EE 5373 Introduction to Remote Sensing Systems
Credit Hours: 3
MW 1:30 to 2:50 pm

Prerequisite Courses: (EE 3384 and EE 2353 and MATH 3323) or Permission of the instructor.

Course Description:
Introduction to imaging principles and system performance parameters for optical systems used in multi/hyperspectral remote sensing. Study and evaluation of existing and proposed ground-based, airborne, and satellite remote sensing platforms. Introduction to the end-to-end information processing chain including algorithms, methodologies and tools for information extraction and management in multi/hyperspectral remote sensing. Discussion of research trends in the area.

Instructor:
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Learning Outcomes:
After completion of this course, students should be able to:
- Understand the fundamentals of imaging for remote sensing applications using multispectral and hyperspectral imagers.
- Understand the parameters of the imaging system and how they affect the quality of the collected image.
- Apply algorithms for atmospheric compensation, geo-referencing to remote sensing imagery.
- Apply signal and image processing, and pattern recognition techniques to the analysis of remote sensing imagery.
- Use software tools such as ENVI/IDL or MATLAB for the analysis of remote sensing imagery.

Required Materials:

Textbook

References

Online Resources
1. Electronic access to multiple remote sensing journals is available online from the UTEP Library.
8. MATLAB Hyperspectral Image Analysis Toolbox (HIAT)
http://www.censis.neu.edu/software/hyperspectral/hyperspectral.html
9. MultiSpec: A Freeware Multispectral Image Data Analysis System
https://engineering.purdue.edu/~biehl/MultiSpec/

Software Tools
• Most homework will require the use of programs such as MATLAB or ENVI/IDL.
• ENVI/IDL student version can be purchase from
• MATLAB is available from My.Apps.UTEP.edu.
• MATLAB tutorials and books are available from the UTEP Library.
• Some homework may require the use of GIS software. ArcGIS is available in My.Apps.UTEP.edu

Course Policies:

Grading:
The final grade will be based in two tests (40%), homework (35%), and a Project (25%). You need to complete and hand in all work to pass the course. An incomplete grade is given only for a valid reason when arrangements have been made with me and only if the student was passing the course. Late course work will not be accepted. No make-up work will be given.

Grading Policy:
A: 90%-100%
B: 80%-89.99%
C: 70%-79.99%
D: 60%-69.99%
F: 0-59.99%

Classroom Etiquette:
Part of being a professional is being on time and being prepared to do your job. This applies to your career as a student as much as it does to your future career as an engineer. You are expected to be in class and prepared to participate at the scheduled start time. Wireless devices (cell phones, PDA’s, MP3 players, Smart phones, etc.) are allowed in the classroom. It is recognized that devices of this sort provide emergency access for your family and loved ones. However, please use professional discretion with these devices. This includes shutting them off or setting them in the silent mode before coming to class. Do not use text messaging or web browser features while you are in class. If you must answer the phone, please do so after discretely leaving the room. You may return to class once your call is finished.

Cheating and Plagiarism:
Cheating is unethical and not acceptable. Plagiarism is using information or original wording in a paper without giving credit to the source of that information or wording: it is also not acceptable. Do not submit work under your name that you did not do yourself. You may not submit work for this class that you did for another class. If you are found to be cheating or plagiarizing, you will be subject to disciplinary action, per UTEP catalog policy.

Course Statements: (Civility, disability, military, etc.)

Center for Accommodations and Support Services (CASS):
If you have a disability and need classroom accommodations, please contact the Center for Accommodations and Support Services (CASS) at 747-5148, or by email to cass@utep.edu, or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at www.sa.utep.edu/cass.

Civility:
We expect course business to be conducted in a civil manner. Disrespectful behavior towards the instructor or classmates is not acceptable. Any uncivil behavior in class will be subject to disciplinary actions per UTEP policy.
### Course Schedule (Tentative):

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<thead>
<tr>
<th>Topic</th>
<th>Recommended Reading</th>
<th>Lectures</th>
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<tr>
<td><strong>Introduction to remote sensing and a brief historical overview, course introduction</strong></td>
<td>Sch: Ch. 1</td>
<td>1</td>
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<tr>
<td><strong>Physics of remote sensing: introduction to radiometry, fundamental equation in different regions of the electromagnetic spectrum</strong></td>
<td>Sch: Ch. 2</td>
<td>2→4</td>
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<tr>
<td><strong>Sensing systems: camera systems, EO systems, detectors, samples of existing systems, sensor resolution</strong></td>
<td>Sch: Ch. 3</td>
<td>5→6</td>
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<tr>
<td><strong>Data Models: Statistical models for multi/hyperspectral imagery. Simple visualization techniques using scatterplots and scattergrams. Noise models. Spatial statistics. Topographic and sensor effects.</strong></td>
<td>Sch: Ch. 4</td>
<td>7→9</td>
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<tr>
<td><strong>Spectral transforms. Feature extractions from MSI/HSI</strong></td>
<td>Sch: Sections 5.1→5.5</td>
<td>10→12</td>
</tr>
<tr>
<td><strong>Contrast enhancement: single band, color composites</strong></td>
<td>Sc: 5.6</td>
<td>13→14</td>
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<tr>
<td><strong>Spatial processing: Linear and nonlinear filters. Edge detection. Fourier transforms. Scale-Space representations.</strong></td>
<td>Sch: Ch. 6</td>
<td>15→16</td>
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<tr>
<td><strong>Correction and Calibration</strong></td>
<td>Sch. Ch. 7</td>
<td>16→18</td>
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<tr>
<td><strong>Registration and Fusion</strong></td>
<td>Sch. Ch. 8</td>
<td>19→21</td>
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<tr>
<td><strong>Multispectral Image (MSI) Processing: per pixel processing, classification, transformations</strong></td>
<td>Sch. Sections 9.1→9.8</td>
<td>22→26</td>
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<td><strong>Hyperspectral Image (HSI) Processing: extension of multispectral methods and dimensionality issues, unmixing, spectroscopy</strong></td>
<td>Sch.9.8→9.9 Professor notes</td>
<td>27→28</td>
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<td><strong>Project Presentations</strong></td>
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<td>29→30</td>
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**Midterm Exam**

| **Correction and Calibration** | Sch. Ch. 7          | 16→18    |
| **Registration and Fusion**   | Sch. Ch. 8          | 19→21    |
| **Multispectral Image (MSI) Processing: per pixel processing, classification, transformations** | Sch. Sections 9.1→9.8 | 22→26    |
| **Hyperspectral Image (HSI) Processing: extension of multispectral methods and dimensionality issues, unmixing, spectroscopy** | Sch.9.8→9.9 Professor notes | 27→28    |

**Final Exam**