Remote Sensing Applications, FO-4452/6452

Instructor: David L. Evans

Prerequisites: A basic photo interpretation or mapping/GIS course or consent of Instructor.
Co-requisite: FO-4451/6451 Remote Sensing Applications Laboratory

YOU MUST CHECK WITH INSTRUCTOR IF YOU HAVE A VISUAL IMPAREMENT. FAILURE TO MEET THE PREREQUISITES OR OBTAIN INSTRUCTOR CONSENT COULD RESULT IN YOUR BEING DROPPED FROM THE COURSE. YOU MUST REGISTER FOR THE CO-REQUISITE COURSE.

Course Description:
Remote sensing is obtaining information about something without physical contact. The most commonly used remote sensing tool is the camera. Aerial photography with film or digital cameras is an integral part of natural resource mapping and monitoring. Use of aerial photography is covered in greater detail in Spatial Technologies in Natural Resource Management (FO-4313/6313 - 4311/6311).

Non-photographic systems being used for natural resource management include satellite-borne sensors, radar, LiDAR, video, digital cameras, and various airborne multi-spectral and hyper-spectral sensors. This course provides a brief review of aerial photography concepts then addresses how data from non-photographic systems are collected and analyzed by digital image processing. Data from these systems and aerial photography provide key inputs to Geographic Information Systems (GIS). GIS is covered in the course GIS for Natural Resource Management (FO-4472/6472 - 4471/6471).

This course and the accompanying laboratory place primary emphasis on digital image interpretation and analysis. It is imperative that each student has a basic understanding of computers with windowing operating environments. Software functions and image analysis techniques will be taught and fundamental computer concepts will be reviewed with respect to the PC operating environment. You should not continue in this course if you are uncomfortable in using computer systems. Examples of concepts you should understand are: moving around in directory structures, creating and deleting directories, copying and deleting files, opening and closing windows, moving windows, starting and stopping applications.

Course Objectives:
1. Review the properties of electromagnetic radiation as they relate to remote sensing;
2. Review basic principles of aerial photography including: camera systems, films, digital imaging, photography acquisition, simple image interpretation, photogrammetry;
3. Describe the characteristics and appropriate applications of different passive and active sensors used for image data collection;
4. Learn methods of visual interpretation of imagery from digital sensors;
5. Learn the principles of basic digital image processing for information extraction;
6. Provide hands-on experience in digital image analysis through laboratory exercises;
7. Learn relationships between remote sensing and GIS in context of resource assessments.

Course Topics:
1. Introduction to Remote Sensing

2. Remote Sensing and Electromagnetic Radiation,
3. Camera Systems,
4. Airphoto / Image Interpretation,
5. Photogrammetry,
6. Non-photographic Passive Systems,
7. Active Sensors
8. Digital Image Processing,
9. Image Enhancement,
10. Image Rectification,
11. Image Classification,
12. Field Data,
13. Imagery/Interpretation Uses in GIS,
14. Applications of Digital Image Analysis.

Text: Lillesand, Thomas M., Ralph W. Kiefer, and Jonathan W. Chipman. 2004/2008. **Remote Sensing and Image Interpretation, Fifth or Sixth Edition** John Wiley & Sons, Inc., New York.

(note you may purchase Fifth Edition but keep in mind there are some minor differences in chapters relating to image classification, and LiDAR).

Grading: Student grades will be based on 3, 1-hour exams (exam 1 = 25%, exam 2 = 30%, exam 3 = 35%) and unannounced quizzes (10%). Much of the information presented in this course is built upon and used throughout the course. Therefore, material on successive exams is *de facto* of a cumulative nature. Quizzes will be based on the previous lecture material and/or assigned reading. There will be no make up quizzes.

Office Hours: 10:00 - 11:00 a.m. Mon. - Fri. or by appointment.

Student Responsibilities:
Students will comply with all responsibilities outlined in the College of Forest Resources Handbook, Professional Expectations Document and the MSU Bulletin. Students are reminded to adhere to the code of conduct of MSU and that misconduct will be dealt with in accordance with guidelines and procedures outlined in the Academic Misconduct Policy accessible at:
http://www/msstate/edu/web/student_policies.html.

I expect each student to make every effort to fully participate in all aspects of the class and lab. Attendance is considered mandatory. If you know in advance that you will have to miss a class, you must notify the instructor. Please arrive in the class or lab prepared for the day's topic by reading the assigned material and by reviewing your notes. Assistance outside of regular class hours may be obtained either in regular office hours or by appointment.

Graduate students who elect to take this course for graduate credit will be required to develop a short additional written review of literature on use of a remote sensing technology in their respective fields of interest. A topic for this report is due prior to the spring break.

Topics	**Reading**	**Class #**
1) Introduction to Remote Sensing Course requirements Grading, tests, assignments	Syllabus	1
2) RS and EMR Background on RS Characteristics of EMR Energy Interactions Reflectance properties of surfaces Remote sensing system characteristics GIS	Ch. 1	1 - 2
3) Camera Systems Passive versus active systems Aerial cameras and films Video cameras Digital cameras Basic image geometry / scale	Ch. 2	3
4) Airphoto / Image Interpretation Elements of photointerpretation Equipment Land use/cover assessments Geology / soils/ landforms Agriculture Forestry, wildlife and other natural resources	Ch. 4	4
5) Photogrammetry Stereoscopy Height and planimetric measurements	Ch. 3	5
6) Non-photographic Passive Systems Multispectral scanners Thermal infrared systems Hyperspectral systems Satellite systems Image interpretation	Ch. 5 & 6	6 - 7
First Lab Meeting Jan. 29		
Exam 1 (Tentative Date: Feb. 3)		**8**
7) Active Sensors Radar LiDAR	Ch. 8	9
8) Digital Image Processing (Background)	Ch. 7	10 - 12

Data processing steps
Statistical considerations
Digital data characteristics
Data display
Image processing equipment

9) Image Enhancement Density slicing Linear and non-linear enhancement Ratios Transformations	Ch. 7	13
10) Image Rectification Sources of errors Ground control selection Resampling Mosaics	Ch. 7	14
11) Image Classification Classifiers Clustering Strategies	Ch. 7	15-17

Grad. Student Report Topics Due: March 5

12) Field Data Collection Use in interpretation / classification Sampling Accuracy assessment		18

Exam 2 (Tentative Date: March 12) **19**

13) Imagery / Interpretation uses in GIS GIS overview Imagery use in GIS Project management	Ch. 7	20-21
14) Applications of Digital Image Analysis Selected Readings	Ch. 4 & readings	22-24
15) Guest Lectures, Last exam review		25-28

Graduate Student Reports Due April 23

Exam 3 (Tentative Date: April 23) **29**