



**Indian Institute of Information Technology, Allahabad Department of
Information Technology**

Syllabus

Name of the Course: Computer Vision

Under Graduate: ICV630E

Post Graduate: ICV240E

1. Objective of the course:
 - a. To provide an overview of how human brain does vision processing.
 - b. To give an introduction about modeling aspect of low-level, intermediate level visual processing: Neuromorphic vision computing
 - c. To give a perspective of machine vision through single camera and stereo vision technologies.
 - d. To give an intuition about machine modeling of 3D structure, motion, activity and so on.
 - e. Brain inspired modeling of high level vision processing such as object recognition, face recognition, activity analysis and so on.
2. Outcome of the course:
 - a. Students will learn basics of stereo vision and algorithms.
 - b. Students will get glimpse of efficiency of human brain vision.
 - c. Students will get new perspective of brain inspired computational vision.
 - d. Students will be able to look at the world in the form of matrices and model the activity happening in world reference frame
 - e. By doing projects they will be able to apply the grabbed knowledge to real problems.
3. Course Plan: As per the below format only

Component	Unit	Topics for Coverage
Component 1	Unit 1: Introduction	Human Vision and Computer Vision ; Eye and Brain; Low, Intermediate and High level Vision processes; Historical Perspectives, Theoretical approaches to Visual Perception and Processing; Visual Illusions; Structuralism, Gestaltism, Ecological Optics and Constructivism; Marr's 2.5 D Sketch; Color Perception and Processing, neuromorphic computing.

	Unit 2: Viewing through Camera; Multiview Geometry	<p>Camera, Image and World Reference Frames; Views and Coordinates Transformations: Orthogonal, Euclidean, Affine, Projective; Camera Calibration.</p> <p>Perspective, and Epipolar Geometry, Binocular Stereopsis, Homography, Rectification, DLT, RANSAC, Depth Map and 3D reconstruction framework, Depth Estimation, stitching.</p>
	Unit 3: High Level Vision Processing	<p>Understanding images and scenes, Four Stages of Visual Perception, Feature level Processing (Edges, Lines, Corners), Surfaces Extraction; Segmentation and Classification; Representations and Organizations of Objects and Scenes; 3D Scene Analysis; Size and Shape Constancy and Illusions; Using knowledge and learning for Object and Scene Recognition, Brain Inspired High level vision computing, Simulation of Visual Attention and Visual Memory Processes.</p>
	Unit 4: Shape from X and Motion Analysis	<p>Light at Surfaces, Phong Model, Reflectance Map, Albedo estimation, Photometric Stereo, Use of Surface Smoothness Constraint, Shape from Texture, color, motion and edges.</p> <p>Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo, Motion parameter estimation; Motion Models and Analysis; Rigid and Non – Rigid Body Motion; Self Motion, Gesture and activity recognition.</p>
Component 2	Projects	<ol style="list-style-type: none"> 1. Projects on applying computer vision algorithms to the real world problem 2. Modeling of brain inspired vision solutions and applying these solutions to solve problems.

Books:

1. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.

3. Vision Science : Photons to Phenomenology, MIT Press, Cambridge, 1999.
4. Handbook of Computer Vision, Vol.1, Vol.2, Vol.3 : Bernd Jahne, Horst Haubecker, and Peter Geibler (Eds.), Academic Press, London, 1999.
5. Siegelbaum, Steven A., and A. J. Hudspeth. Principles of neural science. Eds. Eric R. Kandel, James H. Schwartz, and Thomas M. Jessell. Vol. 4. New York: McGraw-hill, 2000.
6. Purves, D. et al (2008) Neuroscience 4th edition. Sinauer Associates, Sunderland, MA.