ECE 7776: Advanced Digital Signal Processing

Syllabus - DRAFT

Summary: This course surveys recent advances in signal processing concepts, especially those related to the acquisition, formation, processing, analysis, and visualization of images, videos, and similar multidimensional signals. This course begins by reviewing representations and applications of digital signals and images, including common tasks involving such signals. Successive lectures will feature discussions of recent research papers in these areas, and activities applying and reproducing their results. These lectures will connect these concepts to applications in biomedical imaging, computational photography, image and video compression, and other areas. As time permits, this class will include guest lectures on special topics and ongoing research in related areas at UVA. Graded activities will include reviewing and critiquing papers, a midterm exam, and a semester-long research project.

Instructor: Daniel Weller
Assistant Professor, ECE
Rice Hall, Room 309
Email: dweller@virginia.edu (please put "ECE 7776" in the subject)
Phone: 434-924-4271 (x4-4271 from UVA phone)

Location: Tuesdays, Thursdays
12:30 – 1:45 PM
Mechanical Engineering 305

Office Hours: TBD

Textbook: No textbook is required. In addition to assigned readings from papers and review articles, related reference texts include:

- AC Bovik, *The Essential Guide to Image Processing*, 1st ed., Academic Press, 2009, ISBN 978-0123744579 [e-book available from UVA library]
- RC Gonzalez and RE Woods, *Digital Image Processing*, 3rd ed., Pearson, 2007, ISBN 978-0131687288
- S Mallat, *A Wavelet Tour of Signal Processing,* 3rd ed., Elsevier, 2009, ISBN 978-0123743701
- K Miura (Ed.), *Bioimage Data Analysis*, Wiley, 2016, ISBN 978-3527341221, [free e-book available by Olympus from http://www.imaging-git.com/olympus-website-bioimage-data-analysis]
- J Rittscher, R Machiraju, and STC Wong (Eds.), *Microscopic Image Analysis for Life Science Applications*, Artech House, 2008, ISBN 978-1596932364 [e-book available from UVA library]
- JC Russ and FB Neal, *The Image Processing Handbook*, 7th ed., CRC Press, 2015, ISBN 978-1498740265 [e-book available from UVA library]

Learning Objectives: This course aims to provide the tools to use signal and image processing in research. By the conclusion of this course, students should be familiar with recent advances in signal and image processing, be able to understand and critique published work, and be confident in conducting and communicating research involving signal processing.

Lectures/Discussion: Lectures will frequently feature discussion of assigned readings of papers and review articles. It is essential to have read these papers in advance of class in order to fully benefit and contribute to these discussions. To support this effort, students will be required to submit brief written reviews of these papers for a grade. In addition, each review must include at least one question or discussion point that the student may raise in the class discussion.

Homework: Some lectures may include activities and demonstrations involving implementing and testing techniques described in papers. Some of these activities will include short assignments using the methods described in class. These assignments will be completed as homework and turned in on the specified due date.

Midterm: The midterm exam will be given as a take-home exam and will cover concepts from the preceding lectures and readings. Exam questions will range from exercises like those in the class activities to critiquing a research paper.

Project: This course features a semester-long individual research project. This project should focus on an area of signal and image processing and involve original research (simply reproducing published work is not sufficient). First, students will submit a written proposal describing the research idea and providing a preliminary survey of the relevant literature. Then, students will proceed with their research, providing brief progress updates throughout the semester, and writing a final report.

Final Exam Presentations: In lieu of an exam, each student will present a brief talk describing their research project during the assigned final exam period.

Grading: Homework (20% total), discussions/reviews (20%), midterm (15%), project (35%), and presentation (10%)

Prerequisites: ECE 6750 or instructor permission

Policies: All students are expected to abide by the UVA honor code policy. Late assignments generally will not be accepted; extensions must be approved by the instructor in advance of the due date. If you have concerns about course policies, about accessibility, or other issues, please contact the instructor as early as possible.