

11:372:474 Undergraduate Advanced Remote Sensing  
16:450:615/16:215:604 Graduate Seminar in Remote Sensing

Spring 2009

Class Meeting: M 5:35-6:55 PM ENR 123 W 5:35-6:55 PM ENR 247 (CRSSA Teaching Lab)  
Instructor: Rick Lathrop e-mail: [lathrop@crssa.rutgers.edu](mailto:lathrop@crssa.rutgers.edu)  
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**Course Objectives:** students should learn the fundamentals of digital analysis, interpretation and application of satellite remotely sensed imagery. Students should develop an understanding of digital image processing techniques (including the basic data structures and algorithms involved) and become proficient in the hands-on application of these techniques using the ERDAS image processing workstations. Students should learn not just how but also why and when to apply digital image processing techniques in the analysis of remotely sensed imagery.

Textbooks: J. Jensen, Introductory Digital Image Processing, 3rd ed, Prentice-Hall, 2005;  
ERDAS IMAGINE Field Guide (7<sup>th</sup> edition)  
Graduate students: additional journal articles on reserve at Chang

Week 1 Lecture: INTRODUCTION TO SATELLITE IMAGE ANALYSIS  
Jan 21 Web Lecture 1 & Supplemental: Image Data Acquisition  
Homework 1: Ordering LANDSAT Images  
Reading: Ch 1, 2, 3; ERDAS CH. 1, 3  
Remote Sensing Applications article review handed out

Week 2 Lecture: IMAGE DISPLAY AND ENHANCEMENT  
Jan 26-28 Web Lecture 2 & Supplemental: Image Statistics  
Lab 1: Image Segmentation  
Graduate Student Reading Discussion after Wednesday Lab  
Homework 2: Image Statistics  
Reading: CH 4, 5:151-164, 8:255-272; ERDAS Ch. 4, 6:141-157, ERDAS App A Math Topics

Week 3 Lecture: IMAGE RESTORATION & ATMOSPHERIC CORRECTION  
Feb 2-4 Web Lecture 3  
Lab 2: Image Normalization  
Homework 3: Landsat TM Thermal IR Calibration  
Reading: CH 6; ERDAS Ch. 5:132-135;

Week 4 Lecture: IMAGE RECTIFICATION  
Feb 9-11 Web Lecture 4 & Supplemental: Cartography and Map Projections  
Lab 3: Geometric Correction  
Graduate Student Reading Discussion after Wednesday Lab  
Homework 4: Geometric Correction  
Reading: CH 7; ERDAS CH 10, 13, App. B

Week 5 Lecture: SPATIAL ENHANCEMENT/FILTERING  
Feb 16-18 Web Lecture 5  
Lab 4: Spatial Enhancement  
Homework 5: Spatial Filtering  
Reading: CH 8:276-329; ERDAS Ch. 6:157-160, 189-201  
Remote Sensing Applications article review due

Week 6 Lecture: MULTI-IMAGE MANIPULATION  
Feb 23-25 Web Lecture 6  
Lab5: Principal Components Analysis  
Graduate Student Reading Discussion after Wednesday Lab  
Homework 6: Principal Components Analysis  
Reading: CH 5:164-169, 8:274-276, 296-301; CH 11:443-445; Field Guide CH 6:162-183  
Take-home Exam Distributed. Due Wednesday Mar 10 in class.

Week 7 Lecture: IMAGE CLASSIFICATION: UNSUPERVISED CLASSIFICATION  
Mar 2-4 Web Lecture 7  
Lab 6: Unsupervised Classification  
Homework 7: Spectral Clustering  
Reading: CH 9:379-389; Field Guide CH 7:221-225, 231-235

Week 8 10 Lecture: SUPERVISED CLASSIFICATION  
Mar 9-11 Web Lecture 8  
Lab 7: Supervised Classification  
Graduate Student Reading Discussion after Wednesday Lab  
Homework 8: Supervised Classification Algorithms  
Reading: CH 9:337-389; Field Guide CH 7:257-231, 235-253

Week 9 Spring Break  
Mar 16-18

Week 11 Lecture: CLASSIFICATION REDUX: ADVANCED METHODS  
Mar 23-25 Web Lecture 9  
Lab 8: Knowledge-based Classification  
Reading: CH 9:389-401, CH 10, CH 11:445-457  
Return/Review take-home exam

Week 12 Lecture: ACCURACY ASSESSMENT  
Mar 30-Apr 1 Web Lecture 10  
Lab 9: Accuracy Assessment  
Graduate Student Reading Discussion after Wednesday Lab  
Homework 9: Accuracy Assessment  
Research paper/proposal due  
Reading: CH 13, Field Guide CH 6

Week 13 Lecture: LECTURE: VEGETATION INDICES  
Apr 6-8 Web Lecture 11  
Lab 10: Vegetation Indices  
Homework 10  
Reading: CH 8:301-322, CH 11:431-443, 457-462

Week 14 Lecture: HYPERSPECTRAL REMOTE SENSING  
Apr 13-15 Web Lecture 12  
Lab 11: Hyperspectral Remote Sensing  
Graduate Student Reading Discussion after Wednesday Lab  
Reading: Field Guide CH 10-11

Week 14 Lecture: CHANGE DETECTION  
Apr 20-22 Web Lecture 13  
Lab 12: NJ Change Detection  
Reading: CH 12

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Week 15 Lecture: FUTURE DIRECTIONS

Apr 28-29            Lab 14: Classification Project Due. Project Synthesis.  
Graduate Student Reading Discussion after Wednesday Lab

Week 16 Class Project Presentations

May 4                Graduate Project Presentations  
Take-home final exam distributed May 4

May 11              Final Take Home Exam Due

## COURSEWORK EXPECTATIONS:

Reading assignments are expected to be read prior to the class date that is listed in the syllabus above. Students are expected and encouraged to ask questions concerning the reading assignments and lecture material. **If you don't ask, I won't know you don't understand.** Graduate students will meet every other week after Wednesday lab to discuss the readings.

Homework assignments have been designed to supplement the lecture material and give the student added preparation in some of the details. Homework will be distributed on Mondays and will be returned (completed) to Professor Lathrop the following Monday. Each homework assignment is generally worth 3 points: 0 - not completed; 1 - unsatisfactory; 2 - satisfactory; 3 - excellent. Late homework will be downgraded by 1 point.

Lab assignments are hands-on exercises using the ERDAS image processing work stations. During lab periods, students will work in groups (of 2) to complete the exercises. Interaction between students and the professor is expected and encouraged. Students are encouraged to work in the CRSSA teaching lab, alone or with other class members, outside of normal class periods. Don't let your lab partner do everything - students are expected to develop the proficiency to work unassisted on the ERDAS systems. There will be six lab assignments (5 pts each) during the first half of the semester. Graduate students will have a major cumulative lab assignment during the second half (worth 50 points).

There will be a take-home exam and a final exam. These exams will be on the material covered in lecture, lab and the reading. There will be a literature research paper due during the first half of the semester focussing on RS applications.

There will be a final project incorporating hands-on image classification and/or change detection and/or RS/GIS integration, etc.. The work to complete the project will be done outside of normal class meeting times. Each student is expected to work independently. You can confer with other students on different approaches, techniques used, etc., but the final results and project writeup should be your own. A separate handout concerning the project will be distributed later in the semester.

**The CRSSA teaching lab is open 5 days a week (Monday to Friday) from 8:30AM to 6PM.** Additional weeknight and weekend hours will be posted. You will only be able to work on the ERDAS Image Processing systems during CRSSA's normal posted hours (check [www.crssa.rutgers.edu/help/lab\\_sched\\_html](http://www.crssa.rutgers.edu/help/lab_sched_html)). No eating or drinking. is allowed in the lab.

GRADING:

|                         |                                   |
|-------------------------|-----------------------------------|
| Take-home Exam          | 100 points                        |
| Homework                | 30 points                         |
| Labs                    | 30 points (ugrad) 80 point (grad) |
| Article Review/critique | 40 points                         |
| Final Exam              | 100 points                        |
| Final Project           | 150 points                        |
| <hr/>                   |                                   |
| Total                   | 450 points (ugrad) 500 pts (grad) |