310629 - 3D Data Processing

Coordinating unit: 310 - EPSEB - Barcelona School of Building Construction
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering
Academic year: 2018
Degree: BACHELOR'S DEGREE IN GEOPHYSICAL AND GEOMATICS ENGINEERING (Syllabus 2016).
(Teaching unit Compulsory)
ECTS credits: 4,5
Teaching languages: Catalan

Teaching staff
Coordinator: Albert Prades Valls

Degree competences to which the subject contributes

Specific:
1. (ENG) Determinar, mesurar, avaluar i representar el terreny, objectes tridimensionals, punts i trajectòries.
10. (ENG) Determinar, mesurar, avaluar i representar el terreny, objectes tridimensionals, punts i trajectòries.
2. (ENG) Planificació, projecte, direcció, execució i gestió de processos de mesura, sistemes d'informació, explotació d'imatges, posicionament i navegació; modelització, representació i visualització de la informació territorial en, sota i sobre la superfície terrestre.
6. Basic knowledge about use and computer programmation, operative systems, databases and software programmes with application in the engineering.
3. Capacity for the resolution of mathematic problems that can be set out in engineering. Aptitude to apply the knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and in partial derivates, numeric methods, numeric algorithm, stadistics and optimization.
7. Capacity of spatial vision and knowlege of the graphic representation techniques, for traditional methods of metric and geometric geometry but also for applications of assisted design by a computer.
11. Knowledge and application of methods of minimum adjust quadratic in the scope of topo-geodesic observations, photogrametric and cartographic.
4. Knowledge, application and analysis of the processes of treatment of digital images and special information, proceding from airborne and satellite sensors.
8. Knowledge, use and application of instruments and appropriate photogrametric methods for the fulfilment of cartographic.
5. Knowledge, use and application of instruments and fotogrametric methods and topographic adequated to the realization of non-cartographic raisings.
9. Knowledge, use and application of the treatment techinques. Analysis of special data. Study of models applied to the engineering and architecture.

Generical:
16. Use of teams and instrumental: Capacity to select the necessary ressources to the achievement of the planned goals according to the quality requirements. Use of the teams, in adecuated conditions, with professional efficiency and taking into account the limitations of the instruments and its context of use, in relation with the required precisions.

Transversal:
14. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
12. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
15. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
13. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Teaching methodology

The guided learning hours consist in theoretical classes (big group) where the professor will do an exposition of the concepts that should be dominated about the contents that are treated. Afterwards, and by the practices, is attempt to motivate and involucrate the students to practice actively in their learning.

Learning objectives of the subject

It is pretended that the student achieve the enough knowledge to operate with tridimensional data and extract information of topography relevance.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 112h 30m</th>
<th>Hours large group: 18h 16.00%</th>
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</thead>
<tbody>
<tr>
<td>Hours medium group:</td>
<td>27h 24.00%</td>
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<tr>
<td>Self study:</td>
<td>67h 30m 60.00%</td>
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</table>
## Content

### Introduction

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>11h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Self study:</td>
<td>9h</td>
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</table>

**Description:**
- Representation of ground surfaces. Descriptors of the ground and strategies in the data collection: frequency spectre, curving, covariance, semivariogramme, gradient

### Data collection

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>15h</th>
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<tbody>
<tr>
<td>Theory classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Practical classes:</td>
<td>3h</td>
</tr>
<tr>
<td>Self study:</td>
<td>10h</td>
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</table>

**Description:**
- Strategy for the acquisition of the 3D data collection.
- Selective data collection: most important points.
- Data collection with a fixed dimension: edges and profiles
- Data collection with two fixed dimensions: regular network and progressive data collection.
- Compound data collection.

**Related activities:**
- Activity 1

### Surface models

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>55h</th>
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<tbody>
<tr>
<td>Theory classes:</td>
<td>10h</td>
</tr>
<tr>
<td>Practical classes:</td>
<td>15h</td>
</tr>
<tr>
<td>Self study:</td>
<td>30h</td>
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</tbody>
</table>

**Description:**
- Basic concepts for the surface modelization: Interpolation
- Approach for the ground surface modelization: triangle, grid, modelization of hybrid surfaces.
- The continuity of the surfaces
- Interpolation techniques: Simple linear interpolation, bilinear, spline
- Adjustment by minimum squares of a local surface

**Related activities:**
- Activity 2
- Activity 3
- Activity 5
### Quality control of the surface models

**Description:**
- Quality control: Concepts and strategies. Quality control in the acquisition of the photogrammetric data. Screen of the random errors of the original data.
- Detection of serious errors in the grid of the 3D data based on the remaining information.
- Detection of rude mistakes.
- Evaluation of the exactitude of a DTM: Measurements of precision of a DTM.
- Empiric models of the exactitude of a derived DTM.

**Learning time:** 19h 30m  
- Theory classes: 2h  
- Practical classes: 7h  
- Self study: 10h 30m

### Model representation of multiple scales

**Description:**
- Model representation: a general vision of multiple scales (scale, resolution, and simplification of the representations).
- Hierarchic representation of the models in discreet scales (pyramid shaped structure for the hierarchic representation, quadtree structure for the hierarchic representation).
- Multiscale metrics and model representation of continuous scales.

**Related activities:**
- Activity 4

**Learning time:** 12h  
- Theory classes: 2h  
- Practical classes: 2h  
- Self study: 8h
### Planning of activities

| **BIBLIOGRAPHIC RESEARCH** | **Hours:** 9h  
  Practical classes: 1h  
  Self study: 8h |
<table>
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<tr>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Bibliographic research referring to topics of tridimensional modelization.</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>The activity will be done between the first and the fifth week and is evaluated with a 25% of the final mark.</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>It will be done a brief exposition in class about the topic treated.</td>
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| **INTERPOLATION METHODS** | **Hours:** 4h  
  Practical classes: 2h  
  Laboratory classes: 2h |
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<tr>
<td><strong>Description:</strong></td>
<td>It must be interpreted a little program (in excel, Maple, or in C language) that allows to compare different methods of interpolation.</td>
</tr>
</tbody>
</table>
| **Support materials:**    | The activity will be done between the second and the fourth week and is evaluated with a 10% of the final mark.  
  The necessary material will be available in Atenea. |
| **Descriptions of the assignments due and their relation to the assessment:** | The report of the activity will be delivered during the fifth week. |

| **BASIC TREATMENT OF TRIDIMENSIONAL DATA** | **Hours:** 4h  
  Practical classes: 2h  
  Laboratory classes: 2h |
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>In this activity will be carried out a basic data treatment: elimination of wrong points, generation of the model, etc. above a cloud of points obtained with scaner laser.</td>
</tr>
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</table>
| **Support materials:**                      | The activity will be done between the fifth and the seventh week and is evaluated with a 10% of the final mark.  
  The necessary material will be available in Atenea. |
| **Descriptions of the assignments due and their relation to the assessment:** | The report of the activity will be delivered during the eighth week. |

| **MULTI SCALE TREATMENT OF A MODEL** | **Hours:** 4h  
  Practical classes: 2h  
  Laboratory classes: 2h |
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Are used two nets from the model of heights of the same territorial zone (for example, the model of ICC and the SAR model of the NASA). The activity consists in changing the scale of one of them in order to be comparable.</td>
</tr>
</tbody>
</table>
Support materials:
The activity will be done between the eighth and the tenth week and is evaluated with a 15% of the final mark. The necessary material will be available in Atenea.

Descriptions of the assignments due and their relation to the assessment:
The report of the activity will be delivered during the eleventh week.

SURFACE ADJUSTMENT

<table>
<thead>
<tr>
<th>Description:</th>
<th>Hours: 4h</th>
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<tbody>
<tr>
<td>Given a cloud of points it will have to be done a minimum adjustment quadratic of a surface.</td>
<td>Theory classes: 1h</td>
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<tr>
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<td>Practical classes: 3h</td>
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</tbody>
</table>

Support materials:
The activity will be done between the eleventh and the fifteenth week and is evaluated with a 20% of the final mark. The necessary material will be available in Atenea.

Descriptions of the assignments due and their relation to the assessment:
The report will be delivered at the end of the course.

WRITTEN SCORING EXAM

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<thead>
<tr>
<th>Description:</th>
<th>Hours: 2h</th>
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<tbody>
<tr>
<td>Written exam where the theoretical knowledge will be evaluated.</td>
<td>Practical classes: 2h</td>
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</tbody>
</table>

Support materials:
It will be done in the last week of the course and is evaluated with a 20% of the final mark.

Qualification system

The final qualification is the addition of the following qualifications:

Final mark = 0.25*mark activity 1 + 0.10*mark activity 2 + 0.10*mark activity 3 + 0.15*mark activity 4 + 0.20*mark activity 5 + 0.20*written exam

Bibliography

Basic: