ESE 358 COMPUTER VISION

Dept. Electrical and Computer Engg., Stony Brook University**,**

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Office Hours: Tues. & Thurs.: 10 am to 11 am, and 1 pm to 2 pm.
Room 233 Light Engg. Bldg.

Catalog Description:

Introduces fundamental concepts, algorithms, and computational techniques in visual information processing. Covers image formation, image sensing, binary image analysis, image segmentation, Fourier image analysis, edge detection, reflectance map, photometric stereo, basic photogrammetry, stereo, pattern classification, extended Gaussian images, and the study of the human visual system from an information processing point of view.

3 credits.

Prerequisites: EE/CE majors: ESE 305; ESE 224 or CSE 230. CSE majors: CSE 214 and CSE 220.

Text book:

Computer Vision: Algorithms and Applications, Richard Szeliski, Spinger 2010, Available free at http://szeliski.org/Book/

Reference

Machine Vision, Ramesh Jain, Rangachar Kasturi, and Brian G. Schunck,
McGraw-Hill, Inc., 1995. ISBN 0-07-032018-7 OR ISBN 0-07-113407-7.

The course covers the following topics.

Introduction: image formation, photometric and geometric information in a 3D scene, human visual system, pin-hole camera model and perspective projection, representation of points, lines, planes, and surfaces in 3D, nature and structure of medical images and imaging.

Binary image analysis: algorithms for area, position, perimeter, and connected component labeling algorithms; Morphology: shrinking, expanding, erosion, dilation, opening, closing, thinning operations.

Edge detection: gradient vector (magnitude, direction), smoothing filter, Canny's edge detection algorithm.

Image filtering: convolution, noise, mean, median, knn, Gaussian filtering

Contours: Line fitting, Total LSE, Least Median Square Error, Hough transform, RANSAC,

Color: Physics of color, human perception of color, color models (RGB, HSI, CMYK, etc). Color image processing.

Image segmentation: Image features, split-and-merge algorithms.

Medical Imaging: Principle underlying Computed Tomography; MRI.

Three-dimensional shape recovery: 3D from Stereo Images; Camera model, calibration; 3D Motion from Video. Structured light, other shape-from-x methods (texture, shading, focus/defocus, etc)

High-level Vision: Feature space, feature vectors, Image Matching, Pattern Recognition, Object Recognition, Machine learning, SVM, Artificial Intelligence.

There will be about 4 programming projects using Matlab/Octave.

GRADING
Part I: Assignments
Programming projects : 25 %
Homeworks: 15 %

Part II : Tests 60%

Test 1 : 1 hr. 15 mins. : 20 %
Test 2 : 1 hr. 15 mins. : 20 %
Test 3 (Final exam): 1 hr. 15 mins. : 20 %

Late submission of assignments
Homeworks: Late submissions are not accepted as the weight for any individual homework is small, around 1% of the overall total. Homeworks help prepare for tests and be engaged in a continuous learning process.
Projects: One or two days late: graded out of 75% (at a penalty of 25%). Submissions that are more than two days late or not accepted.
See the SBU Blackboard website of the course for all the latest announcements.

Grading Policy
Grades are assigned based on absolute percentage of total marks as below.
A : 91--100 A- : 86--90
B+ : 81--85 B : 76--80 B- : 71--75
C+ : 68--70 C : 64--67 C- : 61--63
D+ : 56--60 D : 51--55 F : 0--50
Goals: Teach computer vision principles and techniques with application examples in two-dimensional and three-dimensional machine vision.

Course Learning Outcomes
Students should be able to design and implement computational algorithms to solve problems in the following areas:
1. Binary image analysis, connected component analysis, and two-dimensional object recognition.
2. Gray level image analysis including image segmentation, edge detection, and image filtering operations.

3. Stereo image analysis for 3D machine vision and other 3D imaging techniques.
4. Object representation and recognition techniques.