Universidad Zaragoza

**Academic Year/course: 2024/25**

# 69153 - Modeling and Simulation of Appearance

## Syllabus Information

**Academic year:** 2024/25
**Subject:** 69153 - Modeling and Simulation of Appearance
**Faculty / School:** 110 - Escuela de Ingeniería y Arquitectura
**Degree:** 615 - Máster Universitario en Robótica, Gráficos y Visión por Computador / Robotics, Graphics and Computer Vision
**ECTS:** 6.0
**Year:** 1
**Semester:** First semester
**Subject type:** Compulsory
**Module:**

## 1. General information

The course targets computational techniques for simulating physically-based light transport, as well as modeling the appearance of the real world. The final goal is to be able to implement systems capable of generating photorealistic images. The course focuses on the physical and mathematical foundations of light transport and appearance, the definition of (virtual) appearance models, and the main computational techniques for generating synthetic imagery based on these physical models.

## 2. Learning results

The student must be able to:

- Understand the different types of physical processes of light transport.
- Understand the models that define the appearance and transport of light in media and surfaces.
- Understand, analyze and explain computational techniques to solve the models of appearance and light transport.
- Design and develop rendering systems based on Monte Carlo integration.
- Design and implement algorithms that solve material appearance models.
- Analyze the limitations and evaluate the benefits of different rendering algorithms.

## 3. Syllabus

The program is designed to cover the necessary background for understanding modern rendering, including physical and mathematical background. In addition, it will cover most recent trends on rendering, both in industry and academia. In particular, it is roughly articulated as:

1. The physics of light transport
2. Ray tracing
3. Appearance models
4. Monte Carlo methods
5. Direct and global illumination
6. Light transport in participating media
7. Bidirectional methods
8. Denoising, distributed effects and post-processing
9. Production rendering
10. Differentiable rendering and inverse problems

## 4. Academic activities

The course consists of 6 ECTS credits that correspond to an estimated student dedication of 150 hours distributed as follows:

- Theoretical classes: The theoretical concepts of the subject will be explained and illustrative practical examples will be developed to support the theory when necessary. (30h)
- Practical classes: Problems and practical cases will be carried out as a complement to the theoretical concepts studied. (15h)
- Laboratory practices: There will be a series of guided work tutored by the teacher. (12h)
- Study and assimilation of the theory exposed in the master classes. (60h)
- Practical application or research work (27h).
- Assessment tests (6h).

## 5. Assessment system

- **Supervised work and final project (70%):** A set of guided practices will be carried out throughout the course, with a total value of 20% of the grade, as well as a final project related to the theme of the subject, which will be 50 % of the final grade.
- **Presentations (20%):** There will be a series of presentations, followed by turns of questions, throughout the course, focused on various related topics. Participation in the discussion of the round of questions will be positively valued.
- **Exam (10%):** There will be an exam at the end of the course, in order to assess the theoretical knowledge acquired throughout the course.

To pass the course, there is a requirement of a 4/10 minimum in each part of the course, and a weighted average grade greater or equal than 5/10. In the event that one of the parts does not pass the 4/10 mark, the grade will be the maximum between 4/10 and the weighted average.

In case of global evaluation, the students will have to deliver at the end of the course the directed works and the final project (70%) and they will be subject to an exam for the remaining 30%.

## 6. Sustainable Development Goals

8 - Decent Work and Economic Growth
9 - Industry, Innovation and Infrastructure