Department of Geography and Geoinformation Science

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GGS 416 - Satellite Image Analysis
Spring 2019

1. **General Information**

Instructor:	Dr. Arie Croitoru ("Dr. C")
Teaching assistant	TBD
Where:	Exploratory Hall 2103
When:	Tuesdays and Thursdays between 3:00pm to 4:15pm.
Course website:	Blackboard
Credits:	3.0
Prerequisites:	60 credits and GGS 412, or permission of instructor.
Instructor's Office Hours:	Monday 9:30am - 10:30am, Wed 2:30pm - 3:30pm or by appointment (My office is located in Exploratory Hall 2205, the Fairfax Campus).
TA's office hours:	TBD
Contact method:	Blackboard discussion board (preferred), email (acroitor@gmu.edu). I will make an effort to respond within 24-48 hrs, Monday to Friday during regular business hours.

2. **Course Objectives**

Satellite imagery has become a primary data source in geospatial applications. The wide variety of imagery data sources and the vast amounts of imagery are being collected 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**

The primary textbook used in this course is "Computer Processing of Remotely-Sensed Images" by P. Mather and M. Koch (ISBN 978-0-470-74238-9). A digital version of book is available through the Mason Library at: https://tinyurl.com/yc46t9oj (note: if you log in from a computer outside the campus network you will be required to provide your Mason credentials in order to gain full access).

During the course we will also use materials from several other resources, some of 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. "Digital Image Processing, 3rd Edition" by R. C. Gonzalez and R. E. Wood, Prentice-Hall 2009 (ISBN 978-0-13-168728-8).

Additional readings (selected readings from books, research journals, technical reports, and other sources) will be provided via the course website as necessary.

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
1/22, 1/24	Introduction and overview			
1/29, 1/31	Review of remote sensing principles			
2/5, 2/7	Platforms and sensors, sensor geometry		Lab 1	
2/12, 2/14	Sensor geometry (cont.), Digital image formation			Lab 1
2/19, 2/21	Introduction to color spaces		Lab 2	
2/26, 2/28	Image preprocessing (1)			Lab 2
3/5, 3/7	Image preprocessing (2)	Midterm 3/7		
3/12, 3/14	*** Spring Break ***			
3/19, 3/21	Image enhancement		Lab 3	
3/26, 3/27	Georeferencing			Lab 3
4/2, 4/4	Image interpolation		Lab 4	
4/9, 4/11	Image filtering			Lab 4
4/16, 4/18	Image transforms		Lab 5	
4/23, 4/25	Introduction to photogrammetric methods			Lab 5
4/30, 5/2	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 <u>weighted average</u> according to the following weights:

Assignments	35%
Course Participation	10%
Midterm exam	20%
Final exam	35%
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 based on the following score ranges:

Weighted average range[1]	Letter grade
≥ 98.0	A+
97.9 – 93.0	A
92.9 – 90.0	A-
89.9 – 87.0	B+
86.9 – 83.0	B
82.9 – 80.0	B-
79.9 – 77.0	C+
76.9 – 73.0	C
72.9 – 70.0	C-
69.9 – 60.0	D
≤ 59.9	F

Incomplete grades policy: following the university policies, an "Incomplete" grade (IN) <u>may</u> be assigned to a student who is passing a course but who may be unable to complete scheduled course work due to a cause <u>beyond</u> 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 <u>your responsibility</u> 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 <u>your responsibility</u> 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 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.

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[1] Final grades will be rounded to the nearest digit.

11. **Late assignment 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. Requests for deferrals must be made in writing **at least 24 hrs** before the assignment due date/time.

    > **Please note**: Deferral of course work is a privilege and not a right, and there is no guarantee that a deferral will be granted.

12. **Use of computers and electronic devices:**
    During the course we will make use of a classroom space equipped with computers. You are expected to use the computers **only 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 expected not to **not to use your mobile device** during class time.

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.
    - If you wish to email the course teaching team directly on sensitive or personal matters please include "GGS416Sp19" at the beginning of the email subject line.
    - 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.

16. **Responsible Use of Computing:** Students must follow the university policy for Responsible Use of Computing. [See https://universitypolicy.gmu.edu/policies/responsible-use-of-computing/].

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

<u>arranged through the ODS</u> - 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.

Appendix
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_SP19_<assignment number>_<first name>_<last name>**.**<file extension>

    For example, if the student (Captain) Jack Sparrow is submitting assignment 2 as a PDF file, then the name of the submitted file should be:
    GGS416_SP18_2_jack_sparrow.pdf

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