Spring 2022 EECE 7150: Autonomous Field Robotics

Instructor Hanumant Singh

Class 5:50-7:30pm,  Mondays, Wednesdays
Office Hours TBD

In this class, we will do a general survey of some of the important papers and algorithms in the area of field robotics concentrating on applications for land-based, aerial and marine applications. The class will be based on paper presentations and the implementation of the algorithms on Northeastern robots.

Grading
20% Paper Presentation
80% Projects

Note: You are also strongly advised to attend any talks and symposiums at NU in the general area of Robotics.

Textbooks: Not required, but our lectures will follow the work described in part in Multiple View Geometry by Hartley and Zisserman

The basic SLAM work will follow some of the groundwork laid out in  Thrun et al Probabilistic Robots

See also the Python Notebook based
https://github.com/rlabbe/Kalman-and-Bayesian-Filters-in-Python

Lecture 1
        ROS background – Driving the NU autonomous car, Husky, etc with ROS
        Projective Geometry in 2D (CH 2 MVG)
        Warmup problem Monte Carlo techniques (Probabilistic Robotics - Ch 2)
Lecture 2
        Projective Geometry in 2D (Continued)
        Projective Geometry in 3D (CH3 MVG)
        Project 1a Homography Mapping
Lecture 3
        Projective Geometry in 3D (Continued)
        Estimation of Projective Transforms (CH4 MVG)
Lecture 4
        Project 1a Due;   Project 1b Handed out
        Estimation of Projective Transforms (Continued)
        Camera Models (CH 6.1 MVG)


Lecture 5
        SLAM in 2D

Graph based representations

Lecture 6

Problem 1b Due, Project 2 Underwater image dataset

Pizarro Mosaicking Paper

Optimization in GTSAM

Lecture 7

Multibeam calibration

Inter sensor calibration

Kalibr

Lecture 8

iSAM Paper

GTSAM understanding and review

Lecture 9

Epipolar Geometry, Fundamental and Essential Matrices

Project 2 Presentations, Project 3a handed out

Lecture 10

Epipolar Geometry, Fundamental and Essential Matrices (Continued)

Lecture 11

Bag of Words

Lecture 12-13

ORB Slam  Project 3b Handed Out

Lecture 14

ICP

Lecture 15-16

Lego Loam

Project 3b Due; Final Project Discussions

Lecture 17-18

Vins Mono / Kimera

RTAB SLAM

Lecture 19

The Role of ML

Lecture 20-26

Paper Presentations / Final Project Presentations