

San José State University
College of Engineering
Computer Engineering Department
CMPE297-Section 4, Introduction to Video Processing and Analytics
S2019

Course and Contact Information

Instructor: Hua Harry Li, Ph.D.
Office Location: Engineering Building, Room 267A
Telephone: (408) 924-4060
Email: hua.li@sjsu.edu
Office Hours: MW 4:30 -5:30 PM;
Class Days/Time: Thursday 3:00 – 5:45 PM
Classroom: Clark Hall Room 238

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

Automated video analysis and 3D environment perception via vision techniques and machine learning, detection and recognition of temporal and spatial patterns, LoG and DoG convolution, pyramid analysis, Kalman filter tracking. 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 Transform.
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++ compiler, such as gcc compiler.
2. Matlab or Octave.
3. OpenCV.
4. Python
5. Tensorflow Keras API

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](http://www.sjsu.edu/senate/docs/S12-3.pdf) at <http://www.sjsu.edu/senate/docs/S12-3.pdf>.

NOTE that [University policy F69-24](http://www.sjsu.edu/senate/docs/F69-24.pdf) 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

Classroom Protocol

Class participation and attendance are required, please arrive on time, you can bring your laptop to the class if needed.

University Policies

General Expectations, Rights and Responsibilities of the Student

As members of the academic community, students accept both the rights and responsibilities incumbent upon all members of the institution. Students are encouraged to familiarize themselves with SJSU's policies and practices pertaining to the procedures to follow if and when questions or concerns about a class arises. See [University Policy S90-5](http://www.sjsu.edu/senate/docs/S90-5.pdf) at <http://www.sjsu.edu/senate/docs/S90-5.pdf>. More detailed information on a variety of related topics is available in the [SJSU catalog](http://info.sjsu.edu/web-dbgen/narr/catalog/rec-12234.12506.html), at <http://info.sjsu.edu/web-dbgen/narr/catalog/rec-12234.12506.html>. In general, it is recommended that students begin by seeking clarification or discussing concerns with their instructor. If such conversation is not possible, or if it does not serve to address the issue, it is recommended that the student contact the Department Chair as a next step.

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's [Catalog Policies](http://info.sjsu.edu/static/catalog/policies.html) section at <http://info.sjsu.edu/static/catalog/policies.html>. Add/drop deadlines can be found on the current academic year calendars document on the [Academic Calendars webpage](http://www.sjsu.edu/provost/services/academic_calendars/) at http://www.sjsu.edu/provost/services/academic_calendars/. The [Late Drop Policy](http://www.sjsu.edu/aars/policies/latedrops/policy/) is available at <http://www.sjsu.edu/aars/policies/latedrops/policy/>. Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the [Advising Hub](http://www.sjsu.edu/advising/) at <http://www.sjsu.edu/advising/>.

Consent for Recording of Class and Public Sharing of Instructor Material

[University Policy S12-7](http://www.sjsu.edu/senate/docs/S12-7.pdf), <http://www.sjsu.edu/senate/docs/S12-7.pdf>, requires students to obtain instructor's permission to record the course and the following items to be included in the syllabus:

- “Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material.”
 - It is suggested that the greensheet include the instructor's process for granting permission, whether in writing or orally and whether for the whole semester or on a class by class basis.
 - In classes where active participation of students or guests may be on the recording, permission of those students or guests should be obtained as well.
- “Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent.”

Academic integrity

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The [University Academic Integrity Policy S07-2](http://www.sjsu.edu/senate/docs/S07-2.pdf) at <http://www.sjsu.edu/senate/docs/S07-2.pdf> requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The [Student Conduct and Ethical Development website](http://www.sjsu.edu/studentconduct/) is available at <http://www.sjsu.edu/studentconduct/>.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. [Presidential Directive 97-03](http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf) at http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf requires that students with disabilities requesting accommodations must register with the [Accessible Education Center](http://www.sjsu.edu/aec) (AEC) at <http://www.sjsu.edu/aec> to establish a record of their disability.

Accommodation to Students' Religious Holidays

San José State University shall provide accommodation on any graded class work or activities for students wishing to observe religious holidays when such observances require students to be absent from class. It is the responsibility of the student to inform the instructor, in writing, about such holidays before the add deadline at the start of each semester. If such holidays occur before the add deadline, the student must notify the instructor, in writing, at least three days before the date that he/she will be absent. It is the responsibility of the instructor to make every reasonable effort to honor the student request without penalty, and of the student to make up the work missed. See [University Policy S14-7](http://www.sjsu.edu/senate/docs/S14-7.pdf) at <http://www.sjsu.edu/senate/docs/S14-7.pdf>.

Student Technology Resources

Computer labs for student use are available in the [Academic Success Center](http://www.sjsu.edu/at/asc/) at <http://www.sjsu.edu/at/asc/> located on the 1st floor of Clark Hall and in the Associated Students Lab on the 2nd floor of the Student Union. Additional computer labs may be available in your department/college. Computers are also available in the Martin Luther King Library. A wide variety of audio-visual equipment is available for student checkout from Media Services located in IRC 112. These items include DV and HD digital camcorders; digital still cameras; video, slide and overhead projectors; DVD, CD, and audiotape players; sound systems, wireless microphones, projection screens and monitors.

SJSU Peer Connections

Peer Connections, a campus-wide resource for mentoring and tutoring, strives to inspire students to develop their potential as independent learners while they learn to successfully navigate through their university experience. You are encouraged to take advantage of their services which include course-content based tutoring, enhanced study and time management skills, more effective critical thinking strategies, decision making and problem-solving abilities, and campus resource referrals.

In addition to offering small group, individual, and drop-in tutoring for a number of undergraduate courses, consultation with mentors is available on a drop-in or by appointment basis. Workshops are offered on a wide variety of topics including preparing for the Writing Skills Test (WST), improving your learning and memory, alleviating procrastination, surviving your first semester at SJSU, and other related topics. A computer lab and study space are also available for student use in Room 600 of Student Services Center (SSC).

Peer Connections is located in three locations: SSC, Room 600 (10th Street Garage on the corner of 10th and San Fernando Street), at the 1st floor entrance of Clark Hall, and in the Living Learning Center (LLC) in Campus Village Housing Building B. Visit [Peer Connections website](http://peerconnections.sjsu.edu) at <http://peerconnections.sjsu.edu> for more information.

SJSU Writing Center

The SJSU Writing Center is located in Clark Hall, Suite 126. All Writing Specialists have gone through a rigorous hiring process, and they are well trained to assist all students at all levels within all disciplines to become better writers. In addition to one-on-one tutoring services, the Writing Center also offers workshops every semester on a variety of writing topics. To make an appointment or to refer to the numerous online resources offered through the Writing Center, visit the [Writing Center website](http://www.sjsu.edu/writingcenter) at <http://www.sjsu.edu/writingcenter>. For additional resources and updated information, follow the Writing Center on Twitter and become a fan of the SJSU Writing Center on Facebook. (Note: You need to have a QR Reader to



scan this code.)

SJSU Counseling Services

The SJSU Counseling Services is located on the corner of 7th Street and San Fernando Street, in Room 201, Administration Building. Professional psychologists, social workers, and counselors are available to provide consultations on issues of student mental health, campus climate or psychological and academic issues on an individual, couple, or group basis. To schedule an appointment or learn more information, visit [Counseling Services website](http://www.sjsu.edu/counseling) at <http://www.sjsu.edu/counseling>.

CMPE269 Video Processing and Analytics Course Schedule

Course Schedule

Week	Date	Topics, Readings, Assignments, Deadlines
1		Introduction to digital image formation, 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. 2D convolution with LoG (Laplace of Gaussian) kernel and zero crossing for edge detection. DoG (Difference of Gaussian) images, Image Pyramid. TensorFlow Keras
3		Tensorflow Keras for simple Handwritten digits recognition and Image Processing Techniques
4		Tensorflow Keras and CNN architecture. Image binarization, binary image processing, floodfill algorithm, moments computations, and Hough, binary image processing for pattern recognition, shape cognition, and Entropy minimization for feature selections.
5		TF and Keras for PointNet Implementations, Scale Invariant Feature Transform (SIFT) tracking technique, and implementation on gcc parallel cores and GPU. Entropy minimization for feature selections, and Stereo Vision.
6		TF keras and Point Cloud, Image tracking techniques and case study. Function approximation based on Bayes theory.
7		Midterm and Function approximation based on Bayes theory.
8		TF keras and Optical flow.
9		TF pointNet object detections and recognition, Image tracking applications. Image segmentation techniques and its applications in pattern recognition. Nonlinear pattern classifier based on Bayes decision and function approximation.
10		TF Pedestrian Detections and Behavior Analysis. 2D FFT and its power spectrum and phase spectrum. Perceptron neural networks.
11		Motion estimation and optic flow computation. Perceptron neural networks.
12		introduction to Kalman filter Implementation of tracking techniques based on Kalman filter. Steepest gradient descent technique.
13		Case study on CNN, behavior analysis and PointNets. Steepest gradient descent technique.
14		Case study on CNN, behavior analysis and PointNets, Learning by back propagation technique.
15		Comparative study, Learning by back propagation technique.
16		Final comprehensive exam.