UDACITY

Flying Car Nanodegree Program

What You'll Learn

A Short Preview

As a student in the Flying Car Nanodegree program, you are part of a pioneering group of students who are going to build the next generation of transportation systems. You'll push beyond today's quadrotors and remote-controlled drones, and master the skills necessary to create autonomous flight vehicles that will be crucial to the smart transportation systems of the future.

In the first part of the curriculum, you'll focus on the basics of autonomous flight including mission and path planning, state estimation, control, and perception. As you advance through the program, you'll gain an understanding of the bigger picture of autonomous flight as part of the air transportation system. Through a series of hands-on projects, you'll develop the software skills to make drones fly autonomously—skills you can apply directly to hardware drone kits.

Project 1

In this project, you'll get an introduction to various types of aerial vehicles including quadrotor and fixed-wing drones. This will be a high-level overview where you'll learn what it takes to make different types of aerial vehicles fly. We will then focus the course on quadrotors and dive right into projects with our flight simulator.

A key part of your program experience will be the opportunity to work with our flight simulator. We've developed it in-house at Udacity using the Unity game engine. You'll control a drone in the simulator by writing Python code and leveraging the Mavlink library, a communication protocol for micro air vehicles. You'll benefit from a number of features with our flight simulator including a combination of photo-realistic visuals and a powerful physics engine, as well as cross-platform performance.

Right from the start, in the first project you will learn how to make a quadrotor take off and fly in a simple box pattern at a 1.5 meter altitude!

Project 2

You'll embrace a "learn by doing" approach at every step of your journey through the program, and this project represents a unique opportunity to apply your skills. Whereas traditional aeronautics programs start with controls and estimation, you'll begin with planning. This is an easier point of entry that will allow you to directly apply your skills to a real drone kit, once you have mastered planning within the flight simulator.

You will also engage with a wide variety of topics including basic questions such as, how should a vehicle represent its own 3D position and attitude? We will study the problem of how a vehicle flying through an urban environment can plan its flight to avoid obstacles, especially when taking into consideration the complexities of what is physically possible for a flight vehicle, and how environmental factors such as wind can affect the vehicle motion.

In the second project, you'll load in a map of obstacles and plan a collision-free path of waypoints from start to end point, taking into account dynamics to reduce tracking error.

Project 3

Up to this part of the course, we have assumed the vehicle has perfect knowledge of its own position and attitude, but of course that is unrealistic. In the third part of the course, you will focus on state estimation—how can an aerial vehicle determine its position and attitude from sensor data? We will cover topics including how inertial sensors and GPS work, and sensor fusion using non-linear filters of various kinds. We will also study how to calibrate sensors so that the filters know how to use the sensor data most effectively.

In the third project, you'll implement an extended Kalman filter (EKF) that is capable of estimating the attitude and position of a vehicle in flight by fusing a dynamical model of the vehicle with IMU and GPS data.

Project 4

Control is a key component of all aerial vehicles. It is considered one of the hardest challenges, and experts spend years studying controls alone. This will be your opportunity to begin engaging with one of the most fascinating aspects of building aerial vehicles. In this project, you'll focus on the foundational concepts in controls and especially how the limits of control can affect the higher-level autonomy. You will learn concepts such as proportional-integral-derivative (PID) control and the linear quadratic regulator, but also the properties of a control system such as stability and controllability.

By completing this project, you'll learn to implement the attitude controller that you used in earlier projects that allows a vehicle to follow a reference trajectory.

Sound exciting?

We'll tell you more about what our experts have in store for you in the coming weeks, so get on our email list to stay updated, and to get application details!