

# Advanced Remote Sensing

## (GIS5038C– Spring 2008)

### Instructor:

Dr. Xiaojun Yang, 321 Bellamy, Phone: 644-8379, Email: [xyang@fsu.edu](mailto:xyang@fsu.edu)

### Class Hours:

Tuesdays: 9:30 a.m. - 12:00 p.m., 0035 Bellamy Building (COSS GIS Lab)

### Office Hours:

Thursdays and Fridays: 2:00 – 3:30 p.m., or by appointment.

### Teaching Assistant:

Sunny Sim ([sim.sunhui@gmail.com](mailto:sim.sunhui@gmail.com)); her office hours will be announced later.

### Computing Lab Manager (any problem related to computer system):

Mr. Shawn Lewers ([SWL2727@mailier.fsu.edu](mailto:SWL2727@mailier.fsu.edu))

### Course Objective and Description

This course focuses on computer-based methods for information extraction from remotely sensed data to support environmental and cultural applications. Specifically, the course has three major components: an overview of the remote sensing process and the major sensing systems; an in-depth review of the major components in digital image processing from radiometric correction, geometric rectification, image enhancement, thematic information extraction by pattern recognition and artificial intelligence, digital change detection, to thematic accuracy assessment; and an introduction to the LIDAR and hyperspectral remote sensing systems.

The course consists of instructor-led lectures, lab assignments, article review and discussion, and an independent research project. The lectures focus on the core areas of digital image processing. A substantial component of this course consists of computer-based lab assignments that largely practice the principles and methods introduced in the lectures. Weekly discussion of research articles is required for each participant. Each student needs to complete an independent research project and present the result to the entire class.

### Prerequisite

GE04930/5934 (Remote Sensing of the Environment with Lab) or equivalent. In addition to this formal prerequisite, students are expected to have a reasonable background in college algebra and univariate and multivariate statistics.

### Computing Environment, Software and GIS Lab Policies

Windows-based ERDAS Imagine software package will be used for lab assignments. *However, you must be aware that this is not a software training course. If you are looking for such a course (learning a specific software package), you should visit the homepages for specific software packages. These vendors may provide short training courses or more software-specific training materials.*

You will be given a temporary account in order to log on a computer in COSS GIS Lab. This account may expire by the end of the semester. When you are at the computer lab, you must observe the COSS GIS lab and FSU's related policies. The GIS lab rules include:

- *No food or drink in the lab.*
- *Lab computers are for GIS work only. Your other class work is to be done in other labs.*
- *Lab printers are for GIS work only.*
- *DO NOT install software without permission from your instructor or the lab manager. If you need software, ask!*
- *DO NOT save your work on the local machines. Use your Z:\ drive. If you use the local machine or temp directory, others will be able to see your work and it may not be there later.*
- *DO NOT waste color prints, as they are expensive. Use the black and white printer whenever possible.*
- *Be courteous of others in the lab and stay quiet.*
- *Clean up after yourself. Lab attendants will throw out things that are left behind.*
- *DO NOT remove equipment that belongs in the lab from the lab. You will be criminally prosecuted if you are caught.*
- *DO NOT download MP3 or movie files. Most of these websites are compromised by viruses.*
- *Always log-off the computers when you are done, but DO Not shut them down.*
- *No instant messaging is allowed.*
- *Follow the FSU Honor Code and Code of Conduct rules and behave in an adult-like manner.*

*It is your responsibility to check and observe these rules. Any violation of these rules can result in the loss of privileges to use this facility. If that happens, it is your responsibility to find an alternative so that you could work on your lab assignments. If you are unsure about a rule or rules, ask a lab employee or Shawn Lewers (swl2727@fsu.edu).*

### Course Blackboard Site

The Blackboard will be used to host the course lecture and lab materials. You may find the lecture slides there, *but there is no guarantee that these lecture materials will be available on time.* You will still need to take notes during a lecture session. You are required to check that site from time to time because some important announcements may be posted there. The Blackboard address is: <http://campus.fsu.edu>. You will need to use your FSU account username and password to access this site.

### Grading Polices

#### System:

A	94-100	C	72-76
A-	90-93	C-	70-71
B+	87-89	D+	66-69
B	84-86	D	62-65
B-	80-83	D-	60-61
C+	77-79	F	< 59

In qualitative terms, the grade standards are: **A**, Outstanding, few errors or omissions (if any); **B**, Good, only minor errors/omissions; **C**, Satisfactory, at least one major error/omission; **D**, Poor, several major errors/omissions; and **F**, Fail: many major errors/omissions.

**Components:**

<i>Components</i>	<i>Description</i>	<i>Weights</i>
Lab assignments	There are 10 lab assignments to be completed within a fixed time frame	25%
Two exams	Non-cumulative; open book and need to be completed within 24 hours	2X20%
Journal article review	Review a major research article published within last five years, discuss your review in the class with a powerpoint presentation of 20 minutes or so, and write a review report (no more than 4 pages in double space). Active participating in the discussion is required	10%
Research project	Identify a technical or applied topic, write a short proposal, conduct research, present the findings to the entire class, and write a final report (12 pages in double space excluding tables and figures)	25%

**Attendance:**

Students are required to attend all classes and be punctual. Missing even one lecture can affect your grade substantially. Announcements regarding the course outline and the schedule of the lectures, labs and exam (including changes of these) may be made in class. All organizational/administrative announcements made during the class period are assumed to be known by all students. *Cell phones, pagers, alarms, laptops, calculators, and other electronic devices must be turned off in class at all times. In a lecture session, please do not log on any lab computer!*

**Exams:**

The exams can involve any material covered in lectures, reading or discussion assignments, and labs. There is no provision for extra credit work. A make-up exam might be arranged only when you present an acceptable excuse: documented illness, deaths in the immediate family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. Most other excuses for missing an exam are not acceptable. This policy will be strictly applied.

**Lab grading policies:**

Lab grade will be combined with other components (exams and article review) to form a single grade for the entire class. Grades of your lab exercises are based on the quality of your answers. Any answer should be concise and be well organized. They must be **in print**. The grade for each of the exercises is reported as *points\_scored /total\_points\_of\_exercise*. For example, if an assignment is worth 20 points and your answers score 16 points then you should see 16/20 on your marked assignment.

Each of the assignments will have a due day clearly written on the first page of your lab assignment. The due time is 5:00 p.m. on the due day. Any assignment that is turned in after the due day is considered late, which will receive penalty strictly.

The penalty for a late assignment is based on the number of days late (including weekends). If an assignment is late less than 24 hours, it is considered 1 day late. If an assignment is late less than 48 hours but more than 24 hours, it is considered 2 days late, and so on. Late assignments are penalized 20% per day. Here is the formula for calculating the points of a late assignment:

$$\text{Points}_{\text{get}} = \text{Points}_{\text{scored}} - 0.20 * \text{num\_days\_late} * \text{Points}_{\text{scored}}$$

The minimum value of  $\text{Points}_{\text{get}}$  is 0. Assignments handed in after I have returned the graded assignment to class (usually one week after the due date) will receive no points. Again, you must provide acceptable excuse (see exam section) in order to receive more time for you to complete lab exercises without penalty applied. You should discuss with your lab instructor about your situation no later than the due day. This policy will be applied stickily.

*Note that every person must hand in his or her own lab assignments. Working together is permitted and encouraged, BUT each person will be graded separately, must answer "creative response" questions independently, and must create his or her OWN maps if appropriate. Turning in identical or substantially similar assignments will result in significant grade reduction.*

#### **Journal article review and discussion:**

Each participant is required to review at least one major research article chosen by yourself. The article must be chosen from a major scholarly journal (check Section Course Materials for details) and must NOT have been reviewed by you in a different course. You are **NOT** allowed to use any web materials to replace a journal article. Each participant needs to do a 15-minute powerpoint presentation and lead discussion for one article. The leader is expected to prepare a set of questions (5 or so) for that particular article in one week before the actual discussion. These questions should be posted on the Blackboard site momentarily with the help of the Instructor, and each student will need to address these questions when reading through that article. The leader should prepare some slides to initiate the discussion, and summarize the major findings resulting from the classroom discussion. The summary report is due one week after the discussion. Each discussion session could last up to 30 minutes depending upon the topic. All students are expected to participate the discussion.

#### **Research project:**

To be discussed in a separate document.

### **Course Materials**

**Required Textbook:** Jensen, JR. 2005. *Introductory Digital Image Processing: A Remote Sensing Perspective* (3<sup>rd</sup>). Upper Saddle River, N.J. : Prentice Hall.. Book is required and is available at the campus bookstore. **You should bring this book for all lecture and lab hours.**

#### **Other Textbooks:**

- Aronoff, S. 2005. *Remote Sensing for GIS Managers*. Redlands. California: ESRI Press. 487p.
- Berlin, G. L.L. and Avery, T.E. 2003. *Fundamentals of Remote Sensing and Airphoto Interpretation* (6<sup>th</sup>). Upper Saddle River, N.J. : Prentice Hall. 540p.

- Campbell, J.B. 2002. *Introduction to Remote Sensing* (3<sup>rd</sup>). New York: Guilford Publications. 620p.
- Donnay, J. P., Barnsley, M. J., and Longley, P.A. 2001. *Remote Sensing and Urban Analysis*. London: Taylor & Francis. 268p.
- Drury, S. A. 1998, *Images of the Earth : A Guide to Remote Sensing* (2<sup>nd</sup> ed). Oxford, Oxford University Press. 203 p.
- Frohn, R.C. 1998. *Remote Sensing for Landscape Ecology : New Metric Indicators for Monitoring, Modeling, and Assessment of Ecosystems*. Boca Raton: Lewis Publishers. 99 p.
- Gibson, P.2000. *Introductory Remote Sensing: Digital Image Processing & Applications*. Routledge Chapman & Hall. 288 p.
- **Jensen,J. 2007. *Remote Sensing of the Environment : An Earth Resource Perspective (2nd)*. Upper Saddle River, N.J. : Prentice Hall. 592p.**
- Landgrebe, D. A. 2003. *Signal Theory Methods in Multispectral Remote Sensing*. New Jersey: Wiley-Interscience. 508p.
- Liang, S. 2004. *Quantitative Remote Sensing of Land Surfaces*. New Jersey: Wiley-Interscience. 534p.
- Lillesand, T.M., Kiefer, R. W. and Chipman, J.W. 2007. *Remote Sensing and Image Interpretation* (6<sup>th</sup>). New York: Wiley. 756p.
- Lo, C. P. 1986. *Applied Remote Sensing*. New York : Longman. 393 p.
- Lunetta, R.S. and Elvidge, C.D. (eds.) 1998. *Remote Sensing Change Detection : Environmental Monitoring Methods and Applications*. Chelsea, Michigan: Ann Arbor Press. 318 p.
- **Mather, P.M.2004. *Computer Processing of Remotely-Sensed Images (3<sup>rd</sup>)*. Chichester: Wiley. 324 p.**
- Paine, D. P. and Kiser, J.D. 2003. *Aerial Photography and Image Interpretation* (2<sup>nd</sup>). New Jersey: Wiley. 622p.
- Richards, J.A. and Jia, X.. 1999. *Remote Sensing Digital Image Analysis : An Introduction*. Berlin: Springer. 363 p.
- Schowengerdt, R. A. 1997. *Remote Sensing: Models and Methods For Image Processing* (2<sup>nd</sup>). London: Academic Press. 522p.
- Schultz, G. A. and Edwin T. Engman (eds.), 2000, *Remote Sensing in Hydrology and Water Management*. Berlin: Springer. 483 p.
- Woodhouse, I. H. 2006. *Introduction to Microwave Remote Sensing*. Boca Raton, Florida: CRC Press, 370p.

### **Remote Sensing Journals**

- *Photogrammetric Engineering and Remote Sensing* (American Society for Photogrammetry and Remote Sensing)
- *International Journal of Remote Sensing* (Taylor & Francis)
- *Remote Sensing of Environment* (Elsevier)
- *IEEE Transactions of Geosciences and Remote Sensing*
- *IEEE Geoscience and Remote Sensing Letters*
- *ISPRS Journal of Photogrammetry and Remote Sensing*
- *International Journal of Applied Earth Observation and Geoinformation*
- *Canadian Journal of Remote Sensing* (CRSS)
- *GIScience and Remote Sensing*

- *GeoCarto International*

***Electronic discussion groups and internet for remote sensing:***

Students with an electronic mail account can sign up for an electronic discussion group on remote sensing or/and digital image processing. The most important group is called IMAGRS-L Group. There are many discussion groups for individual software, e.g., there is one for ERDAR Imagine and one for IDRISI.

Another trend in remote sensing is the use of Internet to deliver remotely sensed data. Some image analyses can also be done through the Internet. You should constantly check the websites. There are many websites on remote sensing. You can use a search engine, such as <http://www.google.com/> to search for them. If you are reading this syllabus in our remote sensing class website, you will be directed to link to a number of important websites for information on programs and data.

**Honor Code**

The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to ". . . be honest and truthful and . . . [to] strive for personal and institutional integrity at Florida State University." (Florida State University Academic Honor Policy, found at <http://dof.fsu.edu/honorpolicy.htm>.)

*PLAGIARISM: All submitted assignments must be your own original, independent work. All sources must be properly cited(especially in the graduate student paper). Ask the instructor if you are unsure what to do. Plagiarism will result in significant grade reduction.*

**ADA Requirements**

Students with disabilities needing academic accommodation should:

- (1) register with and provide documentation to the Student Disability Resource Center; and
- (2) bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class.

This syllabus and other class materials are available in alternative format upon request.

For more information about services available to FSU students with disabilities, contact the:

Student Disability Resource Center  
97 Woodward Avenue, South  
108 Student Services Building, FSU  
Tallahassee, FL 32306-4167  
(850) 644-9566 (voice)  
(850) 644-8504 (TDD)  
[sdrc@admin.fsu.edu](mailto:sdrc@admin.fsu.edu)  
<http://www.disabilitycenter.fsu.edu/>

## Spring 2008 Tentative Schedule

Weeks	Date	Lectures	Labs	Readings	Discussion/ Comments
1	1/8	Course introduction and remote sensing principles	Lab 1: Introducing remote sensing process (4 weeks)	Ch. 1	NA
2	1/15	Remote sensing data acquisition	Lab 2: Image resolution and information content	Ch. 2	Review guidelines
3	1/22	Digital image processing systems and image display and visualization	Lab 3: Data formats, contrast stretching, and density slicing	Ch. 3-5	Article selection due
4	1/29	Image preprocessing: radiometric and geometric corrections	Lab 4: Map Composition	Ch. 6-7	Questions due
5	2/5	Image enhancement (i)	Lab 5: Radiometric correction	Ch. 8	Proposal due /discussion 1
6	2/12	<b>Exam One</b>			
7	2/19	Image enhancement (ii)	Lab 6: Geometric correction	Ch. 8	Discussion 2
8	2/26	Pattern recognition (i)	Lab 7: Image enhancements	Ch. 9	Discussion 3
9	3/4	Pattern recognition (ii)	Lab 8: Image classification	Ch. 10	Discussion 4
10	3/11	<b>FSU Spring Break ; Enjoy!!!</b>			
11	3/18	Accuracy assessment and change detection	Lab 9: Knowledge-based classification	Ch. 12-13	Discussion 5
12	3/25	Special topics in remote sensing (I): lidar remote sensing		Jensen (2007): Ch. 10	Discussion 6
13	4/1	Special topics in remote sensing (I): hyperspectral remote sensing	Lab 10: Change detection and spatial modeling	Ch. 11	Discussion 7
14	4/8	<b>Exam Two</b>			
15	4/15	<b>Reserved for research project work</b>			
16	4/22	<b>Research Presentations/Report Due Midnight April 22</b>			