ENPM 809T – Autonomous Robotics: Spring 2021 Syllabus

Master of Engineering Program in Robotics

Lecture Details

Section 0201
Mondays from 4:00 pm to 6:40 pm
Online only

Section 0101
Thursdays from 4:00 pm to 6:40 pm
Online only

Instructor

Steven E. Mitchell, Ph.D.
Office: EGR 2128
Office Hours: 330-400pm Mon/Thurs via Zoom lecture link, and by request
Preferred Means of Contact: mitchels@umd.edu

Teaching Assistant

Sandeep Kota Sai Pavan (skotasai@umd.edu)
Office Hours: Tuesdays & Wednesdays 3:00 – 4:00pm

Course Description

This is a hand-on course exploring the principles of robotic autonomy. Students will explore the theoretical, algorithmic, and implementation aspects of autonomous robotic modeling and controls, perception, localization and SLAM, planning, and decision making. These techniques will be applied through completion of a semester-long hands-on project employing the course material, ground-based mobile robots, and Python. Each student is required to build and test their own robot this semester.

Students will perform hands-on exercises in most lectures to gain a deeper understanding of how a selected set of these technologies can be applied to real-world robotic environments.

Required Technology

Students will need a personal computer on which Python can be installed (installation details provided during first lecture) along with a Raspberry Pi and robotics kit (both available for purchase).

Textbook(s)

There exists no single textbook that comprehensively covers the material included in this course. The following resources are ***optional*** and will augment the lecture materials:

- Introduction to Autonomous Mobile Robots by Siegwart, 2011
- Probabilistic Robotics by Thrun, 2005
- Planning Algorithms by LaValle, 2006
- Intro to Mechatronics and Measurement Systems, by Alciatore, 2012
- Introduction to Sensors for Ranging and Imaging by Booker, 2009
- Python Programming and Visualization for Scientists by DeCaria, 2016
- Practical Python and OpenCV by Rosebrock, 2014
- Raspberry Pi for Computer Vision by Rosebrock, 2019

Grading Policy

Course grades will be based on the following ***approximate*** grade weights:

Assignments & Exercises	80%
Final Project	20%

Assignments and exercises will be performed both in and outside class hours. Attendance and participation will be self-evaluated and considered with final grade decisions made by the professor.

It is your responsibility to confirm the proper grades are recorded on ELMS for all graded work. You have **two weeks from the date graded work is returned to dispute a grade**.

Academic Integrity

By enrolling in this course, each student assumes full responsibility as a participant in UMCP's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.shc.umd.edu.

Syllabus Note

This course syllabus is subject to change. The most recent version is available on the course website (ELMS). ***Please check regularly for updates***.

ENPM 809T – Autonomous Robotics: Spring 2021 Class Schedule

Master of Engineering Program in Robotics

Week	Dates	Topic / Event	Reading / Other
1	1/25 1/28	Course Introduction — Python Fundamentals Introduction to Python — sanitycheck.py **Homework #0.1 due**: Speed dating	Siegwart Chp. 1 DeCaria Chp. 1-5, 7, 10
2	2/1 2/4	Introduction to Course Project — Ground-up setup/config of Raspberry Pi Python & the Raspberry Pi **Homework #1 due**: **data in Python & Bill of Materials confirmation**	Siegwart Chp. 4 DeCaria Chp. 1-5, 7, 10
3	2/8 2/11	Perception — OpenCV Fundamentals via VNC QR codes **Homework #2 due: confirm RPi up and running, cv2.videoWriter()**	Siegwart Chp. 4 Toth Chapter 1 IntroRemoteSensing.pdf
4	2/15 2/18	Perception — Lidar & Velodyne demo GPIO Sonar & coding interface with distance sensor **Homework #3 due: object tracking with RPi**	Siegwart Chp. 4 IntroLidar.pdf VLP-16
5	2/22 2/25	Locomotion & Kinematics — Assemble vehicle Mount RPi camera **Homework #4 due: arrow tracking & orientation with RPi**	Siegwart Chp. 2-3
6	3/1 3/4	Locomotion & Kinematics — Assemble vehicle Overview of DC motors & H-bridge Teleoperated control of vehicle	Siegwart Chp. 2-3
7	3/8 3/11	Locomotion & Kinematics — Open vs. closed-loop control Servo motors & Gripper **Homework #5 due: complete assembly of ground vehicle, teleoperation**	Siegwart Chp. 2-3
8	3/15 3/18	*SPRING BREAK*	
9	3/22 3/25	Locomotion & Kinematics — Open vs. closed-loop control Servo motors & Gripper	Siegwart Chp. 2-3
10	3/29 4/1	Localization — Motor encoders Repeatedly drive robot in user-defined straight line	Siegwart Chp. 5
11	4/5 4/8	Localization — SMTP & IoT sending videos/data back to control station Map trajectory using Matplotlib **Homework #6 due: servo gripper functionality, localization basic theory**	Siegwart Chp. 5
12	4/12 4/15	Localization / Sensor Fusion — IMU sensor fusion **Homework #7 due: motor encoder tracking, forward reverse left right**	Siegwart Chp. 5 BNO055 datasheet
13	4/19 4/22	Planning & Navigation — Auto-rotation using block tracking algorithm Autonomous object retrieval **Homework #8 due: IMU functionality**	Siegwart Chp. 6
14	4/26 4/29	Grand Challenge Practice **Homework #9 due: sequence of moves, plot trajectory in Matplotlib**	
15	5/3 5/6	Grand Challenge	
16	5/10	Open Session - **Final Project Videos Due 11:59pm Friday 5/14** -	