

Subject Code: 1ET2030402	Subject Title: Computer Vision and Applications
Pre-requisite	---

Course Objective: The core objective of this course is to make the students aware and have some expertise with various facets of advance research in computer vision in various subareas such as reconstruction, segmentation and grouping, object and activity recognition, scene understanding, and vision and language. This course aims to present various learning approaches from image and video data will be covered and include topics from convolutional neural networks, recurrent neural networks, structured predictions and others. This course shall act as platforms for the students wishing to carry out further research in methods of models in images, depth recovery from stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credit	Theory		Practical		Total
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	5	60	40	30	20	150

Subject Contents				
Sr. No	Topic	Total Hours	Weight (%)	
1	Introduction to Computer Vision: History, Area of applications, Three 'R's of Computer Vision – reconstruction, recognition and (re)organization, 3D from images, Special effects	4	10	
2	Image Formation and Filtering: Light and Color, Convolution, Image Pyramids, Image Filtering and Hybrid Images, Thinking in Frequency	6	15	
3	Feature Detection and Matching: Edge Detection, Interest Points and Corners, Local Image Features, Feature Matching, Model Fitting and RANSAC	8	15	
4	Cameras, Multiple Views and Motion: Cameras and Optics, Stereo Introduction, Camera Calibration, Epipolar Geometry and Structure from Motion, Feature Tracking and Optical Flow	10	20	
5	Recognition: Recognition Overview and Bag of Features, Large-scale Instance Recognition, Large-scale Category Recognition and Advanced Feature Encoding, Detection with Sliding Windows: Viola Jones and Dalal Triggs, Pascal VOC and Big Data, Human Computation and Crowdsourcing, Modern Boundary Detection and Sketches, Context, Spatial Layout, and Scene Parsing	12	25	
7	Deep Learning: Neural Networks, Convolutional Networks for Recognition, Object Detectors Emerge in Deep Scene CNNs, Deep Geolocalization, MS COCO and Deeper Deep Architectures, Structured Output from Deep Learning, Unsupervised Learning and Style Transfer, Generative Networks – Colorization	8	15	

Review Presentation: The student is expected to refer at least two peer reviewed journal papers related to this domain/subject. The student is expected to identify issues/challenges and emerging trends in the domain/subject. Student is supposed to explore various video lectures (E.g. NPTEL) available in the domain/subject. Student is required to make a review-presentation on the work carried out for the same.

Recommended sites for journal papers are (1) dl.acm.org (2) springer.com (3) sciencedirect.com (4) elsevier.com (5) ieeexplore.ieee.org (6) scholar.google.co.in (7) scopus.com or others of similar repute.

Course Outcome:

After learning the course, the students should be able to:

1. Object and scene recognition and categorization from images.
2. Practically hands on aspects of computing with images.
3. Geometric relationships between 2D images and the 3D world.
4. Understand to image formation, measurement, and analysis.
5. Image matching methods.

List of References:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Computer Vision: A Modern Approach by Forsyth and Ponce.
3. Probabilistic Graphical Models by Koller and Friedman.
4. Dictionary of Computer Vision and Image Processing, by Fisher et al.
5. Deep Learning, by Goodfellow, Bengio, and Courville.
6. Machine Learning: A Probabilistic Perspective by Murphy.

E-Resources / Web Links

1. <http://szeliski.org/Book/>
2. <http://www.cs.rochester.edu/u/cxu22/t/577F16/>
3. <http://cs.brown.edu/courses/csci1430/>
4. <http://luthuli.cs.uiuc.edu/~daf/CV2E-site/cv2eindex.html>
5. http://www.siu.edu/~sumbaug/438_syl.html
6. <http://luthuli.cs.uiuc.edu/~daf/CV2E-site/cv2eindex.html>
7. <http://www.cs.ubc.ca/~murphyk/MLbook/>
8. <http://pgm.stanford.edu/>

List of Experiments:

Note: The experiment list provided beneath is for reference only. The course teacher may change/formulate it as per his/her methodology and requirement.

1. Introduction to CVIPlab/OpenCV.
2. Two-dimensional fast transforms - Fourier (FFT), cosine (DCT), Haar, Walsh, Hadamard, wavelet transforms.
3. Feature extraction - binary, RST-invariant, histogram, spectral and texture object features.
4. Pattern classification - nearest neighbor, K-nearest neighbor and nearest centroid.
5. Edge/Line detection and edge linking - Kirsch, pyramid, Sobel, Prewitt, Roberts, Laplacian, Frei-Chen, Hough transform.
6. Histogram Thresholding Segmentation
7. Image segmentation - fuzzy mean, histogram thresholding, median-cut, principal components transform/median cut, spherical coordinate transform/center split, gray level quantization, split and merge.
8. Histogram-based image enhancement - histogram equalization, histogram slide, histogram shrink/stretch, local equalization, histogram hyperbolization, histogram specification, adaptive contrast filters (standard, logarithmic, exponential), gray-scale piecewise linear modification.

9. Morphological filters - binary iterative morphology, gray-scale and color erosion, dilation, opening, and closing.
10. Open Experiment (Student have to identify the simple problem and try to implement it-if possible)
[Research papers from reputed Journals & Conferences.]