CSCE 867: Computer Vision

Spring 2021

Dr. Yan Tong
Today’s Agenda

Welcome and self-introduction

Various administrative issues.

What is this course about?
Dr. Tong’s Research: Multimodal Affective Computing – An Area of Computer Vision

- Eye Movement
- Facial Muscular Movement
- Head Movement
- Body Movement
- Voice

Sensing → Modeling Interactions → Reasoning → Feedback

Eye gaze, Facial Activity, Head Pose, Body Gesture, Speech
Now, Tell Me About Yourself!

- Name
- Major
- Why do you take Computer Vision?
Course Overview

No face-to-face class meetings

A 100% online synchronous instructional method via Blackboard Collaborate Ultra

- Synchronous lectures at scheduled meeting time
- Project presentations

You are required to attend lectures and present your project on time
Class Communication

Send me an email at tongy@cse.sc.edu if you have any questions regarding the course.

Class homepage
http://www.cse.sc.edu/~tongy/csce867/csce867.html

Blackboard Collaborate Ultra
• Synchronous online lectures
• Project presentations

Blackboard (blackboard.sc.edu)
• Discussion board
• Course announcements, homework assignments, projects, quizzes, and references.
• Submission of assignments

MS Teams
• Virtual office hours by appointment
Tentative Syllabus

Available in Blackboard and at class website

http://www.cse.sc.edu/~tongy/csce867/csce867syl.pdf
Goals and Learning Outcomes

This graduate level course will cover both classical and recent exciting progresses on the theory and practice of the computer vision. After taking the course,

• You will achieve the necessary knowledge to solve various practical computer-vision problems

• You will build a solid background for further computer-vision research.
The following is a list of tentative topics we plan to cover in this one-semester class (Changes may be made based on the available time):

- **Image formation:**
  - Computational model of camera
  - Radiometry
  - Camera calibration

- **Early vision on one image:**
  - Linear filters
  - Edge detection
  - Features

- **Early vision on multiple images:**
  - Stereo vision
  - Motion estimation

- **Mid-level vision: segmentation and object tracking**

- **High-level vision**

- **Special topics on applications**
Recommended Textbook


We will not cover all the topics in this textbook

We will discuss some topics that are not in this textbook
Reference


If you don’t have image processing background

Grading

Grading System:

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<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tr>
<td>A</td>
<td>100-90</td>
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<td>B+</td>
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Grading policy:

*Homework assignments (4) (5% each)
*Programming projects (2) (10% each)
One midterm exam (15%)
One research-oriented course project (30% in total)
*Quizzes (10) (15% in total)

*Late submission may be accepted with late submission penalty applied
Late Submission Policy

- A due date is specified for each assignment or each deliverable of the project.
- All course deadlines are listed in Eastern Time Zone.
- Late submissions of homework, programming projects, or quizzes can be accepted if completing it within one week after the deadline with late submission penalty applied:
  - 10% loss for the first day late and an additional 5% loss for each following late day
  - Everyone is granted for a ONE-TIME waiver of late submission penalty – No penalty if you submit your assignment in three days after due date. For team deliverables, you cannot use the waiver if any member in the team has used the waiver before. Please notify me in advance, when you use this waiver.
- No late submission of final project presentation or written report is allowed
- No makeup exam is allowed except excusable absences with appropriate documentations
The Nature of This Course

This is a computer science course

• It will involve two programming projects
  – Choose the language you are most familiar with
  – Matlab/C++ is recommended

• It will involve a large amount of math
  – Calculus, linear algebra, geometry
  – Probability, random processes
  – Analog/digital signal processing
  – Optimization theory
  – Graph theory

• Make sure you’re prepared for this
The Nature of This Course

This is a graduate-level course

• Research oriented – project is the emphasis
  – 30% in your final grade

• Understanding → creativity
  – your own original work/opinion/result

• Basic knowledge → research frontier
  – learn through reading recent papers
The Nature of This Course

This is a multi-disciplinary course

- Computer vision has applications in many fields, such as medicine, military, internet, library, etc.
- Computer-vision research involves tools from many fields, such as signal processing, physics, mathematics, psychology, geometry, optics, color science, graphics, optimization, artificial intelligence, machine learning, etc.
- It is a very challenging but important problem in computer science, and many computer-vision problems are open problems.
- It is not a very well-established discipline such as physics and calculus, many topics are application-oriented.
- Linear algebra, probability and statistics are very widely used in computer vision for building many vision models.
Final Project Topics

Option 1: A complete research project
- Introduction (problem formulation/definition)
- literature review
- the proposed method and analysis
- experiment
- conclusion
- reference

Option 2: A survey research
- A well-defined problem or topic
- a complete list of previous (typical) work on this problem
- clearly and briefly describe it
- analyze each methods/groups and compare them
- give the conclusion and list of references
Final Project Requirement

Requirements and deliverables:

• Decide topic and write a one-page abstract (due 11:59pm, Friday, Feb. 26)
• Discussion with the instructor
• Research work and final report writing
• Oral presentation

Teamwork (2-person team) is acceptable for Option 1 ONLY

• talk to the instructor first
• under a single topic, each member must have his/her own specific subtopic
• a combined report, but each member needs to clearly show his/her own contributions
• combined presentation if necessary
Final Project Requirement

Written report due time: 11:59pm, Thursday, April 29

Report format: the same as a complete conference paper

Academic integrity (avoiding plagiarism)
- don’t copy other person’s work
- describe using your own words
- complete citation and acknowledgement whenever you use any other work (either published or online)

Evaluation
- Abstract (be clear and concise) 20%
- written report (be clear, complete, correct, etc..) 50%
- oral presentation 30%
- quality: publication-level project – extra credits up to 10%
Project Requirement

Notes:

• you are encouraged to incorporate your own expertise in, but the project topic must be related to the content of this course
• discuss with the instructor on topic selection, progress, writing, and presentation
• Use the library and online resource

Major research journals and conferences on computer vision

• International Conference on Computer Vision (ICCV)
• IEEE International Conference on Computer Vision and Pattern Recognition (CVPR)
• IEEE Trans. Pattern Analysis and Machine Intelligence (PAMI)
• International Journal on Computer Vision (IJCV)
• You may find useful literature in them for your project
Vision

“Vision is the process of discovering from images what is present in the world and where it is” – David Marr
Computer Vision

Computer Vision is the study of analysis of pictures and videos (using computers) in order to achieve results similar to those as by human.
An Example

Problem: Given an image $I$, finding people in images

Question: Does $I$ contain an image of a person?
“Yes” Cases
“No” Cases
Why Computer-Vision

We are using computer vision techniques every day in our daily life.

Numerous applications
• 3D/4D Medical image
• Surveillance
• Image retrieval from database
  – Google image
  – Amazon go
• Self-driving
• Robotics
• and more …

https://www.castlewallsecurity.com/home-security-cameras/
http://www.ablesw.com/3d-doctor/surgmod.html
https://cars.usnews.com/cars-trucks/autonomous-vehicle-levels
https://www.extremetech.com/tag/boston-dynamics
Computer-Vision Resources

A comprehensive computer-vision homepage


Computer vision resources

http://resources.visionbib.com/