

## FO-4313/6313 Spatial Technologies in Natural Resource Management

**Instructor:** Robert C. Parker  
Thompson Hall Room 345  
325-2775  
[rparker@cfr.msstate.edu](mailto:rparker@cfr.msstate.edu)  
Office hours: 8:00 a.m. to 5:00 p.m. or by appointment

**Updated:** July 15, 2009

**Time/Place:** Lectures @ 10:00-10:50, MWF in Room A208  
Laboratories: 12:00 - 2:50 Monday or 3:00 - 5:50 Wednesday in Room A313

**Prerequisite:** FO 3015 or GR 2313 or consent of instructor

**YOU MUST CHECK WITH THE INSTRUCTOR IF YOU DO NOT SATISFY THE PREREQUISITES OTHERWISE, YOU WILL BE DROPPED FROM THE COURSE.**

### Course Description:

Spatial Information Technologies (SITs) used in natural resource assessment and management include Remote Sensing systems, Global Positioning Systems (GPS) and Geographic Information Systems (GIS). Remote sensing is the characterization of a target or phenomenon without physical contact. Cameras and electronic imaging devices collect much the information that is ultimately interpreted and used to make decisions for natural resource management. GPS is used to determine precise locations of points/areas of interest on the surface of the earth. A GIS is a collection of geographically referenced data, personnel, and computational tools designed to efficiently provide information that is used to assist in spatial analysis and decision-making processes.

This course provides the opportunity to learn the use of SITs in resource management. The skills you will learn are essential for making timely decisions in the information age. We will expose you to the basic elements of SITs but it is ultimately your responsibility to assimilate this knowledge and utilize it to develop and refine your professional skills.

### Course Objectives:

1. Develop basic understanding of the nature and representation of geographic data;
2. Develop a working knowledge of use of aerial photography and other imagery in natural resource assessments;
3. Teach interpretation and measurement techniques that are used to extract information from aerial imagery;
4. Teach methods of spatial data collection and manipulation for resource assessment; and
5. Provide hands-on opportunities to use SIT equipment and software commonly used in professional practice for resource management.

### Student Evaluation:

The student performance in assimilating and utilizing the principles presented in this course will be evaluated on the basis of:

<b>Unannounced pop/daily quizzes .....</b>	<b>20%</b>
<b>Three hour exams (10%, 20%, 30% respectively) .....</b>	<b>60%</b>
<b>NO final exam (0%)</b>	
<b>Laboratory exercises .....</b>	<b>20%</b>
<b>Total</b>	<b>100%</b>

The averages in each category will be weighted by the appropriate percentage. Make-up quizzes will not be given except for absences approved by the instructor of record. Prior approval of known absence is required for non-medical/emergency absences. Class attendance will be evaluated on the basis of the daily/weekly pop quizzes. A=90+, B=80-89, C=70-79, D=60-69, F=<60

**Tentative Exam Dates:** Exam 1 - Wednesday, October 14 (10:00 a.m.)  
Exam 2 - Wednesday, November 11 (10:00 a.m.)  
Exam 3 - Wednesday, December 2 (10:00 a.m.)

**Text:** None; Lecture notes and Laboratory Exercises available on CFR Computer Network via the N:\FO4313 directory or via the web at [www.cfr.msstate.edu](http://www.cfr.msstate.edu) - forestry department - courses - FO-4313/6313

### **Supplemental Texts:**

Avery & Berlin.1992. Fundamentals of Remote Sensing and Air Photo Interpretation. 5<sup>th</sup> Ed., McMillan Publ. Co., NY, NY.

Lillesand & Kiefer. 2000. Remote Sensing & Image Interpretation. 4<sup>nd</sup> Ed. J. Wiley and Sons, NY, NY.

**Academic Misconduct:** All occurrences of academic misconduct will be dealt with in accordance with guidelines and procedures outlined in the Academic Misconduct Policy at:  
<http://msuinfo.ur.msstate.edu/handbook.fac/iv.html#AA>

Students must adhere to the MSU Honor Code:

“As a Mississippi State University student, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do.”

and write and sign the following statement on every exam or project completed in the class room:

"On my honor, as a Mississippi State University student, I have neither given nor received unauthorized assistance on this academic work."

### **Student Responsibilities:**

1. Total and responsive attention during lectures and labs! Disruptive and/or disrespectful students will be evicted from the classroom or laboratory.
2. Attendance at all labs and lectures. Appropriate medical excuse must be presented to the instructor the first day following the student's absence(s). **Absences for reasons other than medical reasons will not be excused unless prior approval has been obtained from the instructor.** Attendance roll will be called to assist the instructor in learning student names; however, the unannounced daily/pop quiz grades will be the primary measure of attendance. **Make-up exams or pop quizzes will not be available except for legitimate reasons.**
3. Make requests for clarification during the lectures and labs or for an office appointment. If you do not understand the material that is being presented, if I skip intermediate steps, or if I lecture too fast, please raise your hand and ask, in a respectful manner, to slow down, clarify, fill in the gaps, and/or repeat the material/subject. It is very easy to assume a student knows something and to skip

intermediate steps or to become so engrossed in a topic that I talk too fast. It is your responsibility to understand the material, whatever it takes. I don't mind repeating something until you get it nor do I mind meeting with you after class. Please do not wait until the day before/of an exam to request help. When you don't understand the material, either resolve it in class during the lecture or make an appointment with the instructor.

4. Be prepared to participate in lecture and laboratory discussions. **Review the previous day's lecture notes and read the current day's assignment before you come to class and be prepared to answer questions!** My questions and requests for student discussion are a sincere attempt to make you THINK and to RELATE the material to the broad aspects of resource management. Think and relate are the key words to your success in this and other forestry courses.

5. Be prepared for daily quizzes; all you have to do is review the notes from the previous lecture. The daily quizzes are used to evaluate your progress in assimilating the material and the effectiveness of the instructor in presenting the material.

6. Be prepared for written exams and give prior notification if you cannot make a scheduled exam. Make-up exams will be given if and only if you have a legitimate excuse.

7. Demonstrate your desire to learn the subject and apply it to your profession. If you're not interested in improving your professional knowledge, enroll in another course.

8. Conduct yourself as a professional and treat others in a courteous and respectful manner. Unprofessional and/or disrespectful conduct will not be tolerated in this course.

9. I would appreciate receiving your constructive criticism regarding how the course can be improved to meet your needs and possibly your expectations. It is my responsibility to expose you to the concepts and practices that I know, through experience, you will need in your professional career. There is, however, more than one way to "skin the cat", so if you're serious about learning, I can assure you that I am here for you and are willing to do whatever it takes to present the material in a meaningful way. Be an active participant in the learning process!

10. Students who elect to take this course for **graduate credit** will be required to develop an additional short written report on SIT applications in their respective fields of interest.

**Lecture Topic Outline and References**  
**FO-4313/6313 Spatial Technologies in Natural Resource Management**

<b>Topic Series</b>	<b>No. Lectures</b>
<b>1. Introduction to Spatial Technologies</b> - Course syllabus, requirements, grading, exams/grading - Topic outline and references - Technology Acceptance - Spatial Technologies for Resource Managers - Historical perspectives	1
<b>2. Spatial Information Concepts</b> - Spatial awareness - Geographic Entities - Measurements, location, pattern - Sampling, inferences - Map and imagery characteristics	2
<b>3. Electromagnetic Radiation (EMR)</b> - Energy relationships - Atmospheric/target interactions - Target reflectance	2
<b>4. Remote Sensing Systems Overview</b> - Passive and active sensors - Cameras (film, video, digital) - Scanners (types, image characteristics) - Radar - Lidar	1
<b>5. Aerial Film Cameras, Photo Geometry, Films/Filters, Image Formation</b> - Single Lens Reflex vs. human eye - Focal length, aperture, shutter speed, depth of field - Characteristics of aerial photos - Stereoscopic vision - Stereoscopes - types and proper use - Preparing photo's for stereoscopic viewing, Stereograms - Orienting photos for stereoscopic viewing - Use and care of aerial photographs - Image sharpness and resolution vs. contrast - Aerial Films - panchromatic, infrared, color, color IR - Filters -yellow, red, green, polarizing, antivignetting - Resolution - Season/utility considerations - Economic considerations: film, filter, season, scale	2

<b>6. Principles of Image Interpretation</b>	2
<ul style="list-style-type: none"> <li>- Applicability of remote sensing in environmental studies</li> <li>- Activity sequence of image interpretation</li> <li>- Attributes of an image interpreter</li> <li>- General image analysis</li> <li>- Object attributes for interpretation - shape, size, shadow, site, tone/color, texture, location/association, pattern</li> <li>- Rule of thumb for image analysis</li> <li>- Cultural features</li> <li>- Terrain and drainage analysis</li> </ul>	
<b>7. Scale and Measurements from Aerial Photography</b>	4
<ul style="list-style-type: none"> <li>- Expressions of scale – equivalent, graphic, RF</li> <li>- Representative Fraction (RF)</li> <li>- Scale determinations</li> <li>- Scale conversion</li> <li>- Scale variations</li> <li>- Problem solving</li> <li>- Lengths and linear distances</li> </ul>	
<b>EXAM 1</b>	
<b>7. Scale and Measurements from Aerial Photography cont'd</b>	2
<ul style="list-style-type: none"> <li>- Area measurements</li> <li>- Displacement height measurement on single vertical photos</li> <li>- Stereographic parallax height measurements</li> </ul>	
<b>8. Digital Remote Sensing, Image Representation and Enhancements</b>	1
<ul style="list-style-type: none"> <li>- Image formats (digital and hardcopy)</li> <li>- Band combinations</li> <li>- Computer enhancement functions</li> </ul>	
<b>9. Basic Analysis Concepts for Digital Imagery</b>	1
<ul style="list-style-type: none"> <li>- Image exploration</li> <li>- Basic spatial operators</li> <li>- Image classification concepts</li> </ul>	
<b>10. Remote Sensing Mission Planning</b>	2
<ul style="list-style-type: none"> <li>- Information requirements</li> <li>- Time, cost quality considerations</li> <li>- Sensor considerations</li> <li>- Flight planning specifications</li> <li>- Example of flight plan for aerial photography</li> </ul>	
<b>11. Map Projections, Grids, Image Rectification, Planimetric Mapping</b>	3
<ul style="list-style-type: none"> <li>- Characteristics of projections</li> <li>- Common projections</li> <li>- Map grid systems</li> <li>- Ground control and image rectification</li> <li>- Control point selection</li> <li>- Image preparation for mapping</li> <li>- Image interpretation and transfer of information</li> </ul>	

- Heads-up mapping
- Orthophotography and mosaics

<b>12. Global Positioning Systems and Use</b>	3
- The GPS: satellite and receivers	
- Data accuracy	
- Data collection and use in natural resources applications	
- GPS data in remote sensing and GIS applications	

## EXAM 2

<b>13. Resource Inventory Methods</b>	2
- Estimation of tree and stand characteristics from imagery	
- Tree and stand volumes from aerial photography	
- Area determination	
- Aerial timber cruises with photography and Lidar	
- Large-area resource inventory with satellite data	
<b>14. GIS Organization and Basic Functions/Outputs</b>	2
- GIS infrastructure/organization	
- Hardware/software environment	
- Basic vs. advanced functions	
- Outputs	
<b>15. GIS Data Structures, Topology, Relational Databases, Accuracy Issues</b>	2
- Computer file structure	
- Relational databases	
- Graphic data representation (raster vs. vector)	
- Topology	
- Raster and vector pros and cons	
- Scale/accuracy issues	
- Other sources of error	
<b>16. GIS Data Input, Editing, Storage</b>	2
- Input devices	
- Data sources	
- Digitizing	
- Error detection/correction	
- Projections	
- Database construction	
- Metadata	
<b>17. Elementary GIS Operations, Classification Functions</b>	2
- Data exploration	
- Database links, simple query	
- Measurements	
- Recoding /reclassification	
- Neighborhood/buffer functions	

<b>18. Statistical Surfaces</b>	<b>1</b>
- Surface basics	
- Interpolation	
- Terrain analysis	
- Discrete surfaces	
<b>19. Spatial Operators, Overlay Operations, Models and Modeling</b>	<b>3</b>
- Proximity analysis	
- Network analysis	
- Overlay operations (map algebra, vector overlay, clipping/masking)	
- Site selection/suitability	
- Predictive models	
- Model validation	
<b>20. GIS Organizational Issues</b>	<b>1</b>
- GIS design	
- Project management	
- User training	
- Maintenance	
<b>EXAM 3</b>	
<b>Total Lectures</b>	<b>43</b>
<b>Total One Hour Exams</b>	<b>3</b>

## Laboratory Exercises for FO 4313/6313

Lab	Laboratory Title & Topics	Materials/Equipment
1.	Introduction to Spatial Technologies: a. aerial film-filter-season combinations b. photo geometry c. stereoscopy d. photo-map orientation	pocket stereoscope grease pencil masking tape engineer scale sample imagery
2. 2a. 2b.	Scale and Measurements from Aerial Photography: a. average and point scale b. horizontal distance, bearing, and area	engineer scale 9" by 9" mylar/tracing paper 30-60-90 triangle
3. 3a. 3b.	Height Determination: a. Single Photos b. Stereo Pairs	engineer scale pocket stereoscope T-square Abrahms Parallax Bar "dot" single photots- power plant stereograms
4.	Image Interpretation: a. non-photographic systems digital imagery      lidar satellite imagery    radar b. photographic systems visual interpretation of satellite imagery land-use vegetative cover interpretation c. verification	Avery test booklet Visual Search Test pocket stereoscope USDA Handbook 308 SE Station 112 USDA Handbook 262 Auburn P.I. Key Stereograms 1-14
5. & 6.	Mapping Concepts: a. projections and grids b. control points c. image interpretation d. image rectification with vertical sketchmaster d. planimetric digitizing/mapping with ARCVIEW	20" x 24" mapping paper pocket stereoscope stereo triplicate grease pencil engineer scale vertical sketchmaster
7.	Mission Planning: a. aerial imagery b. non-photographic imagery	engineer scale 7.5' quad t-square and 30-60-90 triangle
8. & 9.	GPS: a. GPS concepts and use b. data specifications and types; data collection c. post processing for area and mapping	computer diskette GPS unit data cable
10.	GIS Computer Concepts: a. overview of ArcView b. basic functions/outputs c. data types (spatial and attribute) d. measurements	computer diskette

11. & 12.	GIS Data Input, Editing, and Storage: a. attribute table management b. data creation/editing c. creating buffers d. data storage	
13.	GIS Operations: a. data query b. feature merger c. table intersection d. feature intersection	
14.	Practical Exercise: (continuation of Labs 5 & 6) a. control points b. image interpretation c. digitizing spatial data d. entering attribute data e. fulfilling management queries f. preparing final/presentation map	