A. JAMES CLARK
SCHOOL OF ENGINEERING

Course: ENPM 673 – Perception for Autonomous Robots
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Course Description
This class teaches Image Processing and Computer Vision techniques for Mobile Robots. The class covers three topics: Image Processing (Image Enhancement, Filtering, Advanced Edge and Texture), 3D Vision (3D Geometry from Multiple view geometry, Motion Processing and Stereo) and an Introduction to Image Segmentation and Object Recognition. Students will be introduced to a number of existing software toolboxes from Vision and Robotics, and will implement a number of smaller projects in Matlab.

There will be six problem sets assigned during the semester. These include some pencil and paper exercises, but mostly they will include programming assignments to be done in Matlab. Students will have one or two weeks for each problem set, depending on its size.

There will be two exams: a midterm, and a final, both take-home. Each exam will be cumulative, covering all material learned to that point in the class, with a greater emphasis on material learned since the previous exam. Exams and problem sets will all be based on material discussed in class.
These will be weighted for the final grade as: Homework 60%, midterm a total of 20%, final exam 20%.

Course Outline
1.a Introduction: Sensors, robots and sensorimotor systems
1.b. Theoretical eyes
2.a Image formation: Geometry
2.b Non-traditional sensors and perceptual coordinate systems
3.a Image operations, histogramming and histogram equivalization
3.b Matlab tutorial
4.a Image formation: lightness
4.b Image formation: color
5.a Filtering, correlation, convolution, noise
5.b Fourier transform
6.a Edge detection
6.b Feature extraction: lines, Hough transform, corners, SIFT features
7.a Projective geometry in perception
7.b Epipolar geometry and multiple view geometry
8.a Camera calibration
8.b Stereopsis

9.a Segmentation: Clustering
9.b Segmentation: Energy minimization
10.a Texture analysis
10.b Texture segmentation
11.a Motion and optical flow
11.b Egomotion from flow, motion segmentation
12.a Tracking and Kalman filtering
12.b SLAM (Simultaneous Localization and Mapping), approaches to navigation
13.a Recognition using geometry
13.b Recognition through machine learning

Code of Academic Integrity

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity of the Student Honor Council, please visit http://shc.umd.edu/SHC/HonorPledgeInformation.aspx.