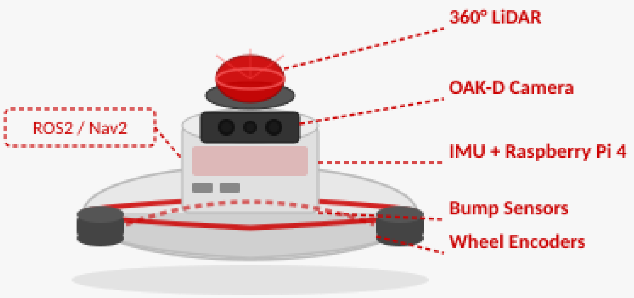
NORTHEASTERN UNIVERSITY

EECE 5550

Mobile Robotics

4 Credit Hours

Navigate the Unknown — From Kinematics to Autonomous Exploration



TurtleBot 4

Course Mobile Robot Platform

- 360° RPLidar A1 for mapping
- OAK-D stereo depth camera
- 9-DOF IMU + wheel encoders
- ROS2 / Nav2 autonomous navigation

Core Theory

- Kinematics & Dynamics
- State Estimation & Filtering
- Probabilistic Robotics
- Localization — EKF & Particle
- Mapping & SLAM
- Motion Planning & Control

Perception & Sensing

- Computer Vision Fundamentals
- LiDAR, Sonar & Range Sensors
- GPS & IMU Integration
- Coordinate Systems & Geometry
- Odometry & Dead Reckoning
- Sensor Fusion Architectures

Platforms & Projects

- TurtleBot4 & ROS2 Framework
- Lab 1 · Robot Kinematics
- Lab 2 · Probabilistic Localization
- Lab 3 · SLAM Implementation
- Lab 4 · Motion Planning
- Final · Autonomous Navigation

What You Will Do

- Derive and implement kinematic models for wheeled and aerial mobile robots
- Design Kalman and particle filters for real-time pose estimation under uncertainty
- Build a full SLAM pipeline that simultaneously maps an environment and localizes a robot
- Program a TurtleBot4 in ROS2 to navigate autonomously through unknown terrain
- Apply motion planning algorithms — RRT, A*, and potential fields — to real robot tasks
- Present a semester project demonstrating end-to-end autonomous robot navigation

Autonomous Navigation Final Project

Teams design and implement a complete autonomous navigation system on a real mobile robot platform. Projects have included person-following robots, swarm mapping, and mobile manipulators — demonstrated live at the end of the semester.

Deliverables: Homework sets · Paper presentation · Semester project · Oral defense

Prerequisites

EECE 2520 & EECE 2560 or CS 3000 or graduate admission
Linear algebra, multivariable calculus, probability & statistics

Who Should Enroll?

ECE, CS, or ME graduate & senior undergrad students
Anyone building autonomous robots or pursuing robotics research