OLD DOMINION UNIVERSITY

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

EECE 795/895 – Computer Vision♣

Catalog Description

EECE 795/895. Principles and applications of computer vision, advanced image processing techniques as applied to computer vision problems, shape analysis and object recognition. (3).

Objective

The objective of this course is to convey the basic issues in computer vision and major approaches that address them. After completing the course, the students may expect to have the knowledge needed to read and understand the more advanced topics and current research literature, and the ability to *start* working in industry or in academic research. However, this course is *NOT* designed to be a "cookbook" course that gives just a survey of the methods needed in "practice", nor will it cover "commercial" systems in any detail. An emphasis will be placed on the implementation of computer algorithms using high level programming languages such as C/C++, MATLAB etc. to process images.

Prerequisites & Co-Requisites
Regular graduate standing is required to enroll in this course. Access to a personal computer running Windows NT and onwards, a World Wide Web browser and Knowledge of C/C++ or MATLAB (or any other high level programming language) is mandatory. You may use the departmental/college/university clusters.

Data Structures and good programming skills. Ability to convert informal descriptions into computer algorithms. Students must be able to program, preferably, in Matlab or OpenCV.

Basic Mathematics - Good familiarity with calculus and analytical solid geometry is essential. If you have not used them for several years, you must be prepared to spend some time to review them. Some knowledge of linear algebra, matrix theory and elementary probability theory will also be helpful.

Knowledge of EECE 783/883 (*Image Processing*) is helpful.

Instructor	Dr. Khan M. Iftekharuddin Professor and Chair, Department of Electrical and Computer Engineering Office: Department of Electrical and Computer Engineering 231C Kaufman Hall Norfolk, VA 23529 (757) 683-5481 Office (757) 683-3220 Fax WWW: http://www.odu.edu/~kiftekha/ECE795_895/ECE795.html
Lectures **Location**	Time: MW 3:00 pm – 4:15 pm Kaufman 225
Office Hours	By appointment.
Textbooks	D. Forsyth and J. Ponce, Computer Vision: A Modern Approach, Prentice-Hall, 2nd Ed.,

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♣*Note: This document may be changed/modified at the instructor's discretion. The changes/modification, if any, will be communicated to you promptly.*

2012. (Required)
E. Trucco and A. Verri, Introductory Techniques for 3D Computer Vision, Prentice Hall, 1998.

References

R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2011.

B. Cyganek and J. P. Siebert, An introduction to 3D Computer Vision Techniques and Algorithms, Wiley, 2010.

In addition, additional papers may be made available to the class.

Computer Usage

Computer simulations will be assigned which require use of any high level programming language to process digital images. The C/C++ compilers, the MATLAB are available in ECE departmental clusters and College of Engineering clusters. In addition, some other types of image visualization and manipulation software packages such as *Paint Shop Pro* (http://www.jasc.com/psp.html) may be downloaded from the WWW. To perform all programming, processing, and viewing of the resulting images locally, the image processing algorithms may be implemented on a personal computer running preferably, MATLAB, OpenCV or any other high level language.

Laboratory Assignments

Approximately 2-3 laboratory assignments and a final project will be given over the duration of the semester, corresponding to the topics itemized in the tentative schedule section. Approximately 2-3 weeks will be given for completion of a particular laboratory assignment. Each assignment will consist of computer simulations, which require knowledge of the MATLAB, OpenCV or any other high level programming language. Students are encouraged to discuss the basic concepts on the assignments; however, the implementation of algorithms/code must be their own. In addition, analytical (written homework) problems may be assigned at regular intervals.

The objective of the final project is to have each student work on a research-related project on image processing. The students will be given option to propose and discuss project ideas with the instructor. Those who do not have a suitable project idea, they will be assigned a project. These projects may involve significant computer simulations and/or analytical development. Students may be allowed to team-up in group of 2 (depends on the class enrollment). Substantial instructor supervision may be expected.

Each laboratory assignment and homework must be turned in by the beginning of class on the scheduled due date. In the event of extenuating circumstances such as illness or a family emergency, an extension may be granted for with prior permission from the instructor. You will be given additional instructions on the format of the report.

Email for class announcements

Occasionally, we plan to send email to the students updating on immediate class announcements. If you normally use another e-mail account, you need to make sure that mail sent to your ODU account is automatically forwarded to the account you do use.

Exams

There will be one midterm exam. Exams will only be given at the scheduled times unless prior arrangements have been made.

Final Project

An open-ended project will be assigned during the second half of the course. The objective of the final project is to have each student (or a group of 2 students) work on a research-related project on image processing. The students may be given option to propose and discuss project ideas with the instructor. Those who do not have a suitable project idea, they will be assigned a project. These projects may involve significant computer simulations and/or analytical development. Substantial instructor supervision may be expected.

Final Exam

Format is TBD. At the discretion of the instructor, in place of an in-class final exam, an open-ended take-home exam may be assigned during the end of the semester.

Course Grading Policy
The relative weighting of the different types of work used to evaluate individual performance in the course is listed below:

Laboratory Assignments (projects, HW, quizzes –announced and pop):	30%
Midterm:	20%
Final Project:	20%
Final Exam:	30%

Final grades will be computed statistically by examining the averages of all students enrolled in the course. The relative weighting of the different types of work used to evaluate individual performance in the course will be decided later. Final grades will be computed statistically by examining the averages of all students enrolled in the course. The *highest possible* grading curve is shown below (percentages may be lowered depending on overall class performance):

A:	90% -- 100%
B:	80% -- 89%
C:	70% -- 79%
D:	60% -- 69%
F:	< 59.5%

Tentative Syllabus
Following is a list of topics expected to be covered, in anticipated order, and with expected time to be spent on them. This list is intended to be only indicative, the actual topics, the order and the time may vary somewhat depending on various factors including student interests and preparation.

1. **Introduction & Review (2 weeks)**
   Background, requirements and issues, human vision.
2. **Image formation (1 week)**
   Geometry, brightness, color, quantization
3. **Understanding geometry (2 weeks)**
   Camera Calibration, pose estimation
4. **Image features (3 weeks)**
   Edge and line finding, region segmentation, Hough transform, clustering
5. **Stereo vision (2 weeks)**
   Camera calibration and stereopsis
6. **Motion (? weeks)**
   Shape from stereo and motion, motion tracking
7. **Shape analysis and object recognition (? weeks)**
   Shape representation and matching
8. **Recognition (? weeks)**
   recognition and identification from image sequences
9. **Applications survey (? week)**
   Industrial, navigation, mapping, multimedia

Academic Honesty Statement
All work in this course must be completed in a manner consistent with student code of conduct as described in the ODU students' handbook. Violation will result in appropriate disciplinary action.

Disabilities Statement
Any students with disabilities who need accommodations are encouraged to speak with the instructor as soon as possible to make appropriate arrangements for those accommodations. Any student with permit from the students' disability office will be provided reasonable accommodation.

Class Attendance Policy
Prompt class attendance is the policy and practice of the ECE department. The class instructor reserves the right to refuse entrance to latecomers.

Prepared by: Khan M. Iftekharuddin, Ph.D. Updated: August 2015