**BENG 738: Advanced Medical Image Processing**

Spring 2018

Credits 3

TR 3:00 pm - 4:15 pm
Innovation Hall 316

**Instructor:**
Siddhartha Sikdar, PhD
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Department of Bioengineering
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Email: ssikdar@gmu.edu
Phone: 703-993-1539
Office hours: By appointment

**Recommended Prerequisites:** Grade C or better in
1. Signals and Systems (BENG/ECE 320 or equivalent)
2. Digital Image Processing (ECE 537 or equivalent)

**Reference Textbook (available online through IEEE):**
Advanced Biomedical Image Analysis
By: Mark Haidekker
Publisher: Wiley-IEEE Press, 2011
ISBN: 9780470872093

**Course Description:**
Advanced Medical Image Processing covers advanced processing techniques used in modern medical imaging. The course aims at developing an understanding of the mathematical background, principles and application of techniques such as segmentation, registration, morphometry, general linear modeling, principal and independent component analysis. The course will involve extensive hands-on image processing and image analysis using MATLAB.

**Learning Objectives**
At the end of the course:
- Students will be have knowledge of the mathematical foundations of medical image analysis and can apply these concepts to implement algorithms to analyze medical images.
- Students will be able to critically review the scientific literature in the field and identify gaps in knowledge.
- Students will be able to interpret the results image analysis algorithms and compare between different approaches.

**Grading:**
Two take home midterm exams (30%)
Homework assignments (30%)
Final Project Report (30%)
Final Project Presentation (10%)
<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
<th>Readings</th>
<th>Deadline</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Introduction and Perspectives</td>
<td>Chapter 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 2</td>
<td>Image processing and enhancement in the spatial domain</td>
<td>Chapter 2</td>
<td>HW 1</td>
<td></td>
</tr>
<tr>
<td>Week 3</td>
<td>Image processing in the frequency domain</td>
<td>Chapter 3</td>
<td></td>
<td>Project proposal</td>
</tr>
<tr>
<td>Week 4</td>
<td>Applications of the wavelet transform</td>
<td>Chapter 4</td>
<td>HW 2</td>
<td></td>
</tr>
<tr>
<td>Week 5</td>
<td>Adaptive filtering methods</td>
<td>Chapter 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 6</td>
<td>Deformable models, Level set methods</td>
<td>Chapter 6</td>
<td>HW 3</td>
<td></td>
</tr>
<tr>
<td>Week 7</td>
<td>Feature detection and analysis</td>
<td>Chapter 7</td>
<td></td>
<td>Draft Introduction</td>
</tr>
<tr>
<td>Week 8</td>
<td><strong>SPRING BREAK, NO CLASS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 9</td>
<td>Texture analysis</td>
<td>Chapter 8</td>
<td>HW 4</td>
<td>Take Home Midterm 1</td>
</tr>
<tr>
<td>Week 10</td>
<td>Shape analysis</td>
<td>Chapter 9</td>
<td></td>
<td>Methods + revisions</td>
</tr>
<tr>
<td>Week 11</td>
<td>Applications of fractal methods</td>
<td>Chapter 10</td>
<td></td>
<td>HW 5</td>
</tr>
<tr>
<td>Week 12</td>
<td>Image registration</td>
<td>Chapter 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 13</td>
<td>Image compression</td>
<td>Chapter 12</td>
<td></td>
<td>Results + revisions Take Home Midterm 2</td>
</tr>
<tr>
<td>Week 14</td>
<td>3D visualization: surface rendering</td>
<td>Chapter 13</td>
<td></td>
<td></td>
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<tr>
<td>Week 15</td>
<td>3D visualization: volume rendering</td>
<td>Chapter 13</td>
<td></td>
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<tr>
<td>Week 16</td>
<td><strong>Final Project Presentations</strong></td>
<td></td>
<td>Final report due</td>
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Course structure:
The course will consist of a weekly lecture, weekly homework assignments, two take home exams, a written project report and project oral presentation. The homework assignments and take home exams will involve programming in MATLAB. The project will involve in-depth original research on a topic of choice and implementation of an image analysis algorithm to solve a specific research problem. It is expected that the final project report will be of the caliber of a publishable IEEE conference paper.
**Homework:**
There will be assigned homework throughout the semester. The homework will involve programming and analysis of real medical image data.

**In-class Participation:**
You are expected to attend and prepare for each class. This includes reviewing previously covered material, as well as completing the assigned reading.

**Midterm Exams:**
There will be two take home midterm exams in the class. The midterm exams will be open book and notes. They will consist of problems involving analysis of medical image data. You will have to decide for yourself what methods you will need to use to solve the problem. There will typically be many correct answers. The exams will test your understanding of the underlying algorithms, and their application to real problems. The exams will be assigned via Blackboard on Thursday and will be due on the following Tuesday. The topics covered in the exams will not be cumulative, i.e., the second midterm exam will only cover material discussed after the first midterm.

The reason for the take home exam instead of a traditional in-class exam is to eliminate the artificial constraint of time to allow you to think critically about a problem. Prepare for the take home exam in the same way you would prepare for a traditional in-class exam. If you fail to prepare ahead of time, I can assure you that you will not do well on the exam.

Since the midterm exams are take home, particular attention will be paid to concerns about plagiarism and cheating. Please review the statement on Academic Integrity described later in the Syllabus. All suspicious cases will be referred to Honor Committee without exception. The sanction for an Honor Committee violation on an exam in this class is a straight F. In particular, do not even think about engaging in the following, since it is quite likely you will be caught and referred to Honor Committee.

DO NOT collaborate with anyone else on the exam. The exam is supposed to be entirely your own work. If two students make suspiciously similar mistakes that are unlikely to be caused by chance, you will be referred to Honor Committee and the burden will be on you to provide evidence that you did the work yourself. If your answers otherwise raise suspicions, I might ask you to orally defend the answer to me.

**Project:**
The students will be required to do an individual course project that will integrate the material learnt in the course. The project presentations and report will substitute for a traditional comprehensive final exam. Typically the project will involve development and analysis of an image analysis algorithm to solve a specific well-defined research problem. The student will be expected to seek out and integrate relevant information and demonstrate an ability to apply knowledge of concepts discussed in class and evaluate the results. Students will develop sections of the project report throughout the semester and receive feedback. Please see the separate document describing the course project in more details.
The project report will be completed through a draft/feedback/revision process. The final project report should be formatted as a 4-page, 2-column, IEEE conference paper in 12-point Times New Roman font, with appropriate references in IEEE format. The project report is expected to consist of four sections: (1) Introduction and Background, (2) Methods and Materials, (3) Results and (4) Discussion and Summary. Students are expected to submit drafts of these four sections by the indicated due dates. I will provide commentary on the draft, and the revised draft will be due by the indicated dates. For more detailed description of the expected contents of the project report, please see the project description.

**Academic Honesty and Collaboration:**

The integrity of the University community is affected by the individual choices made by each of us. GMU has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow at all times are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct.

Homework problems are designed to be undertaken independently. You may discuss your ideas with others and conference with peers; however, it is not appropriate to give your work to someone else to review. You are responsible for making certain that there is no question that the work you hand in is your own. If only your name appears on an assignment, your professor has the right to expect that you have done the work yourself, fully and independently.

Plagiarism means using the exact words, opinions, or factual information from another person without giving the person credit. Writers give credit through accepted documentation styles, such as parenthetical citation, footnotes, or endnotes. Paraphrased material must also be properly cited. A simple listing of books or articles is not sufficient. Plagiarism is the equivalent of intellectual robbery and cannot be tolerated in the academic setting.

There will be a zero tolerance policy in this course for plagiarism and cheating in the written project report, in homework submissions, and in take home exam. Every instance of plagiarism or cheating will be reported to the GMU Honor Committee. No excuses. No exceptions. If you have any doubts about what constitutes plagiarism, please see the instructor. **The sanction for an Honor Committee violation on an exam will be a straight F.**

**Email Policy:**

You must use your Mason email account for all email correspondence having anything to do with your work at Mason. Federal laws protecting your privacy rights require that we only communicate student information directly to students – and use of the university email system is our only way to validate your identity. You may forward your campus email elsewhere, but we can respond only to a Mason email account.

**Relevant Campus and Academic Resources**

**Disability Services**

Any student with documented learning disabilities or other conditions that may affect academic performance should: 1) make sure this documentation is on file with the Office of Disability Services (SUB I, Rm. 2500; 703-993-2474; http://ods.gmu.edu) to determine the
accommodations you might need; and 2) talk with the instructor to discuss reasonable accommodations.

Office of Diversity, Inclusion and Multicultural Education
SUB 1, Rm. 2400; 703-993-2700; https://odime.gmu.edu

Writing Center
Robinson 114A; 703-993-1200; http://writingcenter.gmu.edu

**WAVES: Wellness, Alcohol and Violence Education and Services**
WAVES promotes wellness within the Mason community through health education, alcohol/drug assessment and education, and violence awareness, prevention and sexual assault response. We help students make healthy, safe choices and encourage lifelong, thoughtful healthy decision-making through individualized support, creative programming, and evidence-based education and outreach.

WAVES office 703-993-9999
SUB I, Suite 3200
24-Hour Sexual and Intimate Partner Violence Crisis Line 703-380-1434
waves.gmu.edu

- 703-360-7273 (Fairfax County Office for Women and Domestic and Sexual Violence Services 25 hotline)
- 703-228-4848 (Arlington County Domestic Violence Services Hotline)
- 703-368-4141 (Prince William County Sexual Assault Victims Advocacy Services (SAVAS) hotline)
- 1-800-838-8238 (Virginia Family Violence and Sexual Assault Hotline)
- 1-800-656-HOPE (Rape, Abuse and Incest National Network)
  https://ohl.rainn.org/online/

**CAPS: Counseling and Psychological Services**
Counseling and Psychological Services (CAPS) provides a wide range of free confidential services to students, faculty, and staff. Services are provided by a staff of professional clinical psychologists, social workers, counselors, learning specialists, and psychiatric providers. CAPS individual and group counseling, workshops, and outreach programs are designed to enhance students’ personal experience and academic performance. Visit us at caps.gmu.edu for additional resources.

- For consultation or emergency assistance during office hours call 703-993-2380.
- For assistance during non-office hours, call University Police at 703-993-4357.
- 703-527-4077 (CrisisLink)
- 1-800-273-8255 (National Suicide Prevention Lifeline)
- 1-877-838-2838 (Veterans' Crisis Hotline)

**Student Health Services (SHS)** — Provides confidential health care to enrolled students in emergency and non-emergency circumstances on the Fairfax, Arlington and Prince William campuses. If there is a medical emergency and Student Health Services (SHS) is closed, please
contact the free after-hours nurse ((703) 993-2831), a hospital emergency room, an urgent care facility, or call 911.

SUB 1, Suite 2300
703-993-2831

University Police:
Emergency: 911              Non-Emergency: (703) 993-2810
Reporting a Crime (Crime Solvers Anonymous Tip Hot-Line): (703) 993-4111
Mason Police Website: http://police.gmu.edu/