

### 3D Visualisation

Code: 104391  
ECTS Credits: 6

| Degree   | Type | Year | Semester |
|--|------|------|----------|
| 2503740 Computational Mathematics and Data Analytics | OB   | 2    | 1        |

### Contact

Name: David Marín Pérez  
Email: david.marin@uab.cat

### Use of Languages

Principal working language: catalan (cat)  
Some groups entirely in English: No  
Some groups entirely in Catalan: Yes  
Some groups entirely in Spanish: No

### Teachers

Enric Martí Godia

### Prerequisites

Linear Algebra

### Objectives and Contextualisation

The main objective is to provide students with the theoretical framework necessary to graphically represent three-dimensional objects and recover their geometric properties from two-dimensional projections.

### Competences

- Calculate and reproduce certain mathematical routines and processes with ease.
- Demonstrate a high capacity for abstraction and translation of phenomena and behaviors to mathematical formulations.
- Formulate hypotheses and think up strategies to confirm or refute them.
- Make effective use of bibliographical resources and electronic resources to obtain information.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Work cooperatively in a multidisciplinary context assuming and respecting the role of the different members of the team.

### Learning Outcomes

1. "Explain ideas and mathematical concepts pertinent to the course; additionally, communicate personal reasonings to third parties."
2. Contrast, if possible, the use of calculation with the use of abstraction in solving a problem.

3. Develop autonomous strategies for solving problems such as identifying the ambit of problems within the course, discriminate routine from non-routine problems, design an a priori strategy to solve a problem, evaluate this strategy.
4. Evaluate the advantages and disadvantages of using calculation and abstraction.
5. Make effective use of bibliographical resources and electronic resources to obtain information.
6. Manage homographic transformations and consequent representation.
7. Manage quaternions in data-representation algorithms.
8. Read and understand a mathematical text at the current level of the course.
9. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
10. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
11. Understand the group of quaternions and their application to geometry and visualization.
12. Work cooperatively in a multidisciplinary context, taking on and respecting the role of the distinct members in the team.

## Content

1. Euclidean geometry. Rigid motions. Clifford's algebras, quaternions and rotations.
2. Affine geometry. Affine transformations, simple ratio, convex combinations of points. Bezier's curves.
3. Projective geometry. Projectivities, cross ratio.
4. Differential geometry of curves. Frenet's frame.

## Methodology

There will be three types of directed activities: theory classes where the concepts of the subject will be introduced, problem classes where the students will manipulate these concepts and seminary classes where specific software will be used to obtain accurate graphic representations of three-dimensional objects.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

## Activities

| Title              | Hours | ECTS | Learning Outcomes                     |
|--------------------|-------|------|---------------------------------------|
| Type: Directed     |       |      |                                       |
| Problems           | 13    | 0.52 | 4, 2, 11, 3, 1, 8, 7, 6, 10, 9, 12, 5 |
| Seminars           | 12    | 0.48 | 4, 2, 11, 3, 1, 8, 7, 6, 10, 9, 12, 5 |
| Theory             | 27    | 1.08 | 4, 2, 11, 3, 1, 8, 7, 6, 10, 9, 12, 5 |
| Type: Supervised   |       |      |                                       |
| Tutorship sessions | 10    | 0.4  | 4, 2, 11, 3, 1, 8, 7, 6, 10, 9, 12, 5 |
| Type: Autonomous   |       |      |                                       |
| Programming        | 27    | 1.08 | 4, 2, 11, 3, 1, 8, 7, 6, 10, 9, 12, 5 |
| Solving problems   | 27    | 1.08 | 4, 2, 11, 3, 1, 8, 7, 6, 10, 9, 12, 5 |

## Assessment

The evaluation will consist of an intrasemestral exam that will count 30% of the note, an examination at the end of the semester that will count 30% of the note, a program work about 3D reconstruction that will count 20% of the note and the remaining 20% will be obtained from the work made in the seminar classes. In case that the continuous assessment note thus obtained does not reach 5, the student who has completed 2/3 of the evaluation activities may take a recovery exam whose grade will substitute that of the two partial exams.

## Assessment Activities

| Title        | Weighting | Hours | ECTS | Learning Outcomes                     |
|--------------|-----------|-------|------|---------------------------------------|
| Final exam   | 30%       | 3     | 0.12 | 4, 2, 11, 3, 1, 8, 7, 6, 10, 9, 5     |
| Midterm exam | 30%       | 3     | 0.12 | 4, 2, 11, 3, 1, 8, 7, 6, 10, 9, 5     |
| Program work | 20%       | 1     | 0.04 | 4, 2, 11, 3, 1, 8, 7, 6, 10, 9, 12, 5 |
| Seminar work | 20%       | 2     | 0.08 | 4, 2, 11, 3, 1, 8, 7, 6, 10, 9, 12, 5 |

## Bibliography

A. Reventós, Afinitats, moviments i quàdriques, Manuals de la Universitat Autònoma de Barcelona, 2008.

A. Reventós, Geometria projectiva, Materials de la Universitat Autònoma de Barcelona, 2000.

M. do Carmo, Geometría diferencial de curvas y superficies. Alianza Editorial, 1990.

D. Shreiner, G. Sellers, J. Kessenich, B. Licea-Kane, OpenGL Programming Guide, 8th Eds, 2013, Addison-Wesley. Red book.

OpenGL Superbible - Comprehensive Tutorial and Reference, 7th eds, Addison-Wesley, 2016. Blue book.

Edward Angel, David Shreiner, Interactive Computer Graphics - A top-down approach using OpenGL, 6th ed, Pearson Education, 2012.

## Software

OpenGL or similar.