San José State University
College of Engineering

Computer Engineering Department
CMPE297-Section 2, Introduction to Video Processing and Analytics

S2019

Course and Contact Information

Instructor: Hua Harry Li, Ph.D.

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Class Days/Time: Thursday 3:00 – 5:45 PM

Classroom: Engr Building Room 343

Faculty Web Page and MYSJSU Messaging (Optional)

Copies of the course materials such as the syllabus, major assignment handouts, etc. can be found on line at SJSU CANVAS, the same material is also provided at the following yahoo group, see URL below: https://github.com/hualili/CMPE297

Course Description

Computer Vision, automated video analysis and 3D environment perception via Computer Vision techniques and machine learning, detection and recognition of temporal and spatial patterns, LoG and DoG convolution, pyramid analysis, OpenCV Hands-on labs.

Course Learning Outcomes (CLO)

Upon successful completion of this course, students will be able to:

1. Understand 2D convolution, LoG, DoG, and Lindberg L(x,y;s) techniques, able to utilized and deploy them for feature extractions to characterize videos.
2. Understand FFT and its power spectrum.
3. Understand Scale Invariant Feature Transforms.
4. To be able to design video tracking algorithms based on Kalman filter technique.

Required Texts/Readings

Textbook

- Robot Vision by B.K. P. Horn, the MIT press, ISBN 0-262-08159-8, or 0-07-030349-5 (McGraw Hill).
- Digital Image Processing *(optional)*, 3rd Edition, by Rafael C. Gonzalez and Richard E. Woods, Prentice Hall, ISBN 0-201-18075-8.
- *Reference textbook* Learning OpenCV, Computer Vision with the OpenCV Library by Bradski and Kaebler, O'Reilly Publisher, ISBN 978-0-596-51613-0, 2011.
- *Reference textbook (optional)* Computer Graphics with OpenGL, 3rd Edition, by Hearn Baker, Prentice Hall, ISBN 0-13-015390-7.

Other Readings

1. OpenCV on line reference: http://docs.opencv.org/index.html
2. OpenGL on line reference (OpenGL programming guide): ftp://ftp.sgi.com/opengl/contrib/kschwarz/OPEN_GL/REFERENCE/OGL_PG/oglPG.pdf
3. My lecture notes https://groups.yahoo.com/neo/groups/EE264ImageProcessing-HarryLi/files .

Other equipment / material requirements

1. C/C++ compiler, such as gcc compiler.
2. Matlab or Octave.
3. OpenCV.

Course Requirements and Assignments

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in University Policy S12-3 at http://www.sjsu.edu/senate/docs/S12-3.pdf.

NOTE that University policy F69-24 at http://www.sjsu.edu/senate/docs/F69-24.pdf states that "Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading."

Grading Policy

Quiz, Homework, Labs	30%
Midterm Examination	30%
Final Examination	40%

0-59	F
60-69	D
70-79	C
80-89	B
90-100	A

CMPE269 Video Processing and Analytics Course Schedule

Course Schedule

Week	Date	Topics, Readings, Assignments, Deadlines
1		Introduction to Computer Vision and Deep Learning, image sequence and digital video formation, understand a technique using C to manipulate digital images and avi videos, tools for image processing/video processing, Matlab (or open source equivalent Octave), and OpenCV etc. GPU computation platform.
2		2D convolution technique, human visual perception system, Lindberg Image L(x,y;s). Implementation on gcc and GPU platform. Feature characterization, Mean, covariance matrix.
3		2D convolution with LoG (Laplace of Gaussian) kernel and zero crossing for edge detection. DoG (Difference of Gaussian) images, Image Pyramid, maxima of DoG(x,y;s), and Feature characterization.
4		Image binarization, binary image processing, floodfill algorithm, moments computations, and Hough, binary image processing for pattern recognition, shape cognition, and Implementations. Entropy minimization for feature selections.
5		Scale Invariant Feature Transform (SIFT) tracking technique, and implementation on gcc parallel cores and GPU. Entropy minimization for feature selections.
6		Image tracking techniques and case study. Function approximation based on Bayes theory.
7		Midterm and Function approximation based on Bayes theory.
8		Nonlinear pattern classifier based on Bayes decision and function approximation.
9		Image tracking applications. Image segmentation techniques and its applications in pattern recognition. Nonlinear pattern classifier based on Bayes decision and function approximation. Deep Learning and Tensorflow Introduction.
10		2D FFT and its power spectrum and phase spectrum. Perceptron neural networks, TF and Keras API for deep learning enabled techniques, and Alex Net.
11		Motion estimation and optic flow computation. Perceptron neural networks. TF and Keras APIs implementation of AlexNet.
12		introduction to Kalman filter Implementation of tracking techniques based on Kalman filter. Steepest gradient descent technique and TF Keras based implementation.
13		Case study on self-driving applications. Steepest gradient descent technique.
14		Case study on self-driving applications. Learning by back propagation technique.
15		Comparative study, facial recognition techniques. Learning by back propagation technique.
16		Final comprehensive exam.

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Spring 2019