ECE4580 Course Syllabus

ECE4580

Computatonal Computer Vision (3-0-0-3)

CMPE Degree
This course is Elective for the CMPE degree.

EE Degree
This course is Elective for the EE degree.

Lab Hours
0 supervised lab hours and 0 unsupervised lab hours

Course Coordinator
Vela,Patricio Antonio

Prerequisites
ECE 3084 or 3550

Corequisites
None

Catalog Description
Computational and theoretical aspects of computer vision. Application areas include robotics, autonomous vehicles, tracking, and image-guided surgery. Includes major project.

Textbook(s)
Horn, *Robot Vision*, MIT Press, 1986. ISBN 0262081598, ISBN 9780262081597 (required)

Course Outcomes
Upon successful completion of this course, students should be able to:

1. Derive and describe image formation with regards to world and camera relative geometry;
2. Describe the process of camera calibration and its related optimization formulations;
3. Apply stereo triangulation and epipolar constraints for solving vision related problems;
4. Describe the relationship between the heat equation, diffusion, and Gaussian smoothing;
5. Apply and implement differential and convolutional operators as discrete stencil operations;
6. Explain the role of optimization in solving vision-based problems or estimating visual properties;
7. Describe the purpose of adding prior constraints or regularization terms to computer vision derived optimization problems.
8. Describe fundamental approaches to segmentation and clustering;
9. Explain the equations underlying optical flow and their derivation from cost functionals;

Student Outcomes

In the parentheses for each Student Outcome:
"P" for primary indicates the outcome is a major focus of the entire course.
“M” for moderate indicates the outcome is the focus of at least one component of the course, but not majority of course material.
“LN” for “little to none” indicates that the course does not contribute significantly to this outcome.

1. (P) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. (LN) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. (LN) An ability to communicate effectively with a range of audiences
4. (LN) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. (LN) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. (LN) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. (M) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topical Outline

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Introduction

Classic methods of linear filtering

Sketch of wavelet techniques

Edge detection

Segmentation

Optical flow and stereo disparity

Shape recognition

Color and texture processing

Motion planning and tracking

Applications:
- Robotics
- Image-guided surgery
- Controlled active vision
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