ECE474/574 Robotic Navigation with SLAM – 3CR

Instructor: Dr. Aleksander Malinowski http://olek.matthewm.com.pl/

Course description

Principles of locomotion, sensing, localization, and motion planning of mobile robots; building of and locating in probabilistic maps; cooperative localization, mapping, and exploration; cooperative object transport; multi-robot motion coordination; reconfigurable robotics; and team learning;

Prerequisites by topics

Knowledge of data structures and proficiency in programming in C++ including at least some idea of classes (OOEDS), linear algebra, and planar analytical geometry.

Textbooks and/or other required material

1. ***Introduction to Autonomous Mobile Robots, 2/ed.*, by R. Siegwart, I. R. Nourbakhsh, D. Scaramuzza, MIT Press, 2011, ISBN: 978-0262015356**
2. **Adept MobileRobots open source ARIA project**, http://robots.mobilerobots.com/wiki/ARIA
3. *Pioneer 3DX Technical Documentation* provided by Adept MobileRobots at http://www.mobilerobots.com/

Course Objectives

1. Understanding principles of mobile robot movement and ability to select mobility design appropriate for an application.
2. Understanding principles of mobile robot kinematics so that it could be utilized in movement controllers
3. Familiarity with sensors available for robot localization
4. Ability to apply simple control laws in wall following or reach target position algorithms
5. Ability to build a probabilistic map of surrounding environment
6. Ability to locate a mobile robot in the probabilistic map
7. Ability to navigate the map in order to achieve a preset goal
8. Ability to apply objectives listed above to teams of mobile robots with or without explicit communication among robots

Topics Covered

1. Locomotion of mobile robots
2. Kinematic models and constraints, maneuverability, workspace, motion control
3. Overview of sensors useful for mobile navigation
4. Challenge of localization, localization vs. programmed solutions
5. Map representation, probabilistic map-based localization
6. Autonomous map building
7. Planning and navigation
8. Robot communication
9. Docking of marsupial robots