310624 - Digital Photogrammetry

Coordinating unit: 310 - EPSEB - Barcelona School of Building Construction
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering
Academic year: 2019
Degree: BACHELOR'S DEGREE IN GEOINFORMATION AND GEMATICS ENGINEERING (Syllabus 2016).
ECTS credits: 7,5 Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: Buill Pozuelo, Felipe
Others: Muñoz Capilla, Francisco Javier

Degree competences to which the subject contributes

Basic:
CB1EGG. The students have demonstrated possess and comprehend knowledge in a field of study that comes from high school, and is used to a level that, while is supported in advanced textbooks, it also includes some aspects that involve knowledge from the field of study in the vanguard.
CB2EGG. The students must know how to apply their knowledge to the work or vocation in a professional way and possess the competences that are used to be demonstrated by the elaboration and defense of arguments and the resolution of problems inside their own field of study.

Specific:
CE10EGG. Knowledge, application and analysis of the processes of digital image treatment and spatial information, proceding from airbone and satellite sensors.
CE15EGG. Knowledge about: Security, health and labour risks inside the scope of this engineering and the sorroundings of its application and developement
CE16EGG. Knowledge and application of methods and geometric techniques inside the scope of the different engineerings
CE8EGG. Knowledge, using and application of instruments and appropiate topographic methods in order to carry out cartography.
CE9EGG. (ENG) Coneixement, utilització i aplicació de les tècniques de tractament. Anàlisi de dades espacials. Estudi de models aplicats a l'enginyeria i arquitectura. (Mòdul comun a la branca Topografia)

Generical:
CG1EGG. Design and develope geomatic and topographic projects.
CG5EGG. Determine, measure, evaluate and represent the ground, tridimensional objects, points and trajectories.
CG8EGG. Planification, project, direction, execution and management of measurements processes, information systems, image exploitaition, positioning and nagevation; modeling, representation and visualization of the territorial information in, under and above the ground surface.
CG10EGG. Planification, project, direction, execution and magement of processes and products of application in the environment, agronomy, forest and miner engineising inside the geomatic field
CG13EGG. Use of teams and instruments. Using of precision instruments, their characteristics, and also its use, transfer of data, treatment and interpretation of themselves.
CG12EGG. Planification, project, direction, execution and mangement of processes and products of application in the register, ordination of territory and valoration inside the geomatic field.
CG7EGG. Management and execution of investigation projects, developement and innovation inside the scope of this engineering.

Transversal:
310624 - Digital Photogrammetry

CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

Teaching methodology

The guided learning hours consist in, give theoreticl classes (big group) where the professor does a brief exposition to introduce the general goals of learning related with the basic concepts of the subject. Later and by practical exercises, the professor tries to motivate and involve the students to make them participate in its learning.

Support material in ATENEA is used: goals of learning by contents, concepts, examples, programation of evaluation activites, guided learning and bibliography. Also consists in giving classes, where is worked by the resolution of exercises or problems related with the specific learning goals of each one of the contents of the subject. In this problem sessions is pretended to add some generic competences.

After each session are proposed tasks to do outside of class, that must be worked individually.

Also it have to be considered other hours of autonomous learning, like the ones that are dedicated to oriented lectures and the resolution of the proposed problems about the different contents, by the virtual campus ATENEA.

Learning objectives of the subject

At the end of the subject the student must be capable of:

- Know, use and apply the techniques of treatment and analysis of special data
- Know, use and apply instruments and adequated photogrametric methods for the realization of cartography
- Know, use and apply intruments and adequated photogrametric methods for the realization of non cartographic surveying
- Know, use and apply the processes of difital image treatment and special information, from aerotransported sensors and satellites
- Knowledge and application of minimum quadratic adjustment in the environment of topo-geodesic observations, photogrametric and cartographic.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 187h 30m</th>
<th>Hours large group:</th>
<th>30h</th>
<th>16.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>45h</td>
<td>24.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>112h 30m</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
## Content

<table>
<thead>
<tr>
<th>Introduction to photogrametry</th>
<th>Learning time: 7h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study: 4h</td>
</tr>
</tbody>
</table>

**Description:**
In this chapter is introduced the concept of photogrametry, its different acceptions and analise its historic evolution. There is shown a description of the photogrametric methods where it will be seen the applications of photogrametry, the flux of work, the photographic coverage, the phases of the process of restitution, reconstruction of bundle and his position in the space. It will enter in the coordinate systems used in photogrametry and the changes of coordinates in the different systems. Also there will be seen the systematic errors that appear and how should be corrected.

**Related activities:**
- Activity 1
- Activity 2

<table>
<thead>
<tr>
<th>Digital instrumentation</th>
<th>Learning time: 5h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study: 3h</td>
</tr>
</tbody>
</table>

**Description:**
The instruments used in the productive digital processes are analized. The different types of restitutors and photogrametric digital stations, and the boxes or informatic modules are caracterized are looked over. The different digital photographic cameras, photogrametric and the digital video cameras are evaluated. Topics:
- Generalities
- Capture instruments
- Digital photogrametric systems
- Digital photogrametric stations

<table>
<thead>
<tr>
<th>Analytical and digital photogrametry</th>
<th>Learning time: 20h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 5h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Self study: 12h</td>
</tr>
</tbody>
</table>

**Description:**
Is presented in a general way the mathematic methods that ares used in photogrametry. In this content are introduced the equation of colineality, the spacial recession and the intersection of two or more images. It will be shown the relative orientation with the condition of coplanarity and with the condition of colineality. Finally it will be dedicated a topic for the external orientation and another for the autocalibration.

**Related activities:**
- Activities 3 and 4
### Aerotriangulation

**Description:**
The present content is dedicated to the aerial triangulation, where it will be seen the adjustment of bundles in block and the adjustment of independent models. Also will be done a study about source of errors and an analysis of residues after the adjustment.

**Related activities:**
Activity 5

**Learning time:** 26h 40m
- Theory classes: 6h
- Practical classes: 4h
- Self study: 16h 40m

### Non cartographic photogrametry

**Description:**
Are shown the instruments and techniques used in the non cartographic photogrametry where it will be seen:
1) Introduction
2) Instruments, cameras, restitutor
3) Calibration of non metric cameras
4) Photogrametric products

**Related activities:**
Activity 6

**Learning time:** 12h 30m
- Theory classes: 2h
- Practical classes: 4h
- Self study: 6h 30m

### Generation of Digital Models of the Ground

**Description:**
Revision of the different digital models (MDT, MDE, MDS...)
Sections:
- Digital models of the ground
- Type
- Applications

**Related activities:**
Activity 7

**Learning time:** 25h
- Theory classes: 3h
- Practical classes: 4h
- Self study: 18h
### LiDAR

<table>
<thead>
<tr>
<th>Learning time: 5h</th>
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<tbody>
<tr>
<td>Theory classes: 1h</td>
</tr>
<tr>
<td>Practical classes: 1h</td>
</tr>
<tr>
<td>Self study: 3h</td>
</tr>
</tbody>
</table>

**Description:**
Foundations of the Lidar technology. Basic process of data. Introduction to the capture and production of MDT by LiDAR data. Application of LiDAR technology and MDT in engineering and environment. Combination of LiDAR sensors with digital cameras about aerial platforms (planes, UAV, etc).

### Photographic rectification. Ortoprojection

<table>
<thead>
<tr>
<th>Learning time: 23h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>Practical classes: 4h</td>
</tr>
<tr>
<td>Self study: 15h</td>
</tr>
</tbody>
</table>

**Description:**
Analysis of the processes for the obtention of photographic rectification, the ortoimages, digital ortophotographies (true and conventional) and the mosaics.  
Sections:  
· Rectification  
· Ortoprojection  
· Digital orthography  
· Mosaic confection  
· Products

**Related activities:**
[ENG] Actividad 8

### Photogrammetry from satellite

<table>
<thead>
<tr>
<th>Learning time: 5h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 1h</td>
</tr>
<tr>
<td>Practical classes: 1h</td>
</tr>
<tr>
<td>Self study: 3h</td>
</tr>
</tbody>
</table>

**Description:**
Application of satellite images in photogrametric processes.  
Sections:  
· Introduction  
· Systematic errors  
· Rectification of satellite image
### Photogrammetric processes

**Learning time:** 5h  
- Theory classes: 2h  
- Self study: 3h

**Description:**  
Are shown the different algorithms that allow the processing and automation of photogrammetric processes.  
- Geometric processing of images  
- Correspondence of images  
- Automation of photogrammetric processes

### Photogrammetric project

**Learning time:** 6h  
- Theory classes: 1h  
- Practical classes: 1h  
- Self study: 4h

**Description:**  
Realization of a small photogrammetric project  
- Memory of technical specifications  
- Quality in photogrammetry  
- Quality control  
- PNOA

**Related activities:**  
Activity 9
# Planning of activities

| 1 PHOTOGRAPHIC COVERAGE | Hours: 3h  
Practical classes: 1h  
Self study: 2h |
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Project of photogrammetric coverage</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>Exercises to do in class. File with information in the virtual campus (ATENEA)</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>Memory of the practice</td>
</tr>
</tbody>
</table>

| 2 REFINEMENT OF PHOTOCOORDINATES | Hours: 4h  
Practical classes: 1h  
Self study: 3h |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Transformation of coordinates. Correction of systematic errors</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>Exercises to do in the calculus center or laboratory. File with information in the virtual campus (ATENEA)</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>Memory of the practice</td>
</tr>
</tbody>
</table>

| 3 ORIENTATION OF A PHOTOGRAMMETRIC BLOCK | Hours: 5h  
Practical classes: 2h  
Self study: 3h |
<table>
<thead>
<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Process of automatic orientation in a photogrammetric block.</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>Practice to do in the laboratory. File with information in the virtual campus (ATENEA)</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>Memory of the practice</td>
</tr>
</tbody>
</table>

| 4 SPACIAL RESSECTION AND RESTITUTION | Hours: 5h  
Practical classes: 2h  
Self study: 3h |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Orientation of a even photographic and restitution of the characteristic lines of the photogrammetric model</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>Practice to do in the laboratory. File with information in the virtual campus (ATENEA)</td>
</tr>
</tbody>
</table>
| 5 AEROTRIANGULATION | Hours: 7h  
Practical classes: 4h  
Self study: 3h |
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Aerotriangulation by adjustment of bundles of a photogrammetric block</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>Practice to do in the laboratory. File with information in the virtual campus (ATENEA)</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>Memory of the practice</td>
</tr>
</tbody>
</table>

| 6 SURVEYING BY NON CARTOGRAPHIC PHOTOGRAMETRY | Hours: 6h  
Practical classes: 3h  
Self study: 3h |
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<tr>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Surveying by terrestrial photogrammetry of a small patrimonial element in big scale</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>Practice to do in the laboratory. File with information in the virtual campus (ATENEA)</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>Memory of the practice</td>
</tr>
</tbody>
</table>

| 7 CREATION OF MDT. INTERPOLATION OF MDT | Hours: 7h  
Self study: 3h  
Practical classes: 4h |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Creation of an MDT. Edition and obtaining of derivated products</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>Practice to do in the laboratory. File with information in the virtual campus (ATENEA)</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>Memory of the practice</td>
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</table>

| 8 RECTIFICATION. OBTENTION OF ORTOIMAGES | Hours: 7h 20m  
Self study: 3h 20m  
Practical classes: 4h |
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<tbody>
<tr>
<td><strong>Description:</strong></td>
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<tr>
<td><strong>Support materials:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Descriptions of the assignments due and their relation to the assessment:**  
Memory of the practice
### 9 QUALITY CONTROL

<table>
<thead>
<tr>
<th>Support materials:</th>
<th>Hours: 2h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice to do in the laboratory. File with information in the virtual campus (ATENEA)</td>
<td>Practical classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study: 1h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description of the assignments due and their relation to the assessment:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory of the practice</td>
<td></td>
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</tbody>
</table>

### EVALUATION FINAL EXAM

<table>
<thead>
<tr>
<th>Support materials:</th>
<th>Hours: 1h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice to do in the laboratory. File with information in the virtual campus (ATENEA)</td>
<td>Theory classes: 1h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>For the students that haven't passed the evaluation exams. It will be resolved linked exercises to the explained contents and worked until the moment. This activity is evaluated and it corresponds with the 50% of the final mark.</td>
<td></td>
</tr>
</tbody>
</table>

### Qualification system

The final qualification is the addition of the following partial qualifications:
- Activity 1: Exams of long answer 10
- Activity 2: Oral presentations 10
- Activity 3: Projects and reports 10
- Activity 4: Exams and reports of experimental projects 0
- Activity 5: Continuous evaluation 10
- Activity 6: Exams test type 10
- Activity 7: Exams about the resolution of problems 10
- Activity 8: Valoration of delivered projects 10
- Activity 9: Individual practical exercises 20
- Activity 10: Exams of short answer 10

Final mark: $0.1 \times \text{activity 1} + 0.1 \times \text{activity 2} + 0.1 \times \text{activity 3} + 0.1 \times \text{activity 5} + 0.1 \times \text{activity 6} + 0.1 \times \text{activity 7} + 0.1 \times \text{activity 8} + 0.2 \times \text{activity 9} + 0.1 \times \text{activity 10}$

### Regulations for carrying out activities

It is mandatory carrying out the exercises and the laboratory practices.
Exams: resolution of exercises about the associated concepts to the goals of learning of the subject.
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Bibliography

Basic:


Complementary:


Photogrammetric engineering and remote sensing. Falls Church: American Society of Photogrammetry, GW : geomatics world. Lemmer: GITV bv,