



Department of Geography and Geoinformation Science

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GGS 416 - Satellite Image Analysis Spring 2016

1. General Information

Instructor: Dr. Arie Croitoru
Where: Exploratory Hall 2103
When: Thursdays between 1:30pm to 4:10pm.
Course website: Blackboard
Credits: 3.0
Prerequisites: 60 credits and GGS 412, or permission of instructor.
Instructor's Office Hours: Mon 10:00am - 11:00am, Thu 4:30pm - 5:15pm, or by appointment (My office is located in Exploratory Hall 2205, the Fairfax Campus).
Contact method: Message via Blackboard. I will typically respond to messages within 24 to 48 hours Monday to Friday during regular business hours (messages sent during the weekend will be answered on the following Monday).

2. Course Objectives

Satellite imagery has become a primary data source in geospatial applications - from satellite remote sensing to aerial and terrestrial imaging systems and networks, vast amounts of imagery are being collected and utilized in various application areas. The wide variety of imagery data sources is now challenging our ability to manage such data, process it, and derive useful high-level information from it. Motivated by this, the primary objective of the course is to provide a systematic introduction to computer-based processing of satellite imagery techniques for enhancing, processing and extracting spatial information from imagery. Emphasis is put in this course on quantitative computer-based analysis of imagery. In view of this, the objectives of this course are to:

- A. Review basic ideas and theories of image processing and their relation to earth observations.
- B. Introduce analytical techniques and tools that are used in satellite image analysis.
- C. Develop the ability to apply these tools in various application areas.

3. Learning Outcomes

By the end of the course each student will be able to:

- A. Describe some of the key theories and techniques in satellite image analysis.
- B. Effectively communicate concepts and ideas related to image processing and remote sensing to experts, non-experts, and other professionals in a work environment.
- C. Have the ability to appropriately apply the tools and concepts covered in the course for various hypothetical and real-world data processing tasks.
- D. Given a problem or task, be able to effectively analyze it, identify key elements and potential difficulties, and define a strategy for successfully addressing it.

4. Delivery Method

The course will be taught as a combination of lectures, topic/problem oriented discussion, and tutorials based on assigned reading and class discussion.

5. Textbooks

During the course we will use materials from several resources, which are available electronically through the Mason library:

1. "Introduction to Video and Image Processing - Building Real Systems and Applications" by Thomas B. Moeslund, Springer-Verlag, 2012 (ISBN 978-1-4471-2502-0).
2. "Practical Image and Video Processing Using MATLAB" by Oge Marques, Wiley-IEEE Press, 2011 (ISBN 978-1-1180-9348-1).
3. "Remote Sensing Digital Image Analysis – An Introduction" by John Richards, Springer-Verlag, 2015 (ISBN 978-3-642-30062-2).

In addition, we will make use of the first two chapters of the book "Digital Image Processing, 3rd Edition" by R. C. Gonzalez and R. E. Wood, Prentice-Hall 2009 (ISBN 978-0-13-168728-8). These chapters are available online from the publisher at <http://bit.ly/1u4Uajf>. Additional readings (selected readings from books, research journals, technical reports, and other sources) will be provided via the course website.

6. Course outline (tentative)

In this course we will cover the following topics (please note that the topics and their order are subjected to change at the discretion of the instructor, any changes will be announced in class):

Date	Topic	Exam	Assignment	
			Release	Due
1/21	Introduction and overview			
1/28	Principles of remote sensing (1)			
2/4	Principles of remote sensing (2)		Lab 1	
2/11	Digital Image formation			Lab 1
2/18	Introduction to color spaces		Lab 2	
2/25	Introduction to remote sensing data analysis	Midterm		Lab 2
3/3	Image enhancement - Point processing			
3/10	*** Spring Break ***			
3/17	Image enhancement - Histogram processing		Lab 3	
3/24	Image filtering (1)			Lab 3
3/31	Image filtering (2)		Lab 4	
4/7	Geometric transformations (1)			Lab 4
4/14	Geometric transformations (2)		Lab 5	
4/21	Introduction to image segmentation			Lab 5
4/28	Conclusion and outlook			

7. Course Expectations

- This is a 400 level course in the College of Science that involves some use of mathematical and statistical concepts, as well as some principles of computer-based data processing.
- The course involves the use of computer software. During the course, you will be required to use and demonstrate your understanding of the course materials through hands-on processing (e.g., performing computations by hand or writing computer scripts) of data.
- Your work should show attention to detail, with the expectation that the experience provide the basis for potential employers to consider your skills.
- I expect preparation and participation at every class. Attendance is critical (attendance may be verified during class) - you are expected to be at all classes and to make productive use of class time. Your active participation in the class is essential to the success of this course.

8. Grades

At the end of the term all the marks will be totaled as a weighted average according to the following weights:

Lab assignments	40%
Midterm exam	20%
Final exam	35%
Course Participation	5%
Total:	100%

Please note that, in general, assignments and exams will not have the same weight. The weight of each individual assignment or exam will be indicated on the assignment form. Final grades at the end of the course will be assigned using **a combination of absolute achievements and relative standing in the class.**

Incomplete grades policy: following the university policies, an “Incomplete” grade (IN) may be assigned to a student who is passing a course but who may be unable to complete scheduled course work due to a cause beyond reasonable control. Any requests for an incomplete grade must be submitted in writing during the last week of classes, and should clearly indicate the reason for the request. If an IN grade is granted, it is your responsibility to contact the instructor at the end of the semester to make proper arrangements for completing any missing work. For further details on the IN grade please visit: <http://registrar.gmu.edu/records/incomplete.html>

9. Exams

The course includes mandatory written exams. The material covered in the exams will be announced in class. A student who cannot write a course examination due to a cause beyond reasonable control can request (in writing) extension of time to complete an assignment. If the request is approved, it is your responsibility to contact the instructor to reschedule the exam. The date of the final examination is set by the Mason Registrar, please check <http://registrar.gmu.edu/calendars/spring-2016/final-exams/> for details.

10. Assignments:

The course includes several mandatory written assignments on selected topics from the material covered in class and in the assigned reading. Assignments may include tasks such as algorithm development and implementation, analysis of data processing results, and discussion/analysis of theoretical concepts and test cases. All assignments are mandatory. Typically, one to two weeks will be allocated for every assignment (please see Section 11 for details on late submission policies). Submission of assignments should be done only **through the Blackboard course website.**

Please note: Unless noted otherwise, we will grade only assignments that are submitted through the “Assignments” section of the Blackboard system. Please **DO NOT** email assignments directly to the instructor’s or the TA’s Mason email (@gmu.edu) unless specifically instructed to do so.

11. Late lab submission:

Labs submitted between 1 to 3 calendar days past the due date would result in a late penalty of **5 points per calendar day**. As a general rule, labs submitted after **more than 3 calendar days will not be accepted** and incomplete lab work may not be completed after the due date. Exceptions to this policy may be made on a case-by-case basis at the discretion of the Instructor.

Please note: Deferral of course work is a privilege and not a right; there is no guarantee that a deferral will be granted. Please make sure you notify the instructor or the teaching assistant in writing as soon as you know you would like to request a deferral.

12. Use of computers and electronic devices:

During the course we will make use of a classroom space equipped with computers. You are encouraged to use the computers for activities **directly** related to class activities (e.g., viewing class notes or performing in-class hands-on work). During class hours you are expected not to use the computers for any purpose that is not directly related to class activities. Similarly, you are asked to **not to use your mobile device** during class.

13. Academic integrity:

George Mason University is committed to the **highest standards** of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the GMU honor code (online at <http://oai.gmu.edu>).

14. Course website:

The course has a Blackboard website. This website will provide you a single portal through which you may obtain lecture notes, retrieve assignment data and, review links to additional materials, and receive special announcements. You are required to visit the course website **regularly**. Please contact ITU to resolve any issues accessing this website.

15. Electronic Communication:

- All course related email correspondence, including submission of assignments, should be made through the course Blackboard website. Please DO NOT email the instructor or the TA through their @gmu.edu address.
- Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account. [See <https://masonlivelogin.gmu.edu/login>].

16. Responsible Use of Computing: Students must follow the university policy for Responsible Use of Computing. [See <http://universitypolicy.gmu.edu/1301gen.html>].

17. Other Student Resources:

- University Libraries provides resources for distance students. [See <http://library.gmu.edu>].
- The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing. [See <http://writingcenter.gmu.edu>]. You can now sign up for an Online Writing Lab (OWL) session as well as face-to-face session in the Writing Center (see the Tutoring section in the link above).
- **Students with special needs:** If you are a student with a disability and you need academic accommodations, please contact the Office of Disability Services (ODS) at 993-2474 for guidance on preparing an accommodation plan to suit your needs. All academic accommodations must be arranged through the ODS - <http://ods.gmu>. Please do not hesitate to contact the course team regarding your special needs if you encounter any issues or have any concerns.
- **Counseling and Psychological Services:** The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See <http://caps.gmu.edu>].
- **Family Educational Rights and Privacy Act (FERPA):** The Family Educational Rights and Privacy Act of 1974 (FERPA), also known as the "Buckley Amendment," is a federal law that gives protection to student educational records and provides students with certain rights. [See <http://registrar.gmu.edu/privacy>].

Disclaimer: Any typographical errors in this Course Outline are subject to change and will be announced in class. The date of the final examination is set by the Registrar and takes precedence over the final examination date reported by the instructor.

Note: Recording of any kind (audio, video), reuse of course materials, and further dissemination of the course contents is not permitted unless prior written consent of the professor and George Mason University has been given or if recording is part of an approved accommodation plan.

General guidelines for assignment preparation and submission

(For detailed instructions **please refer to the course website**)

Grades of assignments will be based on:

- a) **Academic merit** of your work.
- b) **Conciseness** and **completeness** of your answers. Please write to the point and explicitly address the question or task. Avoid using unnecessary graphics (figures, tables, graphs etc.) unless they serve a specific purpose. Make sure to use captions and to refer to the graphics you include in your written answer. Graphics without any reference or accompanying explanation will be disregarded.
- c) **Presentation**. Remember that your assignment report is a reflection of your thinking and learning process. Please organize your report in a logical fashion so that your answers could be easily identified. A general format for your presentation should, as a minimum, include the following components: (1) a **cover page** clearly indicating your name, the course number (GGS 416) the lab number, and the submission date (2) **Question number**, (3) Your **written answer** and/or description and discussion of your results, and (4) Visualization of your results, e.g. images, graphs, tables, as necessary.
- d) **Organization**. Your lab should be submitted as a single PDF file containing your lab report. If you are required to submit multiple files (e.g code files) all files (including the report) should be submitted in a **single ZIP file**.

Additional hints:

1. Please remember that your assignment is a **professional document**, and should therefore be formatted and constructed accordingly. All assignments are to be typed (including equations and tables). Digital copies of hand-written assignments **will not be accepted**.
2. Submission of a softcopy of your assignment will be made through Blackboard. It is not required to submit a hardcopy of your assignment.
3. When a written assignment report is required, the electronic submission of your assignment report should be made **only in a PDF format**. MS-Word files will **not be accepted**.
4. If more than one file is submitted, you may submit a single **ZIP** file containing all the assignment files. Please note that other compression formats (e.g. rar files) will **not be accepted**.
5. The assignment file you submit should be named as the following:

GGS416_SP16_<assignment number>_<first name>_<last name>.<file extension>

For example, if the student Jack Sparrow is submitting assignment 2 as a PDF file, then the name of the submitted file should be:

GGS416_SP16_2_jack_sparrow.pdf

6. Please make sure to keep a backup of all the materials you submit.