.
Minor, B.S., M.S., Ph. D. in photogrammetry
(4) University of Iowa—Iowa City, Iowa
Dept. of Geology
Ph. D. in remote sensing
(5) University of Kansas, Lawrence, Kansas
Dept. of Geology
M.A., M.S., Ph. D. in Geology w/emphasis on remote sensing
(6) University of Michigan at Ann Arbor—Ann Arbor, Michigan
School of Graduate Studies
M.S. in remote sensing
(7) University of Michigan at Flint—Flint, Michigan
Dept. of Physical Geography
Plans minor in “Graphics”—includes remote sensing and photogrammetry
(8) Michigan State University—East Lansing, Michigan
Possibility of interdepartmental (Geography, Urban Planning and Landscape Architecture, Resource Development) minor in remote sensing
(9) Missouri-Rolla University—Rolla, Missouri
M.S. in geology w/emphasis on remote sensing
(10) University of North Dakota—Grand Forks, North Dakota
Dept. of Geography
B.A., B.S. in Geography w/emphasis on remote sensing
Minor in remote sensing
(11) Ohio State University—Columbus, Ohio
Dept. of Geodetic Science
Minor in remote sensing
Minor, B.S., Ph. D. in photogrammetry
(12) Purdue University—West Lafayette, Indiana
Depts. of Civil Eng. Forestry and Geosciences
M.S., Ph. D. in remote sensing
Dept. of Civil Eng.
Minor in remote sensing
Minor, B.S., M.S. in photogrammetry
(13) University of Texas at Austin—Austin, Texas
Dept. of Geography
Degrees in Geography w/emphasis on remote sensing
(14) University of Wisconsin at Madison—Madison, Wisconsin
Dept. of Civil Eng.
M.S., Ph. D. in remote sensing
(15) University of Wisconsin at Stevens Point—Stevens Point, Wisconsin
Dept. of Geography
B.S. in Geography w/emphasis on remote sensing
(16) Wright State University—Dayton, Ohio
Interdepartmental degree program in remote sensing planned

Western States
(1) University of Arizona—Tucson, Arizona
Committee on Remote Sensing
Minor in remote sensing
(2) University of California at Berkeley—Berkeley, California
Dept. of Civil Eng.
M.S., Ph. D. in photogrammetry and surveying
M.E., Ph. D. in engineering in photogrammetry and surveying
(3) University of California at Los Angeles—Los Angeles, California
Dept. of Geography
B.A., M.A., Ph. D. in Geography w/emphasis on remote sensing
Minor in remote sensing
(4) California State University at Fresno—Fresno, California
Dept. of Civil Eng.
B.S. in photogrammetry and surveying
(5) University of Hawaii at Manoa—Manoa, Hawaii
Dept. of Civil Eng.
Minor in photogrammetry
REMOTE SENSING/PHOTOGRAMMETRY EDUCATION IN THE U.S. & CANADA  279

(6) University of Idaho—Moscow, Idaho
   College of Forestry, Wildlife in Range Sciences
   M.A., M.S., Ph. D. in Forestry
   w/emphasis on remote sensing

(7) Northern Arizona University—Flagstaff, Arizona
   Dept. of Geography
   Minor in remote sensing

(8) University of Northern Colorado—Greeley,

(9) Pomona College—Claremont, California
   Dept. of Geology—Dept. of Astronomy
   Minor in Astrogeology

(10) University of Washington—Seattle, Washington
    Dept. of Civil Eng.
    Minors in remote sensing and photogrammetry—Remote sensing is being expanded to constitute an area of specialization in "regional environmental planning."

LIST D
REMOTE SENSING PROGRAMS IN CANADA

Univ. of Toronto-Erindale (Toronto, Ont)
   Dept. of Eng.
   B.S. in Survey Science (includes photogrammetry and remote sensing), M.S. and Ph. D. in Eng. (may include photogrammetry and remote sensing)

Universite Laval (Ste-Foy Que)
   Dept. of Photogrammetry
   M.S. and Ph. D. in photogrammetry

Univ. of British Columbia (Vancouver, B.C.)
   Dept. of Civil Eng.
   B.S., M.S., M.A., and Sc. in photogrammetry

McMaster Univ. (Hamilton)
   Dept. of Geography
   M.S., and Ph. D. in geography w/emphasis on remote sensing

Univ. of Ottawa (Ottawa Ont)
   Dept. of Geography and Regional Planning
   Plans for major in remote sensing and cartography

Univ. of New Brunswick (Fredericton, NB)
   Dept. of Surveying Eng.
   B. Sc. E. in Surveying Engineering (includes photogrammetry and remote sensing)

LIST E
THE OHIO STATE UNIVERSITY DEPARTMENT OF GEODETIC SCIENCE MASTER'S DEGREE PROGRAM (PHOTOGRAMMETRY)
BY THESIS

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<td>Photogrammetry and Photointerpretation</td>
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<td>Applied Math Methods, G.S. II</td>
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<td>Geometric Photogrammetry</td>
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<td>Geodetic Astronomy Electives</td>
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<td>Spring</td>
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<td>Introduction to Advanced Geodesy</td>
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<td>Computational Photogrammetry</td>
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* Math. At least 10 hours of graduate level mathematics, which may include that taken in Geodetic Science 645 and 646, are required. This requirement may be fulfilled any quarter.

**List F**

**Text Books in Remote Sensing and Photogrammetry**

**Remote Sensing**

*Interpretation of Aerial Photographs*, 2nd Ed., T. E. Avery (1968), Burgess Publishing Co., Minneapolis, Minn. 342 p. $13.95


*Vision through the Atmosphere*, W.E. Knowles, Middleton, (1968), Univ. of Toronto Press, Toronto, Ontario

*Electromagnetic Remote Sensing*, Robert Reeves, (1968), American Geological Institute November $10.00

*Fundamentals of Electromagnetic Remote Sensing*, Thomas Lillesand, (1976), State Univ. of New York, College of Environmental Science and Forestry, Syracuse, N.Y.

*An Introduction to Remote Sensing for Environmental Monitoring*, James P. Scherz, and Alan R. Stevens, Dept. of Civil Engineering, Univ. of Wisconsin Remote Sensing Program Report No. 1


*Remote Sensing for Planners*, Frank V. Westerlund, (1972)

*Radar Remote Sensing for Geoscientists* (Short Course Notes), L.F. Dellwig, A.J. Lewis, A.C. MacDonald, and W.P. Waite, (1972), Univ. of Kansas, Center for Research


*Radiant Energy in Relation to Forests*, Lull and Reifsnyder (1965)

*Manual of Remote Sensing*, American Society of Photogrammetry (1975), 105 N. Virginia Ave., Falls Church, Va 22046. 2 Vol., $22.50 (for students)

**Photointerpretation**

*Aerogeology*, H.F. von Bandat, Gulf Publishing Co., Houston, Texas


*An Introduction to Aerial Photography for Natural Resource Management*, David P. Paine (1975) Oregon State University, Corvallis, Oregon $7.95


*Aerial-Photo Interpretation in Classifying and Mapping Soils* (Ag Handbook 294), Soil Conservation Service (1966), SCS, Department of Agriculture, Washington, D.C. 89 p. ($0.75)

Remote Sensing/Photogrammetry Education in the U.S. & Canada


Air Photo Interpretation for Land Planning, Douglas Way, (1968), Harvard University Press, Cambridge, Mass 137 p. $5.00


Air Photo Analysis and Interpretation, J.D. Mollard (1960), Bellhaven House Ltd., Scarborough, Ontario

La Photo Aerienne, Son Interpretation Dans Les Etudes De L’Environnement Et L’Amenagement Du Territoire, Hugues Gagnon, Editions HRW, Montreal, Toronto $16.50

ASTROGEOLGY


Exploration of the Universe, G. Abell, (1975), Holt, Rinehart & Winston $15.00

Planetary Geology Nicholas M. Short, (1975), Prentice-Hall Inc., Englewood Cliffs, N.Y. $17.95

Moon and Planets, William K. Hartmann, (1972), Wadsworth Publishing Co. $13.95

PHOTOGRAINMETRY

Photogrammetry, Francis H. Moffitt, (1967), International Textbook Company, Scranton, Penn. $15.50


Photogrammetry, Sanjib K. Ghosh, (1975), Lexington Books $22.50

Photogrammetry Kit, Eichler & Tubis

Outline of Photogrammetry, K. Schwidetsky, (1959), Pitman Publishing Corp., 20 East 46th Street, New York, N.Y. 10017


Photogrammetry, B. Hillert (1960), McGraw-Hill Book Company, 330 West 42nd Street, New York, N.Y. 10036 $23.75

Basic Metrical Photogrammetry, Duane Lyot (1959), 896 Queen Ann Place, Glendale, Missouri

ATLASES

Aerial Stereo Photographs, H.R. Wanless, (1965), Hubbard Scientific Co., Northbrook, Ill., 92 p. $3.95

Stereo Atlas, American Geological Institute (1968), Falls Church, Va.

MAP AND PHOTO-INTERPRETATION

Topographic Map and Air Photo Interpretation, Emile D. Chevrier, and D.S.W. Aitkens, (1970), McMillan Co. of Canada $6.50

Radar Fundamentals, Gershan J. Wheeler, (1967) Prentice-Hall, Inc. $11.95

Infrared Radiation, Juan Simon, (1966), Van Nos Reinhold $3.95

Handbook of Military Infrared Technology, W.L. Wolf (1965), Office of Naval Research, Department of the Navy, Government Printing Office $9.30

Optical and Photographic Reconnaissance Systems, Niels P. Jensen, (1968), John Wiley and Sons $17.25


IMAGE PROCESSING

Statistical Pattern Recognition, Chi-Hau Chen (1973), Spartan Book, Hayden Book Co. $17.25


Pattern Classification and Scene Analysis, Richard O. Duda, and Peter E. Hart, John Wiley and Sons, 605 3rd Avenue, New York, N.Y. 10016 $24.75
## Frequency of Selected Textbooks on Remote Sensing and Photogrammetry (U.S.)

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# List H
## Engineering Research Projects in Remote Sensing and Photogrammetry

## Photogrammetry Research

<table>
<thead>
<tr>
<th>Department</th>
<th>Topic</th>
<th># Projects 1973-74/1974-75</th>
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<td>Univ. Illinois-Urbana Champaign</td>
<td>Photogrammetry &amp; geodesy</td>
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<td>Purdue Univ.</td>
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<td>Iowa State Univ.</td>
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## Remote Sensing Research

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<th>Department</th>
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<td>Univ. Arkansas</td>
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<td>Colorado State Univ.</td>
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<td>Illinois Inst. of Tech.</td>
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**Legend**

- Dash (-) indicates that the number of projects cannot be determined from the information submitted to the American Society for Engineering Education.
- ORSER—Office for Remote Sensing of Earth Resources, a division of the Space Science and Engineering Laboratory, Pennsylvania State University.
- LARS—Laboratory for the Application of Remote Sensing, Purdue University.

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