

**Rochester Institute of Technology
Rochester, New York**

COLLEGE of SCIENCE
Center for Imaging Science

NEW COURSE: 1051-420

- 1.0** **Title:** Environmental Applications of Remote Sensing **Date:** Apr. 12, 2001
Credit Hours: 4
Prerequisite(s): College Physics III (1017-213) or permission of instructor
Corequisite(s): None
Course proposed by: Anthony Vodacek

2.0 **Course information:**

	Contact hours	Maximum students/section
Classroom	4	30
Lab		
Studio		
Other (lab demonstrations)		

Quarter(s) offered (check)

_____ **Fall** **X** **Winter** _____ **Spring** _____ **Summer**

Students required to take this course: (by program and year, as appropriate)

Majors in Environmental Science

Students who might elect to take the course:

Any RIT student.

- 3.0** **Goals of the course** (including rationale for the course, when appropriate):
Students gain exposure to the wide range of remote sensing applications used to study the environment. Examples studied in class include both airborne and satellite systems covering the range of electro-optic sensing systems. Concepts are reinforced and demonstrated with state-of-the-art remote sensing hardware (field instrumentation and airborne imaging systems developed and in use at RIT) and software (ENVI software for which the Center for Imaging Science is a Center of Excellence).

4.0 Course description (as it will appear in the RIT Catalog, including pre- and co-requisites, quarters offered)

1051-420 Environmental Applications of Remote Sensing

An introduction to the wide range of environmental applications of remote sensing. Systems for detecting physical phenomena and analysis techniques for extracting useful information are described for active and passive sensors operating throughout the electromagnetic spectrum from both airborne and spaceborne sensors. The Earth's atmospheric, hydrospheric, and terrestrial processes are examined at a global scale. Applications areas studied include monitoring vegetation health, identifying cultural features, assessing water resources, and detecting pollution and natural hazards. (1017-213 or permission of instructor). **Class 4, Credit 4, (W)**

5.0 Possible resources (texts, references, computer packages, etc.)

5.1 *Remote Sensing and Image Interpretation*, Lillesand, Kiefer, and Chipman, 5th Ed.

5.2 Environment for Visualizing Images (ENVI) , software package for manipulating spectral images.

6.0 Topics (outline):

6.1 Properties of electro-magnetic radiation

6.1.1 The sun as a source, blackbody radiation and line sources

6.1.2 Conservation of energy

6.1.1.1 Reflection

6.1.1.2 Transmission

6.1.1.3 Absorption

6.1.1.4 Scattering

6.1.3 Properties of the atmosphere and earth

6.1.2.1 Atmosphere, absorption and scattering

6.1.2.2 Earth targets, reflection and absorption

6.2 Properties of Imaging Systems

6.2.1 Basic aerial camera design, film and digital systems

6.2.2 Determination of image scale

6.2.3 Spectral selection, filters and gratings

6.3

6.3.1 Modular Imaging Spectrometer Instrument (MISI)

6.3.1.1 Visible near infrared spectral calibration

- 6.3.1.2 Visible near infrared radiometric calibration
 - 6.3.1.3 Thermal calibration
 - 6.3.2 Ocean Optics spectroradiometer
 - 6.3.2.1 Spectral calibration by line sources
 - 6.3.2.2 Direct radiometric calibration

- 6.4 Aerial and satellite image interpretation
 - 6.4.1 Elements of interpretation
 - 6.4.2.1 Shape
 - 6.4.2.2 Size
 - 6.4.2.3 Pattern
 - 6.4.2.4 Tone or hue
 - 6.4.2.5 Texture
 - 6.4.2.6 Shadow
 - 6.4.2.7 Site
 - 6.4.2.8 Association
 - 6.4.2.9 Resolution

- 6.5 Image processing and classification
 - 6.5.1 Image processing with ENVI
 - 6.5.1.1 Stretches
 - 6.5.1.2 Transforms (vegetation indices, principal components, etc.)

 - 6.5.2 Classification
 - 6.5.2.1 Unsupervised
 - 6.5.2.1.1 K-means
 - 6.5.2.1.1 ISODATA
 - 6.5.2.2 Supervised
 - 6.5.2.2.1 Spectral angle mapper
 - 6.5.2.2.2 Gaussian Maximum Likelihood

 - 6.5.3 Post classification
 - 6.5.3.1 Smoothing and majority analysis
 - 6.5.3.2 Error analysis
 - 6.5.3.2.1 Error matrix, overall, user's, and producer's accuracies
 - 6.5.3.2.1 Error analysis using Kappa parameter

Homework examples

1. Basic photogrammetry measurements and analysis of image scale
2. Image interpretation of natural features in aerial and satellite images
3. Image interpretation of cultural features in aerial and satellite images
4. Calibration of a thermal image
5. Basic image enhancement techniques using ENVI software

7.0 Intended learning outcomes and associated assessment methods of those outcomes

- 7.1 Calculation of image scale (Homework)
- 7.2 Interpretation methods for natural features in remote sensing images (Homework)
- 7.3 Interpretation methods for cultural features in remote sensing images (Homework)
- 7.4 Practical experience and concepts of electro-optical system radiometric calibration using the RIT Modular Imaging Spectrometer Instrument as an example (Homework)
- 7.5 Perform spatial and spectral enhancement of remote sensing images using ENVI software (Homework)

8.0 Program or general education goals supported by this course

- 8.1 The course is an assessment of imaging systems and methods used for qualitative and quantitative measurement for a variety of environmental application areas. Students will study the basic concepts of system design of field, aerial, and satellite instrumentation. The experience includes hands-on work with research grade equipment providing practical experience in using and calibrating real remote sensing systems to reinforce the theoretical exposure to imaging systems, radiometry, and image interpretation.
- 8.2 Students will work on a long term project (~4 weeks) on image classification for land cover assessment. This project reinforces materials presented earlier in the course by practical application using state-of-the-art image processing software. Error assessment is an important aspect of the analysis, providing the students with feedback on the realistic problems encountered in a real image classification problem.

9.0 Other relevant information (such as special classroom, studio, or lab needs, special scheduling, media requirements, etc.)

- 9.1 Class size is limited to 30 to allow for effective use of computing resources and software licenses. Final four weeks of instruction are in an Imaging Science undergraduate computer lab.

10.0 Supplemental information

None