220141 - Uav Guidance & Autonomous Control

**Coordinating unit:** 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

**Teaching unit:** 707 - ESAII - Department of Automatic Control

**Academic year:** 2018

**Degree:**
- BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
- BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Teaching unit Optional)

**ECTS credits:** 3

**Teaching languages:** English

**Teaching staff**

**Coordinator:** 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**

| Total learning time: 75h | Hours large group: 30h 40.00% | Self study: 45h 60.00% |
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## Content

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<tr>
<th>Module 1: UAV Modelling</th>
<th>Learning time: 14h</th>
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<tr>
<td>Description:</td>
<td>Theory classes: 6h</td>
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<tr>
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<td>Self study: 8h</td>
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- 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

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<tr>
<th>Module 2: UAV Flight Control Loop</th>
<th>Learning time: 17h</th>
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<td>Description:</td>
<td>Theory classes: 7h</td>
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<td>Self study: 10h</td>
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- 2.1. Classical control design: PID controller...
- 2.2. Modern flight control design: LQR Controller, feedback linearization

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

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<th>Module 3: UAV Navigation system</th>
<th>Learning time: 22h</th>
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<td>Description:</td>
<td>Theory classes: 8h</td>
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<td>Self study: 14h</td>
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- 3.1. Navigation loop
- 3.2. Inertial navigation
- 3.3. Sensor fusion using Kalman filter

**Related activities:**
A1, A2 and A3
### Module 4: Guidance and flight control

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

**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

### Planning of activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Description</th>
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<td>A1. Theory lectures</td>
<td>14h</td>
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|                               |        | Theory classes: 12h  
|                               |        | Self study: 2h |
| A2. Laboratory project        | 52h    |  
|                               |        | Theory classes: 16h  
|                               |        | Self study: 36h |
| 3. Final exam                 | 9h     |  
|                               |        | Theory classes: 2h  
|                               |        | Self study: 7h |

### Qualification system

Final exam: 40%  
Project assessment: 60%

### Bibliography