AALBORG UNIVERSITY

General module information
Title: Rendered Lighting Simulation/CGI
Type: Course module
Language of instruction: English
Location of the lecture: Campus Copenhagen

ECTS points: 5 ECTS

Period: 1 September 2022 — 31 January 2023

Placement
1st semester, M.Sc. in Lighting Design

Module coordinator
Georgios Triantafyllidis (coordinator), Lisbeth Nykjær and Christine Pedersen (secretary)

Academic content and relationships to other modules/semesters
The formal study plan description of the module can be found here:

https://moduler.aau.dk/course/2022-2023/MSNLIDM1204?lang=da-DK

The course rational is that students need to have an understanding of how rendered lighting simulations are essential as reproduction of illuminations of a context and how the rendering can be used as design tool and to communicate and develop different aspects of lighting designs. In this context, the course aims to combine references, lectures, literature, techniques, exercises and experiences of how rendered lighting simulations can be implemented and used. The course will follow the following steps:

1. **CGI theory: All the basic information and knowledge that is needed for lighting simulation**
   - Basic Image processing theory

Pixels, Image representation, Color models, Point processing and neighborhood processing, Filtering, Frequency analysis of an image

- Basic Lighting

Qualities of light, point light, spotlight, directional light, sky dome, area light, physically based light, ambient light, decay, diffuse and specular reflection

- Shadows

The visual functions of shadows, secondary shadows, shadow color, shadow size and perspective, hard and soft shadows, shadow algorithms (depth map, raytraced shadows)

- Cameras

Exposure, f-stops, aperture, depth of field, shutter speed, film speed, focus, bokeh effect, histograms, hdri, lens imperfections, gamma correction

- Lighting Environments

Daylight, sunlight, skylight, image based lighting, indoor natural light, global illumination, color bleeding, practical lights, night scenes, distance and depth

- Shaders and Rendering Algorithms

Shaders, diffuse, glossy, specular reflection, view-dependent shading, Fresnel effect, anisotropic highlights, BRDF and BSSRDF, anti-aliasing and sampling, raytracing, Reyes Algorithms, global illumination, caustics

2. **DIALux and Velux Daylight Visualizer**

There will be a workshop for DIALux and Velux Daylight Visualizer, which are used to design, calculate and visualize light professionally – single rooms, whole floors, buildings and outdoor scenes

3. Rendering workshop
There will be a workshop using a rendering software (Blender) and visualization software (Twinmotion) to help students get and improve their skills in rendering

Different visualizations types (architectural and product) will be discussed along with their aim (presentation or storytelling). At that point the students will be given a specific scene which will be the one that they will work with and apply the different modules of CGI that they will learn during this course. We will also present very briefly the modelling basics (points and tips, various approaches and programs)

Then a quick explanation of difference in interior/exterior illustrations will be discussed and afterwards the focus will be on the lighting: different types, settings and effects used in visualizations will be covered. Lighting strategies will be also discussed: i) How do we light our scene? ii) Real world lighting vs best practice

More topics discussed will be linear workflow, mapping techniques, High Dynamic Range imaging and cameras. A brief intro into cameras in the real world vs cameras in software will be presented. Exposure settings/ shutter speeds, Tips for placement/ angles. Brief composition/rule of thirds (How is the storytelling supported by lighting/camera choice)

Another important topic is the materials used. Basic intro the types of materials types in scene. Reflections/ glossiness. Best practice and considerations when creating materials. Then we will do a brief intro in to rendering engines. Different types and their pros and cons.

Finally, a brief intro into post editing our render output will be given. Adding levels/ changing saturation / introducing extra elements in scene i.e. lighting effects/ lens flares. More advanced issues will be also presented: Use of lighting simulations in virtual worlds with Oculus Rift (a virtual reality head-mounted display)

4. AlFA / ClimateStudio workshop
ALFA (Adaptive Lighting for Alertness) and ClimateStudio are two new software that lets architects, lighting designers, and health professionals predict and control the non-visual effects and assess the daylight impact, in order to create environments that are safer, healthier, and more productive.

Because of a multi-level class (students with different backgrounds and skills), there is an early communication to the students with an email before the start of the semester (in August), explaining the goal of this course and suggesting a preparation in order to have the basis needed for this course

Objectives and learning goals
The main objectives and learning goals are that the students are able to analyze, synthesize, and evaluate illumination designs through physics-based, realistic simulation using rendering packages, and to use such simulations as a design tool.

Extent and expected workload
During the course there will be 3 workshops (Rendering & visualization, DIALux/Velux Daylight Visualizer and ALFA/ClimateStudio) and 1 theoretical module (CGI theory).
A mini-portfolio must be handed in at the end of the course with all the works from the three workshops and from the theoretical module.

Lectures: about 2 ECTS
Mini-Portfolio preparation: about 2.5 ECTS (0.5 ECTS per assignment – five assignments)
Examination preparation: about 0.5 ECTS

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Pre-requisites for participation
None

Examination

Modality and duration: Individual oral exam based on submitted mini portfolio. The duration will be 15 minutes followed by 5 minutes deliberation

Assessment: In accordance with the 7-point grading scale

Pre-approved aids: Mini portfolio

Prerequisites for participation: Timely hand-in of mini portfolio

In the beginning of the exam the student will do an approximately 5-7 minutes presentation of the developed project, after which the examiner will ask follow-up questions within the topic of the project and curriculum topics related to it. The grade will be based on a joint evaluation of the quality of the mini portfolio and the oral examination.

Information concerning the mini-portfolio: The mini-portfolio cannot be group-based (should be individual for each student), but the students may help each other and share ideas. The students need to submit the material of their work in the assignments that consist of the mini-portfolio and a final presentation presenting these works in the Moodle page.