LABWORK - QUADROTOR

2019-2020 version

INTRODUCTION

The final goal of the lab is to fly your own controller and perform a trajectory with the best possible performance. The simulation environment is very accurate (at least for moderate speed and angles) and can be extensively used for the design of the control laws. For the experiment with the real system you will need the help of an operator.

During the three sessions you will:

- understand and practice the complex environment,
- design a P, PD or PID controller for the vertical axis
- design a state feedback (with integral effect) for the two horizontal axis
- fly your controller with the real system

TASK I : ALTITUDE CONTROL, SIMULATION

1. Simplified model

Give a simplified model of the system in the vertical axis only. Program a test in order to identify a model for the vertical speed. You will program an automatic take off, a negative step of vertical velocity (0.1 m/s during 3s) and an automatic landing.

2. Design and test of the controller in simulation

Based on the simplified model you will design **a "cascade controller" or a PID controller**. The requirements are as follows:

- Overshoot less than 5% for a standard step input
- steady state error less than 3 cm
- Maximum vertical speed 1 m/s

The controller can be designed on a simplified Simulink model and/or in a dedicated Matlab script or on a trial / error basis.

For the validation test you will program a trajectory as follows: the automatic take off, a reference step (20cm and down) and an automatic landing.

TASK II : HORIZONTAL CONTROL, SIMULATION

1. Model identification

The horizontal displacement (x and y) will be controlled with attitude angle (att_tgt). The actual attitude is controlled with an internal loop embedded in the bebop computer you are not in charge of this part. Before starting the design of the controller we need a simplified simulation model.

The simulation models will be obtained by identification. You will analyze standard step input and derive a first order model (between att_tgt and horizontal velocity).

2. Design and test of the controller in simulation

For this axis you will design a **state feedback** controller. The requirements are as follows:

- Overshoot less than 5% for a standard step input
- steady state error less than 3 cm
- Maximum horizontal speed 1,5 m/s

The validation test will be a 20 cm horizontal step.

TASK III : FULL VALIDATION, EXPERIMENTATION

1. Validation test

Test your controllers in a real flight. The provided script *plotdata.m* gives an idea of how to save and plot interesting data.

You may have not enough time to fine tune your controller but the performance (and difference between experimentation and simulation) must be pointed out and explained.

2. Test in navigation

The final test is a full navigation. A block is provided that gives a full reference trajectory.