

## EE/CMPEN 454 – Fundamentals of Computer Vision

**Designation:** EE elective course for electrical and computer engineering majors.

**University Bulletin Description:** EE (CMPEN) 454: (3) Introduction to topics such as image formation, segmentation, feature extraction, shape recovery, object recognition, and dynamic scene analysis.

Prerequisites: MATH 230 or MATH 231, CMPSC 201 or CMPSC 121.

### Prerequisites by Topics:

1. Understanding and the ability to use three-dimensional analytical geometry and vectors in space.
2. Understanding of matrices and eigenvector/eigenvalue decomposition.
3. Understanding and the ability to use partial differentiation.
4. Good programming experience in C/C++ or Matlab, working knowledge of Unix.

### Textbook/Required Materials:

*Introductory Techniques for 3-D Computer Vision*, by E. Trucco and A. Verri, Prentice Hall, 1998.

### Learning Outcomes:

This course provides the foundational education in computer vision analysis. Through lectures, homeworks, programming assignments, and interactive material available in the course web site [in Angel](#), students are provided learning experiences that enable them to:

1. Capture digital images, and master low-level, mid-level and high-level computer vision techniques, such as noise cleaning, feature extraction, template matching, depth recovery from stereo and object recognition.
2. Become proficient with computer skills for the analysis of digital images.
3. Develop technical writing skills important for effective communication.
4. Acquire teamwork skills for working effectively in groups.

### Topics:

1. Course overview and introduction (1 class)
2. Linear filters; feature extraction; corners, edges, and regions (5 classes)
3. Template matching and intro to stereo (2 classes)
4. Camera projection process; image transformations; parameter estimation (5 classes)
5. Color and light (2 classes)
6. Stereo revisited; general stereo and epipolar geometry (3 classes)
7. Camera motion; optic flow; structure from motion (3 classes)
8. Fundamentals of video; change detection; tracking techniques (3 classes)
9. Object recognition (2 classes)
10. Special topics: e.g., texture synthesis or skin color recognition (2 class)

**Class/laboratory schedule:** Two 75-minutes lectures per week.

### Computer usage:

1. Three computer assignments implemented using Matlab. Technical writing skills, working in teams, development of well-documented code and good programming practices are emphasized.
2. Formal technical reports for the computer projects require the use of word processing and graphics software for presentation.
3. All computer projects must be run in a demonstration session.

### Contribution to Meeting the Requirements of Criterion 5. Curriculum:

This course contributes to both the engineering topics and design components.

This course provides a design emphasis in the area of computer systems.

**Relationship to Program Outcomes:**

- O.1.1. Graduates will possess mathematics skills necessary for electrical engineering.
- O.1.3. Graduates will have attained computer proficiency.
- O.2.5. Graduates will have knowledge of digital systems.
- O.3.1. Graduates will have in-depth technical knowledge in one or more areas of specialization.
- O.3.2. Graduates will have practical understanding of the major electrical engineering concepts and demonstrate application of their theoretical knowledge of the concepts.
- O.5.1. Graduates will have good teamwork skills.
- O.5.2. Graduates will possess good oral and written communication skills.

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