Course guide
220141 - UAVG - Uav Guidance & Autonomous Control

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.
Degree: BACHELOR’S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR’S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Optional subject).
Academic year: 2022
ECTS Credits: 3.0
Languages: English

LECTURER
Coordinating lecturer: Fatiha Nejjari
Others: Bernardo Morcego ; Vicenç Puig

TEACHING METHODOLOGY
The course is divided into the following parts:
 Theory classes
 Laboratory sessions

LEARNING OBJECTIVES OF THE SUBJECT
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.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>45,0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>40.00</td>
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Total learning time: 75 h
## CONTENTS

### 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  

**Full-or-part-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  

**Full-or-part-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  

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

Description:
4.1. Overview of guidance techniques
4.2. Kinematic models for guidance
4.3. Way-point guidance
4.4. Path following for straight line and orbits

Related activities:
A1, A2 and A3

Full-or-part-time: 22h
Theory classes: 9h
Self study: 13h

ACTIVITIES

A1. Theory lectures

Full-or-part-time: 14h
Theory classes: 12h
Self study: 2h

A2. Laboratory project

Full-or-part-time: 52h
Theory classes: 16h
Self study: 36h

3. Final exam

Full-or-part-time: 9h
Theory classes: 2h
Self study: 7h

GRADING SYSTEM

Final exam: 40%
Project assessment: 60%