EE 396: Advanced Topics in Signal Processing

Course Details

Instructor: Ganesh Sundaramoorthi

Course Overview

This is a research course that will cover some topics of interest in computer vision, including image denoising, image segmentation, and image registration. The emphasis will be on creating mathematical models, analyzing these models, and constructing computational algorithms to realize these models.

There are no formal prerequisites, but some knowledge of probability theory, signal processing, and mathematical maturity will be helpful. If the terms like: Gaussian, random variable, Bayes theorem, norm, orthogonal basis, and gradient, sound unfamiliar to you, then this is not the best class to take. Some programming knowledge will be required for completing a project; the exact language does not matter. MatLab is highly recommended for quickly implementing and testing out algorithms.

There are no textbooks required for the course, but I will point out some textbooks as we go along for further reference. Class lecture notes will be posted online as well as additional journal/conference papers for reading.

There are no scheduled office hours. If you would like to meet with the professor, you may email me for an appointment.

Assignments

1. There will be short exercises after many lectures. These will be to, for example, complete derivations that were not fully done in class; these should not be time consuming. Some of these may be collected.

2. Every month, there will be a list of journal or conference papers. Each student will be required to find one partner in the class to discuss the papers. The team will then choose one of the papers and write a one page critique of the paper submitted jointly. I encourage you to discuss the papers with as many classmates as possible, although the critique will be written jointly with only one other student. We will have a short (20 min) class room discussion on the assigned papers, so be ready to discuss the papers.

Critiques will answer questions such as (but not limited to):

- Briefly summarize the main contributions of the paper (in plain english, no equations); this should be no more than a few sentences.
- What problem is being solved? Why is the problem important? What are the real-world applications?
• What are the assumptions that are made? In what cases are they realistic? In what cases are they unrealistic? For what types of images would the method work well? For what types of images would the method fail? Work well?

• How could you improve the method? Are there other ways of solving the problem? What are the advantages/disadvantages of those approaches?

I expect there would be two of these critiques due in the semester.

Project

Each student must complete an implementation based project. You may pick a topic in computer vision that interests you. The topic does not need to be covered in class. To get ideas for projects, you can in addition to the material presented in class, look at the proceedings of conferences in computer vision such as IEEE Conference on Computer Vision (CVPR), International Conference on Computer Vision (ICCV), and European Conference on Computer Vision (ECCV) or journals such as IEEE Transactions on Pattern Recognition and Machine Intelligence, and International Journal of Computer Vision.

A project could be to choose a computer vision algorithm, implement it, and make improvements. Another possibility is implementing different algorithms for the same problem, and critically comparing them. One could even propose an entirely new algorithm, implement it, and perform experiments. You will be required to propose the project to the instructor or turn in a written proposal around the midterm of the semester. You are encouraged to discuss the project with the professor throughout the semester, and report your progress.

Grading

Class participation - 10%, Assignments - 30%, Project - 60%.