CS 773C Machine Intelligence Advanced Applications
Spring 2008 – Object Recognition

Prerequisites: Good background in image processing (CS674), computer vision (CS685), pattern recognition (CS679), linear algebra, probabilities, and statistics. *Credit hours:* 3.0

Meets: TR 1:00-2:15 PM (SEM 257)

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Course Webpage: http://www.cse.unr.edu/~bebis/CS773C

Office Hours: MW 1:00 pm - 2:30 pm or by appointment

Required Text:

We will not use any text in this course; all of the material will be drawn from lecture notes and research papers.

Useful Texts:

- Emanuele Trucco, Alessandro Verri*, Introductory Techniques for 3-D Computer Vision*, Prentice Hall, 1998.
- Forsyth and Ponce, *Computer Vision - A modern approach,* Prentice Hall, 2002.
- Shapiro and Stockman, *Computer Vision*, Prentice Hall, 2001.

Description and Objectives

Recognizing objects from images has been a challenging task in computer vision. This is because objects may look very different from different viewing positions. The most successful approach is in the context of "model-based" object recognition, where the environment is rather constrained and recognition relies upon the existence of a set of predefined model objects. Given an unknown scene, recognition implies: **(i)** the identification of a set of features from the unknown scene which approximately match a set of features from a known view of a model object, **(ii)** the recovery of the geometric transformation that the model object has undergone (i.e., pose recovering)

and, **(iii)** verification that other features coincide with predictions. Since usually there is no *a-priori* knowledge of which model points correspond to which scene points, recognition can be computationally too expensive, even for a moderate number of models. Our goal in this course would be to study several well known techniques in object recognition.

This course is primarily intended for highly motivated students interested in doing research in object recognition and computer vision in general. It will be essential for students to have a solid understanding of basic topics in math, such as linear algebra, probability and statistics, and calculus. It will also be useful to have some knowledge of computer vision, image processing, and geometry.

Topics

- Image Formation and Perspective Projection
- Approximations to Perspective Projection
- Segmentation and Feature Extraction
- 2D Object Recognition Using Geometric Models
- 3D Object Recognition Using Geometric Models
- Object Recognition Using Appearance Models
- Grouping
- Error Analysis

Exams

There would be no exams in this course.

Presentations

Each student would be required to present several papers to the rest of the class during the semester. A list of papers has already been posted on the course's webpage (additional papers will be posted). Papers for presentation will be assigned to students in coordination with the instructor. The presentation of the material should be professional as if it was presented in a formal conference. Students are required to email their presentation slides to the instructor by noon on the day of their presentation. The instructor will post all the presentations on the course's web page. Students are encouraged to suggest other papers or topics that might be interested in presenting.

Reports

Prior to each class, students must turn in a one page summary and critique of the paper(s) to be discussed on that class. The student who is responsible for presenting a paper is expected to have a thorough understanding of the ideas discussed in the paper; however he/she needs to turn no report on that day. A report should include the following parts: (i) the problem addressed, (ii) the methodology, (iii) critique of the approach, and (v) suggestions for improvements and extensions. Reports should be typed.

Video Lectures

In certain classes, we will watch and discuss video lectures, given by experts in the computer vision, which are available on-line. The students might have to study some material related to the video lecture prior to the class and write a report like in the case of student presentations.

Project

Each student would be required to complete a research project and submit a project report. Project topics will be chosen in coordination with the instructor. In general, a student would be required to implement a technique, possibly among those discussed in class, and apply it to some real data. There would be two targeted goals behind the implementation of a particular approach. The first goal would be to verify that the approach works. Towards this goal, each student would be expected to test his/her implementation using various data (links to several object recognition databases are listed on the course's web page). The second and most important goal is to identify weak points of the approach, that is, to identify under what circumstances the approach might fail to produce good results. You should try to demonstrate this using data that actually make the approach fail or perform poor. Identifying ways to improve a given method will get you extra credit and might lead to possible publication. This is not meant to be a research project, but something closer to an extended problem set. However, I will be flexible about the nature of any independent project, and students are encouraged to explore new research ideas as well.

Project reports should include the following: **(1)** Introduction and motivation, **(2)** Problem definition, including project goals, assumptions, constraints, and evaluation criteria, **(3)** Analysis of relevant literature and previous research, and how it relates to the project, **(4)** Details of proposed approach, with sufficient mathematical and algorithmic detail to allow someone else to duplicate your results, **(5)** Objective experimental evaluation and/or sound theoretical proof of proposed approach's performance, **(6)** Implementation details, **(7)** Results, **(8)** Discussion and conclusion

Class Participation

Everyone should read papers before class and contribute to discussion of them.

Course Policies

- Presentation slides and other useful information will be posted on the course web page.

- Late papers will not be accepted, since the goal of these reports is to get you to think about papers before we discuss them.

- Regular attendance is highly recommended. If you miss a class, you are responsible for all material covered or assigned in class.

- You should carefully read the section on Academic Dishonesty found in the UNR Student Handbook (copies of this section are available from http://www.unr.edu/stsv/acdispol.html) Your continued enrollment in this course implies that you have read it, and that you subscribe to the principles stated therein.

- No incomplete grades (INC) will be given in this course and a missed quiz/exam may be made up only if it was missed due to an extreme emergency.

Disability Statement

Any student with a disability needing academic accommodations is requested to speak with me or contact the Disability Resource Center (Thompson Building, Suite 101), as soon as possible to arrange for appropriate accommodations.

Grading Scheme

Class Participation: 10%

Reports: 20%

Presentations: 30%

Project: 40%

A: 90 and above, B: 80-89, C: 70-79, D: 60-69, F: <59

Important dates

3/14/2008 - last day for dropping classes
3/22/2008 – 3/30/2008 - Spring Break