University of Maryland at College Park
Department of Geographical Sciences
GEOG 472
Remote Sensing: Digital Processing and Analysis

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General information about the course

This course introduces conceptual and practical aspects of digital image analysis from space-borne earth-observing instruments. The Lecture-laboratory class will build upon principles introduced in GEOG372, and emphasize the advanced techniques for processing and analyzing remote sensing data. It is a highly technical course but will be taught in a non-quantitative way. Laboratory sessions will give students hands-on experience in the fundamentals of digital image processing and information extraction techniques.

The prerequisites for this course include GEOG372 (Introduction to Remote Sensing) or another introductory course for remote sensing and GEOG306 (Introduction to Quantitative Methods for Geography and Environmental Sciences) or equivalent.

Learning outcomes for the course

Upon successful completion of the course students should be able to:

- demonstrate hands-on skills in:
    - manipulating satellite data with different formats
    - geometric correction and image registration
    - image enhancement for visual interpretation
    - various techniques for extracting surface information of category and numerical variables
- demonstrate an understanding of the advanced principles of remote sensing, including sensor calibration, atmospheric correction, and classification algorithms
- solve some technical issues in an application project using actual satellite data
- locate additional learning materials on-line

Course materials

Required textbook:

Mather, P.M. & M. Koch, (2010) Computer Processing of Remotely Sensed Images: An Introduction, John Wiley & Sons Ltd, 4th Edition, (460 pp.) ISBN: 978-0-470-74239-6

Additional materials:

Additional reading materials will be assigned by the instructor as appropriate throughout the course. These may include selected journal articles, data manuals, and other sources.

Course communication

The main course communication will be carried out through the *Canvas* within the University of Maryland Enterprise Learning Management System (ELMS; https://elms.umd.edu). All students enrolled in the course have access to the system. In addition to communications, *Canvas* will be used by the instructor and the TAs to post assignments and grades and by the students to submit their assignments.

Class structure

The class structure includes one 2 hour lecture period and one 2 hour lab period per week.

Lecture component

During the lectures the instructor will synthesize the core material regarding digital image analysis of satellite-imagery in the optical range of electro-magnetic radiation. In addition, guest talks will demonstrate practical application of the image processing principles. Lecture attendance will not be monitored.

Lab component

The course includes a lab component. Labs will contribute 50% to the total grade for the course. There will be a total of 11 lab exercises each worth 4.5-5% of the total grade. During the lab exercises the students will work individually and in groups to practice hands-on applications of image analysis principles. Small groups will be assigned by the instructor and the TA randomly and the group composition will change weekly. The group will submit a single assignment for all participants who will share the single grade: it is up to the group participants to ensure contributions from all members. Lab presence is required and will be monitored: students not present in the lab during the respective hours will receive a grade of zero on the lab assignment for that week.

Please note that lab presence implies that you should be physically in the lab for the entire duration of your lab hours AND you must be working on the current lab assignment for GEOG472 together with other members of your group.

All deliverables as described in each lab assignment should be submitted to the *Canvas* weekly

Provisional outline of topics covered in the course and exams

Please, note that modifications may be introduced to the schedule as the semester progresses. Updated schedules will be made available to all students via *Canvas* as soon as possible.

Date	Topic	Lab
9/3/2014	Course overview, Intro: a systematic view of RS	Introduction to ENVI
9/10/2014	Earth Observation Missions and Instrumentation	Methods for managing data using the software ENVI
9/17/2014	Understanding Surface Signatures	Analyzing and understanding spectral data
9/24/2014	Geometric Correction and image registration	Geometric correction and image registration
10/1/2014	Radiometric Calibration and Preprocessing	radiometric calibration & Image enhancement
10/8/2014	Atmospheric Effects in Optical Imagery	Atmospheric correction

		and Correction
10/15/2014	Mid-term exam	project proposal development
10/22/2014	Feature Extraction Techniques	Principal component analysis and vegetation indices
10/29/2014	Image Classification Techniques	Clustering analysis
11/5/2014	Land Use/Cover Mapping	Supervised classification
11/12/2014	Change Detection	Change detection
11/19/2014	Accuracy Assessment of derived maps	Accuracy assessment
11/26/2014	Project proposal discussion	No Lab: Thanksgiving recess
12/3/2014	Project completion	Project completion
12/10/2014	Project presentations	Project presentations
TBD	Final exam	

Mid-term and final exams

The course includes 2 non-cumulative exams: 1 mid-term exam (worth 15% of the total grade) and 1 final exam (20% of the total grade). Although the exams are non-cumulative, understanding of the principles acquired in earlier parts of the course will be necessary to answer exam questions in the later parts of the course. All exams will be "closed book" and will present a combination of short answer and long answer questions with an emphasis on problem solving. The exams will test the student's ability to select, **justify**, and describe the use of specific image processing techniques based on the material covered during lectures and lab exercises. On exam day, students are strongly advised to come to class at least 5 min early.

Exam make up policy

Students unable to take the test should notify the instructor at least 3 working days before the scheduled exam date to schedule a make up date. The make up exam must be taken within a week of the scheduled exam date. Failure to take the make up exam or schedule a make up date will result in a zero on the exam.

Final Project

Final Project will present a combination of in-class and out-of-class work and assessment. Various components of the final project will be graded independently and will produce a single cumulative grade for the final project (100 points worth – 15% of the total grade for the course). The components of the project and their contribution to the individual grade are as follows: 1) project proposal (10 points); 2) in class project presentation (10 points); 3) project paper (80 points).

Grade determination

The total grade in the course will be comprised of the grades for the mid-term exam (15%), the final exam (20%), the course project (15%), 10 labs (50%). The general guidelines for letter grades will be as follows: $97 \leq$ "A+" ≤ 110 , $93 \leq$ "A" <97, $90 \leq$ "A-" <93, $87 \leq$ "B+" <90, $83 \leq$ "B" <87, $80 \leq$ "B-" <83, $77 \leq$ "C+" <80, $73 \leq$ "C" <77, $70 \leq$ "C-" <73, $67 \leq$ "D+" <70, $63 \leq$ "D" <67, $60 \leq$ "D-" <63, $60 <$ "F". Minor adjustments may be introduced to the general scheme to allow for students grade distribution.

Expectations of students in the class

Lecture attendance is not required, however, lab attendance is mandatory. Students should be aware that much of the material covered in the class is not available in the textbooks and will be presented in lectures only. Students are strongly encouraged to take careful notes during the lectures.

Students are expected to complete their lab assignments in the Open Lab facilities at the Department of Geography of the University of Maryland during assigned lab hours. All lab assignments are to be submitted via *Canvas* by specific due date and time.

Students are expected to treat each other with respect. Disruptive behavior of any kind will not be tolerated. Students who are unable to demonstrate civility with one another, the teaching assistants, or the instructor will be subject to referral to the Office of Student Conduct or to the University Campus Police. You are expected to adhere to the Code of Student Conduct.

In this class, students will be allowed and encouraged to use their personal computers or other means of technology to take class notes and complete practice exercises.

Academic integrity

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.shc.umd.edu.

Honor pledge must be included in every assignment and exam submitted by the students:

"*I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/paper/examination.*"

Students with disabilities

Every effort will be made to accommodate students who are registered with the Disability Support Service (DSS) Office and who provide the instructor with a University of Maryland DSS Accommodation form which has been updated for the Fall 2014 semester. This form must be presented to the instructor no later than October 1, 2014. The instructor will not be able to accommodate students who are not registered with DSS or who provide the instructor with documentation which has not been reviewed and approved by UM's DSS Office.

Medical excuses

Campus Senate policy requires students who are absent due to illness/injury to furnish documentary support to the instructor. Students must contact the instructor by email or by phone prior to class time in which the student will indicate he/she has an illness/injury. In accordance with the University of Maryland policy on student medical absences, "the University will accept as an excused absence a self-signed note from a student who has missed a single lecture, recitation, or laboratory, attesting to the date of the illness. The note must also contain an acknowledgement by the student that the information is true and correct and that providing false information is prohibited under Code of Student Conduct. The student is also obligated to make a reasonable attempt to inform the instructor of his/her illness in advance."
(http://www.provost.umd.edu/announcements/StudentMedicalAbsences.cfm). In this course, only one self-signed note will be accepted for a single lab absence. If additional labs or any of the exams and in-class assessments (i.e. Major Grading Events) are missed, a written documentation from a health care provider is required. The student must present written documentation verifying his/her illness/injury on the first day of class that he/she returns to class. The student will not be allowed to turn in missed assignments or make up exams if he/she has not provided this documentation. In addition, if it is found that the

student has falsified the documentation provided, he/she will be referred to the University's Student Conduct Office.

Religious observance

By September 11, 2014, students must provide the instructor, in writing, a request for a makeup exam for a specific exam date on this syllabus that students are unable to make due to a specific religious observance (specify) on a specific date. Please refer to the Online Catalog Policy on Religious Observance. Please remember that accommodations are NOT made for travel to and from the religious observance.