GEOL 4315/GEOP 5336: DIGITAL IMAGE PROCESSING

University of Texas at El Paso **Department of Geological Sciences**
Spring Semester 2018

Instructor:

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Class Website:

http://www.geo.utep.edu/pub/hurtado/dip

Check the class website often for updates and announcements. The website is a key part of the class and will be the venue for a lot of important class business. In addition, we will use a server on the Department network for access to a shared drive for submission of course work. **Note that the course does not use Blackboard.**

Class Meetings:

Lecture: Mon., 9:30-11:20 am (Geology 302)
Lecture/Lab: Wed., 9:30am-12:20 pm (Geology 409)
Office Hours: Mon. and Wed. 1-3pm (Geology 301A) or by appointment

Text:

There is no required text to purchase. Course materials will be provided in the form of PDF readings and class notes as well as journal articles from the literature, and these will be made available via the class website and/or the class shared drive.

The following books, while recommended, are not required purchases:

Jensen, 2016, *Introductory Digital Image Processing: A Remote Sensing Perspective* (4th edition): Pearson/Prentice Hall (print ISBN 9780134058160, 013405816X)

Jensen, 2007, *Remote Sensing of the Environment: An Earth Resource Perspective* (2nd edition): Pearson/Prentice Hall, 608 pp. (ISBN 0131889508)

Gonzalez and Woods, 2017, *Digital Image Processing* (4th edition): Pearson/Prentice Hall (print ISBN: 978-0133356724)

Gonzalez, Woods, and Eddins, 2009, *Digital Image Processing Using MATLAB* (DIPUM) (2nd edition): Gatesmark Publishing, 829 p. (ISBN: 9780982085400)

In addition, the MATLAB® and ENVI® documentation will be critical resources during the semester. The following websites will also be good resources:

- The Remote Sensing Tutorial: http://www.fas.org/irp/imint/docs/rst/.
- The Remote Sensing Core Curriculum: http://www.r-s-c-c.org/
- NASA remote sensing online textbook: http://rst.gsfc.nasa.gov/
- Spectroscopy of Rocks and Minerals, and Principles of Spectroscopy (Clark, 1999): http://speclab.cr.usgs.gov/PAPERS.refl-mrs/refl4.html
- Companion website to the DIP and DIPUM books: http://www.imageprocessingplace.com

Grading:

Lab assignments (70%); final exam (20%); lecture and lab participation (10%).

Lab work will normally be assigned and due on Wednesdays. Note that most assignments will be turned in electronically (or as otherwise instructed). Storage space, data, and software will be made available to you on the Geology department computer system. Therefore, you will all need accounts to access to the UTEP open-lab PCs on the 4th floor. Contact me AND the system administrator, Carlos Montana (montana@geo.utep.edu), if you do not have access already. Also be sure to contact BOTH of us for any technical problems throughout the semester. Carlos will be the one to fix things, but I need to know what is going on.

Graduate students will be held to a higher standard than undergraduates. Specifically, selected homework assignments/problems/tasks and selected exam problems will be designated as required for graduate students and extra credit for undergraduates.

Policies:

Show up, show up on time, and show up prepared! Do each reading assignment before attending class, and come to class meetings with questions about what you read and about material from the previous class meeting. Attendance and class participation in both lecture and lab are required. **I reserve the right to drop you from the course if you have excessive absences.** Please **contact Dr. Hurtado about any concerns, schedule conflicts, missed work, etc. ASAP and, whenever possible, <u>in advance</u>.** Valid excuses include illness, absence with the instructor's prior approval, official University business, etc., but **<u>all require documentation</u>**. Unless other arrangements with the instructor are made, **late work will lose 50% of its value for each day it is late, and work will <u>not</u> be accepted more than one week late**. In general, **make-up exams and assignments will <u>not</u> be given**.

If you are a military student with the potential of being called to military service and /or training during the course of the semester, you are encouraged to contact as soon as possible.

If you think you may have a disability or if you are experiencing learning difficulties, please contact the Disabled Student Services Office (DSSO) at (915) 747-5148. They're located in Union East room 106 or you can reach them by e-mail at dss@utep.edu. The student is responsible for presenting to the instructor any DSS accommodation letters and instructions.

While **collaboration on assignments is encouraged**, the intent is to foster problem-solving skills and mastery of the subject matter, not just a quick way to get "answers". **All work is expected to be your own!** The University guidelines for acceptable student conduct are very specific and will be strictly followed. Please read the guidelines (see http://studentaffairs.utep.edu/dos), and contact the Dean of Students or Professor Hurtado if you have any concerns.

Expectations:

The goal of this course is for you to attain a firm understanding of the processing of (remotely-sensed) digital images in the context the Earth and environmental sciences. You will learn how, why, and when to apply digital image processing techniques in order to produce image products of value in answering scientific questions in your own research. The emphasis in this course will be on applications and basic concepts, but there will be mathematical treatments of topics in statistical analysis, Fourier analysis, and principal components analysis, among other topics. Students will be given access to state-of-the-art computer facilities and some instruction on how to use the popular image processing software ENVI®*. Students can expect to gain proficiency in basic MATLAB® programming in the course of the laboratory work**. There will be emphasis on independent work towards a term project. Students are expected to be active participants in the class and laboratory discussions and will be asked to make presentations in class. In particular, the results of term projects will be presented orally.

**Note that students will be assumed to have taken the prerequisite course GEOP 4335 (Remote Sensing), or equivalent and have some experience with ENVI or similar software.*
***Note that there is no expectation of prior experience or proficiency with MATLAB.*

Course Outline:

Note that the details of our schedule are likely to change as the semester progresses. Please be flexible, and let Professor Hurtado know if you have any concerns or suggestions. A preliminary, detailed schedule is attached.

Week #	Meeting Dates (MW)	Lecture Topics (MW) (readings; handouts to be provided)	Lab Assignment (W) (M = MATLAB; E = ENVI)
Week 1	Jan. 17	Review of Remote Sensing; Introduction to Signal and Image Processing (Jensen Ch. 1, 6; DIP Ch. 1; DIPUM Ch. 1)	***No Mon. class meeting; meet for lecture in room 409 on Wed.; no lab assignment this week.***
Week 2	Jan. 22, 24	Review of Remote Sensing; Introduction to Signal and Image Processing <continued>	Lab 1: Introduction to MATLAB and review of ENVI (M/E)
Week 3	Jan. 29, 31	Digital Images; Image Math and Statistics; (Jensen Ch. 4, 5; DIP Ch. 2; DIPUM Ch. 2)	Lab 2: Image Statistics (M)
Week 4	Feb. 5, 7	Image Pre-processing (Geometric and Radiometric) (Jensen Ch. 7; DIP Ch. 2, 3; DIPUM Ch. 2, 3, 6)	Lab 3: Geometric and Intensity Transformation (M)
Week 5	Feb. 12, 14	Spatial-Domain Filtering (Jensen Ch. 8; DIP Ch. 3; DIPUM Ch. 3)	Lab 4: Spatial-Domain Filtering (M/E)
Week 6	Feb. 19, 21	Frequency-Domain Processing and Wavelets (Jensen Ch. 8; DIP Ch. 4, 8; DIPUM Ch. 4, 7)	Lab 5: Frequency Domain Processing and Wavelets (M/E)
Week 7	Feb. 26, 28	Image Enhancement and Reconstruction (Jensen Ch. 8; DIP Ch. 5; DIPUM Ch. 5)	Lab 6: Image Enhancement I (M)
Week 8	Mar. 5, 7	Image Enhancement and Reconstruction (Jensen Ch. 8; DIP Ch. 5; DIPUM Ch. 5)	Lab 7: Image Enhancement II (M)
Week 9	Mar. 19, 21	*TBD*	*TBD*
Week 10	Mar. 26, 28	Color Image Processing (Jensen Ch. 8, 11; DIP Ch. 6; DIPUM Ch. 7)	*TBD*
Week 11	Apr. 2, 4	Image Transforms; Principal Components (Jensen Ch. 8)	Lab 8: Principal Components (M)
Week 12	Apr. 9, 11	Morphology and Segmentation; Classification (Jensen Ch. 9, 11, 12; DIP Ch. 9, 10; DIPUM Ch. 10, 11)	Lab 9: Classification (M/E)
Week 13	Apr. 16, 18	Change Detection (Jensen Ch. 12)	Lab 10: Change Detection (M/E)
Week 14	Apr. 23, 25	*TBD*	*TBD*
Week 15	April 30, May 2	*TBD*	*TBD*