GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2019-2020

Computer Graphics (E016712)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

Course size (nominal values; actual values may depend on programme)

Credits 6.0 Study time 180 h Contact hrs 30.0 h

Course offerings and teaching methods in academic year 2020-2021

A (semester 2)	English	Gent	group work	15.0 h
			lecture	15.0 h
B (semester 2)			lecture	10.0 h
			group work	5.0 h

Lecturers in academic year 2020-2021

Pizurica, Aleksandra	TW07	lecturer-in-charge
Babin, Danilo	TW07	co-lecturer

Offered in the following programmes in 2020-2021	crdts	offering
Master of Science in Electronics and ICT Engineering Technology (main subject Electronics Engineering)	3	B
Master of Science in Electronics and ICT Engineering Technology (main subject ICT)	3	B
Master of Science in Computer Science Engineering	6	B
Master of Science in Computer Science Engineering	6	A
Exchange Programme in Computer Science (master's level)	6	A
Exchange Programme Electronics and ICT Engineering Technology	6	A

Teaching languages

English

Keywords

Computer graphics, image synthesis, image transformation, pixel, contour, three-dimensional visualization

Position of the course

The creation and manipulation of images on a computer have been around for a long time, but the number of applications using computer images continues to increase. Image processing is mainly concerned with the processing, analysis and classification of natural images, stored on computers. Computer Graphics, on the other hand, emphasizes on synthetic images, their storage formats, and the transformations from one form to another. Texture synthesis is of enormous importance in many applications (films, computer games, virtual reality...). Equally important are transformations that change the position and the shape of objects in two-dimensional and three-dimensional images. Projective transformations are needed to represent three-dimensional spaces in two dimensions (e.g., on classical screens). Finally, algorithms to determine the visible and invisible parts of three-dimensional objects are important for a realistic rendering of these objects.

Contents

Applicable for the course of 6 ECTS (course offering A):

- Digital representation of images: Raster images, Vector images
- Elementary graphics algorithms: Rasterization
- Two-dimensional image transformations: Elementary geometric transformations, Sutherland's method
- Three-dimensional image transformations: Elementary geometric transformations, Extension of Sutherland's method, Quaternions and rotation
- Viewing in 3D: Projections, Virtual camera, Visibility of spatial polyhedra

- Illumination and Shading: Phong model, Gouraud shading and Phong shading, Elements of advanced rendering (Ray tracing, Radiosity)
- Curves and Surfaces: Bezier curves, Splines, NURBS
- Texture synthesis: Statistical methods, Tiling methods
- Elements of OpenGL

Applicable for the course of 3 ECTS (course offering B):

- Digital representation of images: Raster images, Vector images
- Two-dimensional and three-dimensional image transformations: Elementary geometric transformations, Quaternions and rotation
- Viewing in 3D: Projections, Virtual camera, Visibility of spatial polyhedra
- Illumination and Shading: Phong model, Gouraud shading and Phong shading, Elements of advanced rendering (Ray tracing, Radiosity)
- Curves and Surfaces: Bezier curves, Splines, NURBS
- Texture synthesis: Statistical methods, Tiling methods
- Elements of OpenGL

Initial competences

Elementary knowledge of two-dimensional and three-dimensional geometry and of two-dimensional trigonometry; practical knowledge of a programming language for the execution of the projects.

Final competences

1. To be able to distinguish the various formats for image storage and to know their specific properties.
2. To understand, and to know how to apply elementary transformations in two and three dimensions, for translation, rotation and distortion of objects.
3. To understand and to know how to apply the concept of viewing in 3D: synthetic camera model, parallel and perspective projections, visibility in a display window.
4. To be able to apply illumination and shading to the generated objects and scenes and to generate synthetic textures.
5. To understand and know how to apply the basic principles of deforming curves and surfaces in 3D.
6. To apply basics of OpenGL for generating and animating virtual graphical objects.
7. Applicable only for the course of 6 ECTS (course offering A): To have acquired the knowledge of a number of simple applications of computer graphics, among others the principle of half-toning, and the design of simple computational geometry algorithms.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Group work, lecture

Learning materials and price

The course material, an extensive PowerPoint presentation and slide notes is made available, free of charge, on the electronic learning platform, as the course progresses throughout the semester.

References

- Edward Angel and Dave Shreiner, Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL, Addison-Wesley, 2012.
- J. F. Hughes, A. van Dam, M. McGuire, D. F. Sklar, J. D. Foley, S. K. Feiner and K. Akeley, Computer graphics: principles and practice (3rd ed.), Addison-Wesley Professional, 2013.
- SIGGRAPH 2017 Tutorial - Edward Angel and Eric Haines: An Interactive Introduction to WebGL and Three.js.

Course content-related study coaching

Interactive support and coaching through the electronic learning platform (a course forum, and a project forum; students may open up new threads themselves); appointments, upon request by e-mail, for personal issues.

Evaluation methods

end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Written examination, open book examination

Examination methods in case of periodic evaluation during the second examination period

Written examination, open book examination

Examination methods in case of permanent evaluation

Participation, report

Possibilities of retake in case of permanent evaluation

examination during the second examination period is not possible

Extra information on the examination methods

During examination period: written closed-book exam; written open-book exam.
During semester: graded project reports and participation. A project involving a research component (evaluated based on the code demonstration and written report). Applicable only for the course of 6 ECTS (course offering A): one or two programming assignements in OpenGL (posted on the electronic learning platform and presented in the class).

Calculation of the examination mark

Weighing:
- 1/3 of the end score is determined by the evaluation of the projects;
- 1/3 of the end score is determined by the evaluation of the answers to questions about the course material;
- 1/3 of the end score is determined by the evaluation of the answers to questions about the application of the course material.
Not participating in any of the evaluation parts or obtaining less than 9/20 for any of these parts implies a non-passing final grade. In this case, even if the calculated score is 10/20 or higher, it is brought to the highest non-passing grade (9/20).