

Module Description, available in: EN

Advanced computer graphics

General Information

Number of ECTS Credits

3

Module code

TSM_AdvCompG

Valid for academic year

2023-24

Last modification

2019-12-11

Coordinator of the 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.

	Lausanne			Lugano	Zurich		
Instruction				X E 100%			
Documentation				X E 100%			
Examination				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 competencies to be acquired

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.

Module content with weighting of different components

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 standard final exams are conducted in written form. For resit exams, lecturers will communicate the exam format (written/oral) together with the exam schedule.

Standard final exam for a module and written resit exam

Kind of exam

Written exam

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: Resit exam as oral exam

Kind of exam

Oral exam

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).