

## Advanced computer graphics

### General Information

#### Number of ECTS Credits

3

#### Module code

TSM\_AdvCompG

#### Valid for academic year

2020-2021

#### Last modification

2019-12-11

#### Responsible of module

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#### Explanations regarding the language definitions for each location:

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

	Berne	Lausanne	Lugano	Zurich
<b>Instruction</b>			X E 100%	
<b>Documentation</b>			X E 100%	
<b>Examination</b>			X E 100%	

#### Module Category

TSM Technical scientific module

#### Lessons

2 lecture periods and 1 tutorial period per week

### Entry level competences

#### Prerequisites, previous knowledge

Linear algebra (vectors, matrices, homogeneous coordinates), C/C++ programming, 3D computer graphics (basic real-time rasterization)

### Brief course description of module objectives and content

The goal of this course is to provide theoretical and practical insights on selected topics related to the algorithms and solutions adopted by modern real-time 3D Computer Graphics (CG) systems.

This class relies on in-depth, hands-on experiences with the implementation of recent GPU programming techniques for increasing the realism and performance of 3D rendering software to deal with complex synthetic images featuring a more accurate lighting model, shadows, multiple post-processing filters, correct transparency, etc.

## Aims, content, methods

### Learning objectives and acquired competencies

Through this course, the student acquires a better understanding of the ecosystem, the technology and mathematics behind current generation's real-time rendering software, and gets solid foundations to further move in this field on his/her own.

The course contents are not only approached from a theoretical or introductory point of view, but always discussed in-depth and supported by their direct, effective implementation (via tutorials and assignments) on dedicated hardware.

Thanks to the direct experience gained in dealing with the complexity of modern GPU programming and selected state-of-the-art techniques used by the leading industry, students can integrate similar solutions in their projects.

### Contents of module with emphasis on teaching content

The module covers the following topics:

- GPU programming via a modern API and with particular focus on performance implications.
- Realistic lighting through Physically-Based Rendering (PBR), global illumination, real-time ray tracing and shadow mapping.
- Deferred rendering: advantages and limitations.
- The problem of correct Order-Independent Transparency (OIT) and its solutions.
- Post-processing effects to enhance image quality: anti-aliasing, High-Dynamic Range (HDR), tone mapping and ambient occlusion.

### Teaching and learning methods

Lectures, tutorials, demos and practical work on computer and dedicated hardware. Students will be asked to implement selected techniques on their own as assignment.

### Literature

Graham Sellers, Richard S. Wright, and Nicholas Haemel. 2015. OpenGL Superbible: Comprehensive Tutorial and Reference (7th ed.). Addison-Wesley Professional.

## Assessment

### Certification requirements

Module does not use certification requirements

### Basic principle for exams

**As a rule, all the standard final exams for modules and also all repetition exams are to be in written form**

### Standard final exam for a module and written repetition exam

Kind of exam

written

Duration of exam

120 minutes

Permissible aids

*Aids permitted as specified below:*

Permissible electronic aids

A simple calculator (without any communication feature).

Other permissible aids

Slides and lecture notes.

### Special case: Repetition exam as oral exam

Kind of exam

oral

Duration of exam

30 minutes

Permissible aids

*Aids permitted as specified below:*

Permissible electronic aids

No electronic aids permitted

**Other permissible aids**

The student can bring and consult a brief summary during the examination (on maximum one A4 sheet, front and back).