Course Syllabus (online)

>> Special Note: Safe return to campus (COVID-19) <<

Students are required to follow the university's public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage (https://www2.gmu.edu/Safe-Return-Campus). Please continue to monitor and follow any university announcements and policy changes regarding the safe return to campus during the semester. Students who become ill with COVID-19 (or are quarantined) and as a result are unable to complete required coursework should contact the instructor to discuss a possible remedial plan for any missed work.

1. General Information

- **Instructor**: Dr. Arie Croitoru (a.k.a "Dr C"), **email**: acroitor@gmu.edu
- **Teaching Assistant**: Mr. Brad Gay, **email**: bgay2@gmu.edu
- **Where**: online via Blackboard
- **When**: a learning module will be released each week on Wednesday and should be completed by the following Tuesday (11:59pm Eastern time). Due dates of other course activities will be specified separately in the instructions of the activity (see Section 5).
- **Course website**: Blackboard
- **Credits**: 3.0
- **Office Hours (held online only during Fall 2020)**:
  - Instructor: Thursdays between 5:30pm and 6:20pm (your attendance in this session is not mandatory but highly recommended), or by appointment.
  - TA: To be determined.
- **Contact method**: Discussion board via Blackboard or by email. Messages will typically be answered within 24-36 hours Monday to Friday; messages sent during the weekend will be answered on the following Monday.

2. Course objectives

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 are 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 Digital Image Processing (DIP) techniques and related topics in Remote Sensing (RS) to enable the extraction of spatial and spatiotemporal information from imagery. In particular, the objectives of this course are to:

1. Review basic **ideas** and **theories** of image processing and their relation to earth observations.
2. Introduce **analytical techniques** and **tools** that are used in satellite image analysis.
3. Develop the ability to **apply** these tools in various application areas.
4. Identify and gain **insight** into some of the emerging trends in DIP as applied to earth image processing.

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3. Learning outcomes

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

1. Have a broad knowledge-base on fundamentals, theory and techniques of Digital Image Processing and Remote Sensing in the context of earth image processing and Geo-Intelligence and other geospatial applications.
2. Articulate and effectively communicate concepts and ideas related to Digital Image Processing and Remote Sensing to both image processing experts, non-experts, and other professionals in a work environment. This objective is particularly important in today's interdisciplinary work environment.
3. Have the ability to appropriately apply the tools, algorithms and concepts covered in the course for various hypothetical and real-world data processing tasks.
4. 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.
5. Perform a critical review of the potential, effectiveness, and reliability of Digital Image Processing and Remote Sensing processing processes and outcomes.

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4. Course schedule (tentative)

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In this course we will cover the topics listed in the table below. Please note that the topics and their order are tentative and are subjected to change at the discretion of the instructor (any changes will be announced in class). Any changes to the academic semester calendar will be announced by the University.

Module Release Date	**Learning Module**	**Test**	**Project Activity**	**Assignment Release***	**Assignment Due***
8/26	(1) Why image processing?				
9/2	(2) The human visual system				
9/9	(3) Image acquisition			1	
9/16	(4) Image resolution and relations between pixels				1
9/23	(5) Gray level transformations	Test 1		2	
9/30	(6) Histogram processing				2
10/7	(7) Spatial filtering / part 1			3	
10/14	(8) Spatial filtering / part 2				3
10/21	(9) Filtering in the frequency domain / part 1			4	
10/28	(10) Filtering in the frequency domain / part 2		Project introduction		4
11/4	(11) Introduction to image morphology	Test 2		5	

11/11	(12) Image morphology algorithms				5
11/18	(13) Introduction to image segmentation				
11/25	*** Thanksgiving Break ***				
12/2	Summary and project presentations		Project submission		

***** For information on the release and due dates of learning modules and assignments, please see Section 5 of the syllabus

In addition to the course schedule outlined here, please refer to Mason's academic calendar (Fall 2020) for information on important dates and follow Mason's announcements on any calendar changes during the semester. In case of any discrepancy between the course schedule and Mason's academic calendar, Mason's calendar and announcements takes precedence. If the campus closes or class is canceled due to weather or other concern, students should check Blackboard as well as the Mason website for updates on how to continue learning and information about any changes to events or assignments.

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5. Course format

The course will be delivered as a distance-learning course that combines individual review and study of course materials, as well as online synchronous and asynchronous discussions and other interactions. The key building blocks of this course are **learning modules**, which are built around a specific topic in the course. Throughout the semester course activities will be following this schedule:

- Each week a learning module will be released on **Wednesday**. Each module should be completed within one week (unless stated otherwise in the course schedule, see Section 9). If a learning module includes a an assignment it will be released with the module.
- Assignments will be due by **Wednesday** by 11:59pm EST. Typically one or two weeks will be given to complete the assignment, depending on its scope. The exact due date of each assignment will be indicated in the assignment instructions.
- Each **Thursday** at 5:30pm – 6:20pm a Blackboard Collaborate session will be held to discuss any questions or issues. This session is optional, however it is highly recommended that you attend it or review its recording.
- The course discussion board will be monitored every day during regular business hours (with the exception of weekends and university holidays).

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6. Reading materials and video resources

The learning modules in the course will typically include both reading materials (e.g. scientific papers, book chapters, written tutorials, etc.) and short videos that review, explain, or demonstrate various topics. You are required to review all these materials.

Textbooks: The following book is a required textbook for this course: "Digital Image Processing, 4th Edition" by R. C. Gonzalez and R. E. Wood, Prentice-Hall 2018 (ISBN 9780133356724). This book is also available for rent and as an eBook (please refer to the Mason Bookstore, the publisher, or other online retailers for further details).

In addition, during the course we will use supplementary materials from several resources, which are available to you electronically through the Mason library (for additional information and direct links to these resources please visit the "Course textbooks" section under the Syllabus menu item in the course website):

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

Other supplementary materials: As the theme of this course is part of a field that is advancing rapidly the course materials will include a combination of selected collection of academic papers, reports and white papers, book chapters, and other online resources. Links to (or instructions on how to obtain) materials that are available online will be made available on the course website according to the course schedule.

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7. Technology Requirements

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In order to be able to fully participate in this course you are required to have regular and reliable access to the following hardware and software components:

7.1 Hardware

- An Intel-based computer with an up-to-date operating system (Windows 10 or Mac OSX 10.13 or higher), at least 4 GB of RAM (8GB recommended), and a dual core or better processor.
- A computer graphics card (either integrated or standalone). A standalone graphics card with at least 2GB - 4GB of ram (depending on your screen size) is recommended but not required
- A stable broadband Internet connection (cable modem, DSL, satellite broadband, etc.), with a consistent 1.5 Mbps download speed or higher.
- A microphone (either built-in or as a separate device). A computer headset or "ear buds" with a built-in microphone is highly recommended. If you are using a built-in or a separate microphone a headset is recommended to prevent sound quality issues.
- A web camera is highly recommended but not required.

7.2 Instructional software

- A supported up-to-date web browser (check which browsers are supported by Blackboard). You can check if your particular browser setup (including any plugins) is supported by Blackboard HERE.
- Blackboard (available upon logging into http://mymason.gmu.edu)
- Zoom (available at https://gmu.zoom.us/)
- Adobe Acrobat Reader (free download)
- Citrix Workspace App (see https://its.gmu.edu/service/citrix-virtual-lab/ for instructions)
- Cisco AnyConnect VPN (see https://its.gmu.edu/knowledge-base/how-do-i-install-the-vpn/ for instructions)
- A document editing software, such as Microsoft Word (part of Office 365 ProPlus) or OpenOffice

7.3 Other software

Throughout this course we will use the Matlab software suite as the main tool for data processing. In addition, we may use open source and freely available software packages when possible. The materials of the course are designed to be compatible with Matlab 2018a or later. While we recognize that the topics covered in this course could be implemented in other programming environments exist (e.g. IDL, Java, C/C++, etc.), we will generally not be able to support such programming environments at this time.

Notes:

1. At this point you are not required to purchase Matlab. During the first few weeks of the course we will discuss the various options that would be available to you for accessing Matlab for the purpose of this course. If you are considering purchasing your own copy of Matlab (student license) please wait until we discuss these options so that you could make a better informed descision.
2. If you are using an employer-provided computer or corporate office for class attendance, it is your responsibility to verify with the computer owner that you will be able to install the necessary applications and that any firewalls installed on such a computer will allow you to gain access to all the electronic course content that is posted on Blackboard.

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8. Course expectations

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8.1 General requirements

1. This is a graduate-level course in the College of Science that involves some use of mathematical and statistical concepts.
2. The course involves the use of algorithms and computer-based processing tools. During the course, you will be required to develop and demonstrate your understanding of these tools. Some course activities will require you to use and/or write code in a computer environment (i.e. Matlab scripts and functions).
3. Your work should show attention to detail, with the expectation that the experience will provide the basis for potential employers to consider your skills.
4. I expect that you will **review all the assigned materials** in every learning model, including any assigned readings, videos, and other resources. This is essential to your success of this course.
5. You are expected to **actively participate** in the scheduled office hours Collaborate sessions as well as in the course discussions.

8.2 Being a distance learning student

Similarly to like face-to-face learning, learning online requires self-discipline, time management, and organization. However, these requirements can become even more important in a distance learning setting, especially when the course is asynchronous. Instead of specifically assigned class hours, the activities and materials are organized into a set of learning modules, which students may complete at their own pace within a given time frame. If you are unfamiliar with distance learning, or if you would like to improve your online learning experience, there are several key themes that you should consider as you develop your approach to taking this distance-learning course. In particular:

- Review this syllabus as well as the course website and make sure you have a good understanding of the course expectations.
- Ensure access to the required hardware and software before the semester begins (see the Technical Requirements section below). Not having the necessary hardware and software tools will impact your ability to participate in the course.
- Build a schedule for your learning activities and follow it. Note that while distance-learning course often do not include extensive face-to-face time, you are required to spend time reading materials, completing assignments, and taking exams.
- Take the time to review all of the assigned course materials (videos, written instructions, book chapters, etc.), and keep notes and comments on what you reviewed. Try to identify key themes and strive to develop a thorough understanding of them.
- Complete assignments on time and submit all assignments. While this is true for both face-to-face and online courses, in a distance learning course it is sometimes more

difficult to notice that you are missing work. Keeping in touch with the course instructor and your peers can help with this.
- Keep track of all the important dates of the course (assignment due dates, exam dates, etc.), as well as the completion time of each learning module.
- Participate in face-to-face or synchronous online sessions as much as possible, and attend face-to-face office hours as necessary. While the course is offered online, you should seek opportunity to interact with the teaching team and other students as much as possible. Such interactions could make a big difference in your learning experience.

A key factor in your success as a distance-learning student is being proactive and self-aware. Like any other learning experience, distance learning requires you to take ownership over your own learning experience. As much of the learning is done individually, it is often easy to overlook important details or even miss key ideas. This is why it is essential that you keep in touch with your peers and with the course team frequently, ask questions, and seek feedback on your progress and work. Throughout this course this can be accomplished in one or more of the following ways:

- **The Discussion Board**: the course discussion board on blackboard contains several discussion themes. Post any questions or feedback in the board.
- **Online Virtual Class Meeting**: during the semester we will hold virtual class meetings via blackboard Collaborate. This is a great opportunity to ask any questions you might have, learn from the questions of others, and interact with both the instructors and students.
- **office Hours**: we hold weekly office hours during which you are encouraged to ask questions and seek feedback. Even if you don't have any specific questions it might be beneficial to attend the office hours so that you could learn from the questions of others. If the office hours time is not convenient for you, please contact the course team to schedule an appointment.

In addition, the course team will send students **announcements and updates** via the blackboard announcements tool. You will receive these messages as emails to your Mason email account. Please do not ignore these messages, it is your responsibility to check your Mason email account and the course website regularly.

Another important resource that could contribute significantly to your success is the **class community**. If you have questions about a course topic, it is likely that some students in your class could help, and sometimes simply discussing the topic with a fellow student will help you understand it better. You may want to establish some connections with other students, participate in discussions, and form study groups that will allow you to discuss the course materials with others and receive their feedback. When communicating with your peers (and your instructor) it is important to **be respectful** of one another. Please be aware that innocent remarks can be easily misconstrued, and that sarcasm and humor can be easily taken out of context. When communicating, please try to be positive and offer **constructive feedback**.

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9. Assessment

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Your assessment in this course includes several interrelated components as described below.

9.1 Assignments

The course will include several mandatory assignments on selected topics from the material covered in class and in the assigned reading. Assignments may include tasks such as (but are not limited to) code implementation, data analyses, analysis of processing results, and discussion/review of theoretical concepts and test cases. Generally, each assignment will have a different weight in the overall assignments component of the course grade, and the weight of each assignment will be provided in the assignment instructions. Typically, one week will be allocated for every assignment. Submission of assignments should be done only through the Blackboard course website. Unless noted otherwise, we will only grade assignments that are

submitted through the "Assignments" section of the Blackboard system. Submission of assignments should be done only through the Blackboard course website. Please do no email assignments directly to the instructor's @gmu.edu or through their Blackboard email.

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

Late submission Policy: assignments submitted between 1 to 3 calendar days past the due date would result in a late penalty of 3 points per day. As a general rule, labs submitted after more than 3 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. 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 as soon as you know you would like to request a deferral.

9.2 Tests

The course will include two short tests that will be delivered through Blackboard. The material covered in the exam will be announced in advance. Generally, all test dates are firm, and exceptions to the test dates (e.g., test “make-up” dates) will not be made. A student who cannot take a course examination because of an incapacitating illness, severe domestic affliction or other compelling reasons can apply for extension of time to complete an assignment. Generally, exceptions to the exam date will not be made.

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

9.3 Mini-Project

The goal of the course mini project is to bridge theory and practice by providing you the opportunity to gain hands-on experience with implementing digital image analysis methods on real-world data. The mini project will be individual, and will include a written report and a video presentation of the project. Specific instructions on the format of the project components and timeline for submitting it will be provided separately.

9.4 Course grades

Each grade component will be given a numerical grade on a 0-100 scale. Some assignments may include bonus tasks. At the end of the term all the marks will be totaled as a **weighted average** according to the following weights:

- **Assignments: 50%**
- **Short Tests (7.5% x 2): 15%**
- **Course mini-project: 25%**
- **Active participation: 10%**

Final grades at the end of the course will be assigned using a combination of absolute achievements and relative standing in the class.

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10. Other important dates

In addition to the course schedule outlined in this syllabus, please refer to Mason’s academic calendar for information on important dates and follow Mason’s announcements on any calendar changes during the semester. The Fall 2019 Mason calendar is available at https://registrar.gmu.edu/calendars . In case of any discrepancy between the Mason calendar and the course schedule in the syllabus the Mason calendar shall prevail.

11. General student expectations

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11.1 Academic Integrity

Mason is an Honor Code university; please see the Office for Academic Integrity for a full description of the code and the honor committee process (https://oai.gmu.edu/). The principle of academic integrity is taken very seriously, and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification. Students are urged to familiarize themselves with the provisions of the GMU honor code (available online at the link provided above).

11.2 Honor code

Students must adhere to the guidelines of the George Mason University Honor Code [See https://oai.gmu.edu/mason-honor-code/].

11.3 Recording and/or sharing class materials

- This class or portions of this class will be recorded by the instructor for educational purposes. These recordings will be shared only with students enrolled in the course through the course website. Your instructor will communicate how you can access the recordings.
- Unauthorized student recording of classroom or other academic activities (including advising sessions or office hours) is prohibited. Unauthorized recording is unethical and may also be a violation of University policy. Students requesting the use of assistive technology as an accommodation should direct such requests to the Office of Disability Services (see Section 17 for details).
- Sharing of instructor-created or other materials created or provided as part of the course (including recordings), and in particular materials relevant to assignments or exams, to public online "study" sites is considered a violation of Mason's Honor Code. For more information, see the Office of Academic Integrity's summary of information about online study sites. Please review this short video regarding sharing course materials online.

11.4 Responsible Use of Computing

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

11.5 Students special needs

Disability Services at George Mason University is committed to providing equitable access to learning opportunities for all students by upholding the laws that ensure equal treatment of people with disabilities. If you are seeking accommodations for this class, please first visit http://ds.gmu.edu/ for detailed information about the Disability Services registration process. Then please discuss your approved accommodations with me. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email: ods@gmu.edu | Phone: (703) 993-2474. All academic accommodations must be arranged through the Office of Disability Services (ODS). Please do not hesitate to contact the course team regarding your special needs if you encounter

any issues.. Please be proactive and let me know how I can help you with any disability issue so that I could provide the best learning environment for your specific needs.

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12. Diversity and inclusion

The course team is committed to upholding Mason's Non-Discrimination Policy and Diversity core values. We welcome and value individuals and their differences including race, economic status, gender expression and identity, sex, sexual orientation, ethnicity, national origin, first language, religion, age, and disability.

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13. Title IX

George Mason University is committed to providing a learning, living and working environment that is free from discrimination and a campus that is free of sexual misconduct and other acts of interpersonal violence in order to promote community well-being and student success. We encourage students who believe that they have been sexually harassed, assaulted or subjected to sexual misconduct to seek assistance and support. University Policy 1202: Sexual Harassment and Misconduct speaks to the specifics of Mason's process, the resources, and the options available to students.

As a faculty member and designated "Responsible Employee," I am required to report all disclosures of sexual assault, interpersonal violence, and stalking to Mason's Title IX Coordinator per university policy 1412. If you wish to speak with someone confidentially, please contact the Student Support and Advocacy Center (703-380-1434) or Counseling and Psychological Services (703-993-2380). You may also seek assistance from Mason's Title IX Coordinator (703-993-8730; titleix@gmu.edu).

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14. Student services

14.1 University Libraries

University Libraries provides resources for distance students. [See http://library.gmu.edu].

14.2 Writing Center

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).

14.3 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].

14.4 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].

14.5 Student Services

In addition to the services noted here, Mason offers students a wide range of great academic and personal support and development services. Additional information about these services can be found at the Stearns Center for Teaching and Learning website.

Disclaimer and copyright

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.