230680 - GPS - GPS and Galileo Data Processing: From Fundamentals to High Accuracy Navigation

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2018
Degree: MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: English

Teaching staff
Coordinator: Hernandez Pajares, Manuel

Prior skills
Basic knowledge on Physics and Mathematics

Requirements

Teaching methodology

Learning objectives of the subject
To introduce the fundamental concepts of satellite positioning. To provide experience in GPS data processing for precision applications. To study some applications of GPS to geodesy and other Earth sciences. Basic contents of the course are the following. GPS observables. Reference systems and time. Orbit determination. Absolute positioning. Differential positioning. Ionosphere and troposphere modelling.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 26h</th>
<th>20.80%</th>
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<tr>
<td></td>
<td>Hours medium group: 0h</td>
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<td>Hours small group: 13h</td>
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<td>Guided activities: 0h</td>
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<td>Self study: 86h</td>
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<td>Content</td>
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<tr>
<td><strong>1. Introduction to space geodesy</strong></td>
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<tr>
<td>Degree competences to which the content contributes:</td>
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<tr>
<td><strong>1.1. Space geodesy and GPS.</strong></td>
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<td>Degree competences to which the content contributes:</td>
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<td><strong>1.2. Basic concepts and historical development</strong></td>
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<td>Degree competences to which the content contributes:</td>
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<td><strong>2. Global positioning system</strong></td>
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<td>Degree competences to which the content contributes:</td>
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<td><strong>2.1. Introduction.</strong></td>
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<td>Degree competences to which the content contributes:</td>
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<td><strong>2.2. Space segment.</strong></td>
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<td>Degree competences to which the content contributes:</td>
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<td><strong>2.3. Control segment.</strong></td>
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<td>Degree competences to which the content contributes:</td>
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<td><strong>2.4. Principles of signal structure and observation.</strong></td>
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<td>Degree competences to which the content contributes:</td>
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<tr>
<td><strong>2.5. GPS ephemeris and message structure</strong></td>
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<tr>
<td>Degree competences to which the content contributes:</td>
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</table>
3. Orbital movement of a satellite

   Degree competences to which the content contributes:

3.1. Trajectory of a satellite in the Earth's gravitational field.

   Degree competences to which the content contributes:

3.2. Elliptical movement of a satellite

   Degree competences to which the content contributes:

3.3. Orbital elements.

   Degree competences to which the content contributes:

3.4. Perturbed movement of a satellite.

   Degree competences to which the content contributes:

3.5. Orbit determination

   Degree competences to which the content contributes:

4. Fundamentals of physics

   Degree competences to which the content contributes:

4.1. Topics of reference.

   Degree competences to which the content contributes:

4.2. Weather.

   Degree competences to which the content contributes:
### 4.3. Electromagnetic signal propagation

**Degree competences to which the content contributes:**

### 5. GPS observables and data processing

**Degree competences to which the content contributes:**

#### 5.1. Observables

**Degree competences to which the content contributes:**

#### 5.2. Parameter estimation.

**Degree competences to which the content contributes:**

#### 5.3. Data reprocessing.

**Degree competences to which the content contributes:**

#### 5.4. Least squares.

**Degree competences to which the content contributes:**

#### 5.5. The Kalman filter.

**Degree competences to which the content contributes:**

#### 5.6. Fast GPS methods.

**Degree competences to which the content contributes:**

#### 5.7. GPS navigation

**Degree competences to which the content contributes:**
# 6. Errors and corrections

Degree competences to which the content contributes:

## 6.1. Basic considerations: precision versus exactitude.

Degree competences to which the content contributes:

## 6.2. Apparent geometry of constellations.

Degree competences to which the content contributes:

## 6.3. Orbits and clocks.

Degree competences to which the content contributes:

## 6.4. Signal propagation.

Degree competences to which the content contributes:

## 6.5. Reception systems.

Degree competences to which the content contributes:

## 6.6. System integrity

Degree competences to which the content contributes:

# 7. Applications

Degree competences to which the content contributes:

## 7.1. Ionosphere modelling.

Degree competences to which the content contributes:
7.2. **Troposphere modelling**

**Degree competences to which the content contributes:**

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**Qualification system**

- Laboratory assignments 50%
- Synthesis test 30%
- Subjective assessment 20%

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**Regulations for carrying out activities**

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**Bibliography**

**Basic:**


**Complementary:**


**Others resources:**