AE483 Final Project

(to be done as a lab group)

This project is an opportunity to do what you like in the lab, and to work as hard on it as you like. In this project, you say what you will do and how it will be evaluated. Examples of projects from prior years will be posted to piazza.

Proposal (due 11:59PM on November 18)

Your proposal should contain the following information:

- Identify a civilian application of quadcopters that is of interest to you (max 50 words).

  An example of a civilian application is delivery of a package (e.g., a book) to a residence. An example of a non-civilian application is delivery of a bomb to a "suspected militant." Within the context of this project, applications that are associated with US government agencies that have become increasingly militarized (e.g., police, FBI, border patrol) will also be considered "non-civilian." Please be specific about your application and about what need would be met by using quadcopters. For example, "search and rescue" is not specific enough. Be creative and ambitious. Include a picture to illustrate your application.

- Identify a capability that your application requires quadcopters to have (max 50 words).

  In most cases, this capability would enable one small part of your chosen application. For example, the delivery of a package might require a quadcopter to pick up a box at one location and put it down at a different location. You might choose that whole process as the capability you want to demonstrate, or you might choose only one part of it (e.g., transport a box from one place to another, assuming this box is already attached to a quadcopter).

- Identify three steps toward achieving your capability (max 100 words each).

  Suppose you want to transport a box from one place to another, assuming that this box is already attached to a quadcopter and that its size and shape are known. Three steps might be to model the quadcopter/box system, to design and implement a controller for this system near hover in simulation, and to verify that this controller works in the lab when used for trajectory tracking. The three steps you identify for your own project should also have this structure: (1) model, (2) simulation, (3) experiment. For each step, be specific about what you will produce, how it will be evaluated, and when it will be done.

- Identify one way in which your project could be extended, time permitting (max 50 words).

  Continuing our example, one thing that might be done after successfully completing each of your proposed steps—and that you will do, given time—is to enable the quadcopter to move a box from one place to another, assuming this box is attached and detached by hand while the quadcopter is hovering.

Your proposal should be submitted as a PDF document with text in size 11 sans-serif font (e.g., arial, calibri, helvetica), single-space, 1-inch margins. An example proposal in this format is attached—it can be used as a template. Details of submission will be posted to piazza.

Report (due 11:59PM on December 13)

Your report should contain the following information:

- Say what you had proposed to do.
- Say what the results were, according to your own measures of success.
- Say what might be done to extend your work in future.

Your report should be submitted as a PDF document with text in size 11 sans-serif font (e.g., arial, calibri, helvetica), single-space, 1-inch margins. It can be as long or short as it needs to be. A typical length might be two pages of text in addition to schematics, plots, derivations, whatever. Please don't stress about this report. It should be short and to the point. Details of submission will be posted to piazza.

Video (due 11:59PM on December 13)

Create a highlight video.

- The length should be 180 ± 5 seconds.
- The first and last 5 seconds should include text with a title, your names, and the following words somewhere in some order: AE483, Fall 2016, Department of Aerospace Engineering, and University of Illinois at Urbana-Champaign.
- The rest should contain anything you feel best communicates what you did, why you did it, and what the results were.

This video will become part of your portfolio, so please take care to present yourself and your work in a professional manner. Details of submission will be posted to piazza.

Presentation (7-10PM on December 14)

Attend a final project party on December 14 from 7-10PM in Talbot 103. Give a brief (maximum 60 seconds) introduction to your project team and your project video. Accept applause. Please plan to stay for the entire event, to support your colleagues.

Grading

- 25% proposal (if it is turned in on time, you get 25%)
- 25% report
- 25% video
- 25% presentation (and attendance) at final project party

AE483 FINAL PROJECT PROPOSAL

A. Person and B. Person

November 14, 2016

https://www.asme.org/getmedia/05b8b9b4-c3c1-4c1c-9a5d-977693ff773d/Developing_Delivery_Drones_hero.jpg.aspx

Application

The application motivating this project is to deliver a package (e.g., a book) from a truck to a residence with a quadcopter.

Capability

Package delivery requires a quadcopter to pick up a box at one location and put it down in a different location. This project will focus only on transport—moving the box from one place to another, assuming it is already attached to the quadcopter.

Steps

1. *Model.* Derive the equations of motion that describe the quadcopter/box system. Linearize and discretize these equations, putting them in standard form (discrete-time, state-space). Complete by Monday, November 28.

2. *Simulation*. Design and implement a controller for the quadcopter/box system near hover in MATLAB by modifying the code that the PIs (A. Person and B. Person) have developed in the AE483 homework assignments. Show that this controller enables trajectory tracking of a straight line between two points with bounded error in simulation by plotting position error as a function of time. Complete by Friday, December 2.

3. *Experiment.* Attach a box to the quadcopter in lab. Implement the same controller that worked in simulation, showing that it enables trajectory tracking of a straight line between two points with bounded error for the real quadcopter/box system by plotting position error as a function of time. Complete by Friday, December 9.

Bonus

Enable the quadcopter to move the box from one place to another, assuming this box is attached and detached by hand while the quadcopter is hovering.