

WM9M3-15 Advanced Computer Graphics

23/24

Department

WMG

Level

Taught Postgraduate Level

Module leader

Kurt Debattista

Credit value

15

Module duration

4 weeks

Assessment

100% coursework

Study location

University of Warwick main campus, Coventry

Description

Introductory description

This module is being created for the MSc in Games Engineering. It will cover advanced computer graphics concepts and keep students up to date with state of the art methods.

Computer graphics is one the main foundations of computer games development. While the first module, Computer Graphics, formed a foundation to enable students to develop high performance renderers for interactive environments as required by video games, this module provides students with a strong fundamental and critical comprehension of the field. It presents the theory and advanced concepts of computer graphics, outlining the mathematical and algorithmic details of the highest quality physically-based methods that are only now beginning to be adopted by industry. This will future proof our graduates to ensure that they can advance games engineering when they are in industry. It will ensure students can comprehend and can evaluate state of the art developments in imaging, architecture and mathematics as they are used in games.

Module aims

The principal aim of this module is for students to be able to develop advanced theoretical concepts in terms of mathematics and algorithms in computer graphics that will serve them in

good stead for future developments in the area. Furthermore, they should be able to read relevant, recently published, research in the field and be able to form a good understanding of it and critically evaluate its potential use for games.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Advanced mathematics for computer graphics (Monte Carlo)

Signal processing

Physically-based rendering

Physically-based shading

Participating media

- Atmospheric
- subsurface scattering

Advanced graphics architectures

Advanced real-time effects

Screen space effects (reflections, filtering etc)

Real-time ray tracing

Perception and the human visual system

Post-processing (perhaps move to games engineering)

- TAA, TMOs

Learning outcomes

By the end of the module, students should be able to:

- Have a comprehensive knowledge of physically-based rendering and shading
- Reduce complex formulations of physically-based solutions for high performance in interactive environments
- Review and critically evaluate state-of-the-art computer graphics research

Indicative reading list

Pharr, M., Jakob, W., & Humphreys, G. (2016). Physically based rendering: From theory to implementation. Morgan Kaufmann. (4th edition coming out in Feb 2023)

Dutre, P., Bala, K., & Bekaert, P. (2018). Advanced global illumination. AK Peters/CRC Press.

Banterle, F., Artusi, A., Debattista, K., & Chalmers, A. (2017). Advanced high dynamic range imaging. AK Peters/CRC Press.

[View reading list on Talis Aspire](#)

Research element

Quite a few of the methods being presented will be state of the art methods available only from recent publications and journals and conferences. Students will be expected to be able to read and evaluate such research papers.

Interdisciplinary

The mathematical and algorithmic skills developed here can be applied to many other fields in computing, physics, maths and engineering. For example, the mathematical methods and architecture used in graphics are very similar to those used in machine learning.

Subject specific skills

Mathematical skills and programming skills.

Transferable skills

Technology literacy, adaptability

Study

Study time

Type	Required
Lectures	10 sessions of 1 hour 30 minutes (10%)
Seminars	1 session of 1 hour 30 minutes (1%)
Tutorials	9 sessions of 1 hour 30 minutes (9%)
Online learning (scheduled sessions)	7 sessions of 1 hour 30 minutes (7%)
Other activity	29 hours 30 minutes (19%)
Assessment	80 hours (53%)
Total	150 hours

Private study description

No private study requirements defined for this module.

Other activity description

29 hours of student self directed study in preparation for in class work. Guidance on self directed study will be provided in class.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time
PMA Project	100%	80 hours
A programming project to implement an advanced rendering method - for example a path tracer with real-time components and physically-based shaders.		

Feedback on assessment

Written feedback will be provided for the assessment.

Availability

Pre-requisites

To take this module, you must have passed:

- All of
 - [WM9M2-15 Computer Graphics](#)

There is currently no information about the courses for which this module is core or optional.