Advanced Remote Sensing (GEOG 408)  
Spring 2014, 3 credit hours

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Office: 4442 Faner Hall  
Office hours: M& W& F 9:00am-11:00am or drop by anytime  
Lecture hours: T 10:00 -11:50 in Faner 2533  
Lab hours: R 10:00 -11:50 in Faner 2524

Prerequisite: 406 or consent

Course introduction and objectives
“Advanced Remote Sensing” (GEOG 408) focuses on theories of advanced digital image processing and analysis, and their applications in geography and environmental resources. This course will provide students with advanced knowledge and skills in the area mainly through lectures and labs. By the end of the course students will master:

- Various sensor systems for collection of remotely sensed data
- Hardware and software for digital image processing
- Statistical analysis of remotely sensed data
- Image display and visualization
- Advanced methods for digital image processing and enhancement
- Advanced methods for digital image classification
- Advanced methods for digital image change detection
- Advanced methods for hyperspectral images, active microwave and Lidar data analysis
- Image based environmental modeling such as global carbon cycling
- Challenges in accuracy assessment
- Remote sensing in 21st Century

In addition to these, students will:
- Learn how to use the advanced digital image processing and analysis technologies and tools to solve problems in geography, environment, etc.;
- Learn how to integrate the advanced technologies with GIS, computer sciences, statistics, etc., to solve practical problems;
- Learn how to work as a good team worker;
- Understand how remote sensing affects the world;
- Learn how to teach themselves to use ERDAS updated versions in the future.

Textbooks and references
- ERDAS Imagine 2013 Tour Guide and Field Guide (provided by instructor and teaching assistant). Required for labs.

**Important journals**
- Remote Sensing of Environment
- ASPRS Photogrammetric Engineering and Remote Sensing
- IEEE Geosciences and Remote Sensing
- International Journal of Remote Sensing
- IJPRS Journal of Photogrammetry and Remote Sensing

**Important websites**
- ENVI: [http://www.ittvis.com/ProductServices/ENVI.aspx](http://www.ittvis.com/ProductServices/ENVI.aspx)
- National Land Cover Data (NLCD): [http://www.epa.gov/mrlc/nlcd.html](http://www.epa.gov/mrlc/nlcd.html)

**Grading**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Participation and attendance</td>
<td>10%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>5%</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>18%</td>
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<tr>
<td>Labs and assignments</td>
<td>30%</td>
</tr>
<tr>
<td>Project</td>
<td>20%</td>
</tr>
<tr>
<td>Final Examination</td>
<td>17%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
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</tbody>
</table>

**Grading Scale**
- 90 - 100% - A
- 80 - 89% - B
Strategies to succeed

Teaching and learning: This course will provide the students with theories and methods of advanced digital image processing and analysis. Students are expected to attend class (both lecture and laboratory) regularly, to take exams, and complete lab assignments, course project, and quizzes. We may also use active learning strategies including shared brainstorming, think/pair/share, case studies, etc., and integrate lecturing and discussion. Students are expected to participate in all the activities. Moreover, learning by doing is critical for you to learn the knowledge and skills from this course. ERDAS Imagine is a widely used software package for image processing and analysis and can be used to perform various tasks and projects related to geography, environment, etc. The laboratory component of this course will make extensive use of this software. Furthermore, we will also introduce other packages.

Labs and course project: We will perform the lab work in Environment GIS Lab located in Faner 2524. This modern computing facility is well equipped and dedicated to meet the technological and computing needs of students. Students are also required to complete 10 labs and a course project using ERDAS Imagine. For these labs, we will use various local, national, and international datasets. In addition to lab instructions, students are encouraged to read the tour and field guides and help documentations provided by the software package to get the insight of this software and various functions that can be used to solve practical problems.

A course project will be completed in groups. Each of the groups consists of 3-4 students and equally participating is required. We are going to provide students with several datasets or options and each of the groups can choose one. For the course project, we just give the task, potential functions to be used, and clues on how to find these functions. Students have to learn how to find out and use these functions to complete the project. Once needed, of course, help is always available from the instructor and teaching assistant. The objective is to let students learn teaching themselves how to use this software to do a project and develop their ability to learn using updated versions. By week 16th, students are required to present their project work in lecture room. The laboratory component of this course is weighted heavily and therefore it is good for students to spend as much time as necessary in this lab.

Policy on late turn in: All assignments must be turned in to receive a grade. Late turning in assignments will be penalized at the rate of 1% per day. After eight weeks, the maximum rate you can receive will be 60%.

Policy on academic dishonesty

We welcome you to this course offered by the Department of Geography and Environmental Resources. This course strictly adheres to the conditions established in the SIUC Student Conduct Code: http://web.coehs.siu.edu/public/her/AcHonPol.php. Acts of academic dishonesty include: 1. Plagiarism, representing the work of another as one’s own work; 2. Preparing work for another that is to be used as that person’s own work; 3. Cheating by any method or means; 4. Knowingly and willfully falsifying or
manufacturing scientific or educational data and representing the same to be the result of scientific or scholarly experiment or research; 5. Knowingly furnishing false information to a university official relative to academic matters; 6. Soliciting, aiding, abetting, concealing, or attempting acts of academic dishonesty. These activities will not be tolerated. Violations will result in failure of the assignment or failure of the entire course.

**Emergency Procedures:**
Southern Illinois University Carbondale is committed to providing a safe and health environment for study and work. Because some health and safety circumstances are beyond our control, we ask that you become familiar with the SIUC Emergency Response Plan and Building Emergency Response Team (BERT) program. Emergency response information is available on posters in buildings on campus, available on BERT’s website at [www.bert.siu.edu](http://www.bert.siu.edu), Department of Safety’s website [www.dps.siu.edu](http://www.dps.siu.edu) (disaster drop down), and in Emergency Response Guideline pamphlet. Know how to respond to each type of emergency.

Instructors will provide guidance and direction to students in the classroom in the event of an emergency affecting your location. It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency. The Building Emergency Response Team will provide assistance to your instructor in evacuating the building or sheltering within the facility.

**Tentative schedule for lectures and labs**

<table>
<thead>
<tr>
<th>Week</th>
<th>Date (Lab)</th>
<th>Topic</th>
<th>Reading</th>
<th>Lab (assignment due next week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan. 14(16)</td>
<td>Course overview and introduction to digital image processing</td>
<td>Jensen Chapter 1</td>
<td>No lab</td>
</tr>
<tr>
<td>3</td>
<td>Jan. 28 (30)</td>
<td>Various remote sensing data (Cont.), hardware and software for digital image processing</td>
<td>Jensen Chapters 2&amp;3, one research article</td>
<td>Lab 2: Analyzing image quality by scaling up and down of spatial and radiometric resolutions</td>
</tr>
<tr>
<td>4</td>
<td>Feb. 4 (6)</td>
<td>Statistical analysis of remotely sensed data</td>
<td>Jensen Chapter 4 One research article</td>
<td>Lab 3: Image histograms, local analysis, correlation between images, statistical filtering, feature space</td>
</tr>
<tr>
<td>5</td>
<td>Feb. 11 (13)</td>
<td>Image display and visualization</td>
<td>Jensen Chapter 5</td>
<td>Lab 4: Composite image (natural color, color infrared, and other combinations), various contrast stretching methods, image merging or fusing</td>
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<tr>
<td>Week</td>
<td>Date</td>
<td>Topic</td>
<td>Readings</td>
<td>Lab</td>
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<tr>
<td>6</td>
<td>Feb. 18 (20)</td>
<td>Advanced radiometric correction</td>
<td>Jensen Chapters 6 and One research article</td>
<td>Lab 5: Haze reduction, and empirical line correction</td>
</tr>
<tr>
<td>7</td>
<td>Feb. 25 (27)</td>
<td>Advanced geometric correction</td>
<td>Jensen Chapter 7, one research article</td>
<td>Lab 6: Advanced geometric correction</td>
</tr>
<tr>
<td>8</td>
<td>Mar. 4 (6)</td>
<td><strong>Midterm exam</strong></td>
<td>No lab</td>
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<tr>
<td>9</td>
<td>Mar. 8-16</td>
<td><strong>Spring break</strong></td>
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<tr>
<td>10</td>
<td>Mar. 18 (20)</td>
<td>Advanced image enhancement algorithms</td>
<td>Jensen Chapter 8 and one research article</td>
<td>Lab 7: Spatial and spectral profiles, ratio image, spatial convolution filtering</td>
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<tr>
<td>11</td>
<td>Mar. 25 (27)</td>
<td>Advanced image classification algorithms, and project introduction</td>
<td>Jensen Chapter 9 and one research article</td>
<td>Lab 8: Vegetation indices and principal component analysis</td>
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<tr>
<td>12</td>
<td>Apr. 1(3)</td>
<td>Artificial intelligence for digital image processing and analysis</td>
<td>Jensen Chapter 10, one research article</td>
<td>Lab 9: Accuracy assessment and uncertainty analysis</td>
</tr>
<tr>
<td>13</td>
<td>Apr. 8 (10)</td>
<td>Hyperspectral image analysis, active microwave and Lidar data analysis</td>
<td>Jensen Chapter 11 and one research article</td>
<td>Project or add a new lab</td>
</tr>
<tr>
<td>14</td>
<td>Apr. 15 (17)</td>
<td>Digital change detection and environmental modeling – global carbon cycling and forest carbon mapping</td>
<td>Jensen Chapter 12 and one research article</td>
<td>Lab 10: Image differencing, change detection, and image-aided spatial interpolation</td>
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<tr>
<td>15</td>
<td>Apr. 22 (24)</td>
<td>Advanced accuracy assessment algorithms, uncertainty analysis, and Remote Sensing in 21st Century</td>
<td>Jensen Chapter 13 and one research article</td>
<td>Project</td>
</tr>
<tr>
<td>16</td>
<td>Apr. 29 (May 1)</td>
<td><strong>Project presentation</strong></td>
<td>No lab</td>
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<tr>
<td>17</td>
<td>May 8th (Thu) 10:10a.m.-12:10p.m.</td>
<td><strong>Final exam</strong></td>
<td>No lab</td>
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