Advanced Games Graphics Techniques

Module Information

2022.01, Approved

Summary Information

Module Code	6208COMP
Formal Module Title	Advanced Games Graphics Techniques
Owning School	Computer Science and Mathematics
Career	Undergraduate
Credits	20
Academic level	FHEQ Level 6
Grading Schema	40

Teaching Responsibility

LJMU Schools involved in Delivery
Computer Science and Mathematics

Learning Methods

Learning Method Type	Hours
Lecture	22
Workshop	22

Module Offering(s)

Display Name	Location	Start Month	Duration Number Duration Unit
JAN-CTY	CTY	January	12 Weeks

Aims and Outcomes

Aims	To describe the architecture of graphics hardware and processing unit.To explain the interaction between a graphics API, its shader and compute language and the GPU architecture.To explain the principles of advanced computer graphics processes across the various stages of the programmable rendering pipeline.To compare and contrast algorithms used to model key aspects of photo realism in real-time.To outline the mathematical models used to represent visual phenomena such as light, colour, shadow, reflection in real-time.To illustrate how post processing techniques can be used to simulate cinematographic effects in real-time.To develop skills in advanced computer graphics operations using a modern graphical API and its shader/compute system.

After completing the module the student should be able to:

Learning Outcomes

Code	Number	Description
MLO1	1	Critically evaluate the state-of-art graphics processes employed in modern games development.
MLO2	2	Critically analyse GPU architecture and how it affects program design.
MLO3	3	Construct complex geometrical shapes procedurally using relevant algorithms.
MLO4	4	Apply advanced computer graphics algorithms and processes to speed up rendering process.
MLO5	5	Apply advanced shader techniques to produce high quality rendering of complex scenery.

Module Content

Outline Syllabus	GPU architecture and shader-Processor Architectures.-GPU vs. CPU.-How shader code is executed by a GPU.Evolution and History of Shader Models-Vertex and Pixel Shaders.-Geometry Shader.-Hull and Domain Shaders.-Compute Shaders for Graphics.Geometry-Geometric operations such as intersection calculation and proximity tests.-Volumes, voxels, and point-based representations.Parametric polynomial curves and surfaces.-Approximation techniques such as polynomial curves, Bezier curves, spline curves and surfaces, and non-uniform rational basis (NURB) spines, and level set method.-Dynamic level of detail.Procedural Content Generation:-Pseudo Random Number Generation.-Perlin noise.-Terrain Generation.-Fractals / Function driven procedurals.-Data Driven vs Pure Procedural.-Water, Particles.-Fluid Rendering in Real-Time.-Blocks and Voxels.Culling techniques-Surface culling (front face, back face).-Occlusion culling.Rendering techniques-Multiple light sources.-Forward Rendering vs. Light Pre Pass vs Deferred Rendering.-Physically Based Rendering – BSDF, BRDF.-Pre-Computed Radiance Transfer (PRT).-Advanced Texture Mapping: Bump mapping/Normal Mapping/Parallax Occlusion Mapping.-Volumetric Lighting.-Global Illumination in Real-Time: Reflection/Refraction/Shadow mapping/Light Mapping (Baked Lighting).Image-based effects and post processing-Spatial / Temporal Blur.-Depth of field / Bokeh.-Bloom-Ambient Occlusion-Non-photorealistic effectsOutput Merger Optimisations-Sample Based-Morphological Anti-Aliasing
Module Overview	This module builds on your knowledge of the principles of 3D graphics and furthers your understanding of advanced computer graphics processes. The module uses a modern GPU-driven graphics API to demonstrate how complex 3D scenes can be constructed from complex geometry and rendered in real-time with special effects. You will focus on state of the art approaches to real-time rendering and how graphics programmers are targeting the goal of photorealistic rendering in real-time.
Additional Information	This module builds on the students' knowledge of the principles of 3D graphics and furthers their understanding of advanced computer graphics processes. The module uses a modern GPU-driven graphics API to demonstrate how complex 3D scenes can be constructed from complex geometry and rendered in real-time with special effects. Focuses on the state of the art approaches to real-time rendering and how graphics programmers are targeting the goal of photorealistic rendering in real-time.

Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Module Learning Outcome Mapping
Technology	Real-Time Rendering	60	0	MLO3, MLO4, MLO5
Centralised Exam	Examination	40	1.5	MLO1, MLO2

Module Contacts

Module Leader

Contact Name	Applies to all offerings	Offerings
Sud Sudirman	Yes	N/A

Partner Module Team

Contact Name	Applies to all offerings	Offerings