This course covers the guidance and control principles that are common to many small unmanned aerial vehicles (UAVs). Building upon classical control systems and modelling theory, students will learn how to mathematically model UAV flight characteristics and sensors, develop and tune feedback control autopilot algorithms to enable stable flight control, and fuse sensor measurements using extended Kalman filter techniques to estimate the UAV position and orientation. Students will realize these concepts through both simulation and interaction with actual UAV hardware.
## Content

### Module 1: UAV Modelling

**Description:**
- 1.1 Autonomous UAV description
- 1.2 UAV dynamics
- 1.3 UAV non linear modeling
- 1.4 UAV simulation

**Related activities:**
- A1, A2 and A3

**Learning time:** 14h
- Theory classes: 6h
- Self study: 8h

### Module 2: UAV Flight Control Loop

**Description:**
- 2.1 Classical control design: PID controller...
- 2.2 Modern flight control design: LQR Controller, feedback linearization

**Related activities:**
- A1, A2 and A3

**Learning time:** 17h
- Theory classes: 7h
- Self study: 10h

### Module 3: UAV Navigation system

**Description:**
- 3.1 Navigation loop
- 3.2 Inertial navigation
- 3.3 Sensor fusion using Kalman filter

**Related activities:**
- A1, A2 and A3

**Learning time:** 22h
- Theory classes: 8h
- Self study: 14h
Module 4: Guidance and flight control

Learning time: 22h
- Theory classes: 9h
- Self study: 13h

Description:
1. Overview of guidance techniques
2. Kinematic models for guidance
3. Way-point guidance
4. Path following for straight line and orbits

Related activities:
A1, A2 and A3

Planning of activities

A1. Theory lectures

Hours: 14h
- Self study: 2h
- Theory classes: 12h

A2. Laboratory project

Hours: 52h
- Theory classes: 16h
- Self study: 36h

3. Final exam

Hours: 9h
- Theory classes: 2h
- Self study: 7h

Qualification system

Final exam: 40%
Project assessment: 60%

Bibliography