

# EML 4930 – Autonomous Vehicles Spring 2022 Syllabus

## 1. Basic Course Information

**a) Instructor** Dr. Carl Crane  
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Class communication is via Canvas messaging.

Office hours: Wed, 9:30 – 10:30 via Zoom (<https://ufl.zoom.us/j/8730685706>)

**b) Class Meeting Time** M, W, F 7th period, 1:55 – 2:45 am, MCC-B 1108

**c) Textbook** None. Web site will link to online references

**d) Additional (optional) References** None.

## 2. Course Objectives and Outcomes

At the end of the class every student should:

- become proficient in programming using the C++ language.
- become knowledgeable of the Linux operating system.
- know how to install and program using the Robotic Operating System (ROS2) ; emphasis is on the publish-subscribe model of communication between processes.
- understand how to define a planned route for an autonomous vehicle.
- be able to develop control algorithms to determine the ‘best’ instantaneous steering, throttle, and braking values in order to maneuver an autonomous vehicle along a planned path
- learn the types and accuracies of GPS and INS positioning systems.
- be able to acquire lidar range data and to identify unexpected obstacles during autonomous navigation.
- become familiar with computer simulations of autonomously navigating vehicles.

Course modules that will be covered in the class to meet these objectives:

1. C++ programming
  - a. Assess student’s programming knowledge (data types, if-then, for loop, while loop).
  - b. Students will install Ubuntu Linux, version 20.04, on their own laptop or desktop.

- c. Students will write and compile C++ programs on their Linux computer. Topics: functions, pointers, structures, classes
2. ROS 2
  - a. Install ROS 2 and Gazebo on Linux computer.
  - b. Go through ROS 2 tutorials. Students will run publish and subscribe examples.
  - c. Show how to use rviz to display data.
  - d. Show how to bag data and then play it back.
3. Navigation Stack
  - a. Define a planned path. A\*
  - b. Determine how to calculate 'best' instantaneous steering, throttle, and brake settings to follow path (no obstacles at this point).
4. GPS/INS Localization
  - a. Introduce GPS accuracies and data rates.
  - b. Discuss INS accuracies and data rates.
  - c. Implement Sylphase GPS/INS and gather data.
5. Lidar Sensing
  - a. Gather data from Velodyne 16 beam sensor.
  - b. Discuss how this data can be used to overlay obstacles along the planned path.
  - c. Determine how to modify the path based on obstacle detections.
6. Gazebo Simulator
  - a. Implement vehicle navigation with simulated GPS localization and lidar sensing.
7. Lidar Map Building and Localization
  - a. Introduce AutoWare mapping and localization approach.
8. Test Bed
  - a. Implement navigation stack, Sylphase GPS/INS, and lidar sensing on go-kart.
  - b. Low speed (20 mph max) path following with no obstacles.
  - c. Low speed path following with obstacles.

### 3. Course Assessment

#### Grading

|          |      |
|----------|------|
| Quiz 1   | 15 % |
| Homework | 50 % |
| Project  | 35%  |

### 4. Other Course Information

- all course correspondence will be via Canvas
- late homework will not be accepted

### 5. Honesty Policy:

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment."

### 6. Honesty Penalty:

All work is to be done individually. Any copied submission will result in a zero for that assignment and a letter grade reduction for the course. For example, if your final grade was to be a B+, it would be reduced to a C+. Class activities are password protected and must be accomplished during class. It will be considered an act of academic dishonesty (on both parties) if a student shares the password and solution with a student who did not exhibit an effort to complete the activity.

### 7. Campus Resources:

- ✦ [U Matter, W Care](#)
- ✦ [Counseling and Wellness Center](#)