Mini-Projects

General info

- 3 topics
  - Fuzzy-PID for Attitude Control
  - Sonar-based Altitude Stabilization
  - GPS Signal Following
- Total of 15 groups composed of 4 students (total of 60 students)
- 5 groups for each topic
- First-come, first-served!

Evaluation

- Oral examination (15', 60% of the final mark)
  - 1 application
  - 2 specific questions
  - No preparation time, personal material not allowed
- Miniproject presentation (40% of the final mark)
  - Presentations & demos (~ max 5' per team)
  - Evaluated by the assistants
  - Presentation and codes will be collected

Structure of the presentation

- Methods (and link to theoretical background)
- Implementation
- Results and conclusions
- Video

Max 5 min per group

Quadrotors availability

- Each group is responsible for a quadrotor
- Quadrotors are available in ELE 132
- A signature is required to take:
  - Quadrotor frame
  - The MAV'RIC board
  - Xbee communication module
  - USB cables
- Quadrotors are provided with no propellers and batteries (no flight operation without supervision)
- A signature is required when the material is brought back

Fuzzy-PID for Attitude Control

As seen during the TPs, the current **control system** of LE Quad is composed of a **cascade of PID controllers**. In this mini-project, you will **design an alternative control scheme called Fuzzy-PID**, where classic PID controller is hybridized with a fuzzy system based on fuzzy rules. You will first implement and test the Fuzzy-PID controller in Matlab/Simulink, then you will port the control scheme to the MAV'RIC board. Finally, you will compare the performance (step response) of the two schemes on the quadrotor platforms.

The work will be evaluated based on the implemented strategy, and also on the performance of the stabilization (amplitude of oscillations, robustness).

During development and evaluation, the **quadcopters will be operated indoor**, flying connected to a gimbal system

Sonar-based Altitude Stabilization

In order to avoid crashes when flying a quadcopter indoor or close to the ground, it is required to accurately control its height above ground. The goal of this mini-project is to **implement an altitude stabilization for indoor flight** (i.e. without GPS).

This project involves both altitude estimation and altitude control. Each team is free to focus on one or both of the two topics in order to obtain the best performance. For altitude control, students can use **PID controllers**, but are free to use **any other type of controller**. For altitude estimation, ultrasound sensors (sonars) will be provided. **To enhance the precision of the estimated altitude,** students may choose to use one of the **filters** seen during the class (ex: kalman filter, complementary filter...) in order to fuse data coming from the sonar, accelerometer and barometer.

The work will be evaluated based on the implemented strategy, and also on the performance of the stabilization (amplitude of oscillations, robustness).

During development and evaluation, **the quadcopters will be operated indoor**, freely flying within the limits of safety ropes.

GPS Signal Following

The goal of this mini-project is **to implement a navigation strategy in order to follow an external dynamic GPS** signal coming from another entity (another flying/ground robot, a moving ground user, etc.).

At the end, the robot should be able to keep a given constant distance to this signal (e.g. stay 5m above the GPS signal).

The work will be evaluated on the implemented strategy as well as on measuring the time integral of the difference between the required distance and the actual distance during an experiment.

If weather permits, the final evaluation of the **mini-project will be carried outside** in a GPS environment. Otherwise, the evaluation will be carried in simulation.