Universidad Zaragoza

Academic Year/course: 2023/24

69724 - Scientific visualization and representation techniques

Syllabus Information

Academic year: 2023/24
Subject: 69724 - Scientific visualization and representation techniques
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 633 - Master's Degree in Biomedical Engineering
ECTS: 3.0
Year: 1
Semester: Second semester
Subject type: Optional
Module:

1. General information

The subject is of an applied nature and focuses on understanding the scientific basis of computer imaging, especially its applications in the visualization of scientific data.

It aims to define the visualization of scientific data, present the basics of computer graphics, analyse the structure of data representations, describe visualization algorithms, and apply them to the world of biomedicine.

Once the subject has been passed, the student is expected to have an overview of the field of data visualization, to know the models and algorithms involved, the tools and methodology, and to know how to choose or design software solutions for a specific problem in the field of visualization.

These approaches and objectives are aligned with the Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), so that the acquisition of the learning results provides competence to contribute to the achievement of Objective 7.3 (energy efficiency), 8.2 (economic productivity), 9.5 (improve technological capacity) and 9.c (access to ICT).

2. Learning results

Upon completion of the subject, the student will be able to:

- Clearly understand the logical structure of the information visualization paradigm proposed by computer graphics.
- Know the most appropriate type of solutions when visualizing scalar, vector, and tensor data.
- Know the algorithms involved in these solutions, in order to be able to evaluate their cost and applicability in each case.
- Know how to propose appropriate solutions to problems of visualization of meshes with several different types of attributes at each node of the space.
- Acquire the experience of working in small groups, and starting from a framework exercise provided by the teacher, know how to modify it appropriately, and be able to solve scientific data visualization problems, mainly biomedical.

The current development of many activities related to the world of biomedicine inevitably requires the use of computer tools that allow the visualization of data obtained from the analysis of a phenomenon or a simulation in order to advance in the development of their projects.

The importance of the learning results of this subject lies in the complete description of both the spatial structures of the data that usually appear, as well as the usual algorithms that underlie most of the computer tools related to the world of scientific data visualization.

3. Syllabus

Theoretical Part:

- General presentation of the problem of scientific data visualization.
- Basic concepts of computer graphics.
- Graphics hardware and software.
- The scientific visualization *pipeline*.
- Basic data representations.
- Fundamental algorithms.
- Visualization of volumetric data.
- Specialized data representations and advanced algorithms.
- Special features of visualization in biomedicine.

Practical Part:

- 3D data processing.

- Interactive applications for data visualization.
    - Visualization of scalar data.
    - Vector data visualization.
    - Visualization of volumetric data.
- Introduction to the development of specific solutions: scripting languages.

4. Academic activities

Master class (20h)**:**

Presentation by the teacher of the main contents of the subject, exemplified by problems related to bioengineering.

Laboratory practices (10h)**:**

Guided practices to be carried out on a computer, with the teacher's support, in 2-hour sessions.

Completion of a tutored practical work (10h)**:**

Application work, proposed to each student or group of two students. There will be a defence of the paper (schedule permitting), which will be oral and public.

Assessment Tests (3h)**:**

Set of theoretical-practical written tests and presentation of reports or papers.

Work and personal study (32h)**:**

for the reinforcement of the theoretical concepts and the preparation and final resolution of the practices and works outside of class hours.

5. Assessment system

The student must demonstrate achievement of the intended learning results through the following assessment activities:

E1: Final exam (30%)

Written exam, common for all students of the subject. The test will consist of theoretical and practical questions.

E2: Laboratory practices (30%)

The evaluation of the practical sessions will be done through the work itself, the results and the reports presented on them.

E3: Tutored practical work (40%)

The evaluation of the tutored work proposed throughout the academic year will take into account the report presented, as well as the suitability and originality of the proposed solution and (if applicable) the public exhibition of the same.

In order to pass the subject, a minimum weighted grade of 5/10 and a grade higher than 4/10 in each of the three parts must be obtained. In case of not obtaining the minimum grade required in any of the three parts, the grade in the subject will be the lowest value between the weighted average of the three parts and 4.

Students who do not opt for the evaluation procedure described above, do not pass these tests during the teaching period, or would like to improve their grade, are entitled to a global test in each of the calls established throughout the academic year, on the dates and times determined by EINA.