Instructor
Professor Simon Leonard, sleonard@jhu.edu, www.cs.jhu.edu/~sleonard
Office: Hackerman 137-B
Office hours: Monday 2:00–3:00 pm, Thursdays 1:3–3:00 pm, Friday 10-11am

Teaching Assistant
Prasad Vagdargi, prasad@jhu.edu
Office: Hackerman 111
Office hours: Monday 10-11am

Meetings
Tuesday, Thursday, 12:00–1:15 pm, Shaffer 301

Textbook

Online Resources
Please visit the web page https://cirl.lcsr.jhu.edu/sensorbasedrobotics for all materials related to this course.
Signup for piazza at https://piazza.com/jhu/spring2020/en600463663

Course Information

- This course surveys the development of robotic systems for navigating in an environment from an algorithmic perspective. It will cover basic kinematics, configuration space concepts, motion planning, and localization and mapping. It will describe these concepts in the context of the ROS software system, and will present examples relevant to mobile platforms, manipulation, robotics surgery, and human-machine systems.

- Prerequisites
  EN.601.226 and AS.110.201 or AS.110.212 and EN.553.310 or EN.553.420

Course Goals
Specific Outcomes for this course are

- Student will learn kinematics, 3D coordinate frames and their derivatives
• Understand the kinematic relationship between sensors and robots
• Learn motion planning algorithms (potential field and sampling-based).
• Derive filtering algorithms used in localization and mapping (Kalman filter, extended Kalman filter, Bayes filter and particle filter).
• Learn system and observation models used in robotics.

This course will address the following Criterion 3 Student Outcomes
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
3. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course Topics
• Rigid body motion and kinematics
• Manipulator Jacobian
• Hand-eye calibration
• Configuration space
• Potential field path planning
• Sampling-based path planning
• Kalman filter
• Extended Kalman filter localization and SLAM
• Bayes Filter
• Particle filter localization

Course Expectations & Grading
There will be five assignments and two exams. Grading will be 50% on the assignments and 25% for each exam. All students will need to use real robots by the end of the semester to earn their final mark.

Key Dates
Assignment due dates:

Assignment 1: February 20th 2020
Assignment 2: March 5th 2020
Assignment 3: April 2nd 2020
Assignment 4: April 16th 2020
Assignment 5: April 30th 2020
Midterm: March 12th 2020
Final: May 6th 2020
**Ethics**

The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition.

In addition, the specific ethics guidelines for this course are:

- No teamwork or collaboration on assignments
- No public or private sharing of code, assignments and exams

Report any violations you witness to the instructor. You may consult the associate dean of student conduct (or designee) by calling the Office of the Dean of Students at 410-516-8208 or via email at integrity@jhu.edu. For more information, see the Homewood Student Affairs site on academic ethics: https://studentaffairs.jhu.edu/policies-guidelines/undergrad-ethics

**Examples of academic misconduct:**

- Use of material produced by another person without acknowledging its source
- Submission of the same or substantially similar work of another person (e.g., an author, a classmate, etc.)
- Intentionally or knowingly aiding another student to commit an academic ethics violation
- Allowing another student to copy from one’s own assignment, test, or examination
- Making available copies of course materials whose circulation is prohibited (e.g., old assignments, texts or examinations, etc.)

Teamwork for assignments is not allowed. You cannot use work from someone else (plagiarism). You cannot share your assignments to someone else (facilitating academic dishonesty).

- You cannot use any material from a classmate or student who took the course in previous semesters.
- You cannot share any material from this course in future semester.

Any academic misconduct (big or small) will be reported to Graduate Affairs (or Office of the Dean) and will be at least sanctioned by an “F” course grade. No negotiation. I will retroactively sanction plagiarism (i.e. a student plagiarize your assignment in future semesters).

Read the Graduate Academic Misconduct Policy:

- For undergraduates: http://e-catalog.jhu.edu/undergrad-students/student-life-policies/
For graduate students: [http://e-catalog.jhu.edu/grad-students/graduate-specific-policies/](http://e-catalog.jhu.edu/grad-students/graduate-specific-policies/)

**Students with Disabilities**

Any student with a disability who may need accommodations in this class must obtain an accommodation letter from Student Disability Services, 103 Shaffer, (410) 516-4720, studentdisabilityservices@jhu.edu.