Catalog Description:
Introduces fundamental concepts, algorithms, and computational techniques in visual information processing. Covers image formation models and 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.
Informal prerequisites: Sophomore level Calculus (e.g. AMS 261/361) and Linear Algebra (e.g. AMS 210), intermediate level programming in any language (e.g. ESE 224). Recommended: Matlab.

Intended students: Junior and Senior level students in Electrical/Computer Engineering and Computer Science.

Text book:

References
Many online resources.

Approximate list of topics in four roughly equal parts:

Part I Image Formation Models and Image Processing

1. Introduction: image formation, photometric and geometric information in a 3D scene, human visual system, pin-hole camera model and perspective projection. MATLAB/Octave for computational vision.

2. Geometric-information: Representation of points, lines, planes, and surfaces in 3D, nature and structure of medical images and imaging. Two-dimensional and three-dimensional geometric transformations of images and 3D scenes.


4. Binary image analysis: algorithms for area, position, perimeter, and connected component labeling algorithms; morphological operations.

5. Image filtering: convolution, noise, spatial and Fourier domain approaches, Gaussian filtering.
Part II Edges, Contours, and Regions.


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


Part III Medical Images, 3D Imaging, 3D Motion

9. *Medical Imaging*: Modes of medical imaging, X-ray Computed Tomography, image reconstruction algorithms; processing images from MRI.


11. 3D Motion from Video, other shape-from-x methods (texture, shading, focus/defocus, etc). Machine and robot vision applications and self-driving cars.

Part IV High-level Vision: Pattern Recognition, Learning, and AI.


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