Rendering & Shading

DPA 8090 FALL 2018

http://cs.clemson.edu/~ekp/courses/dpa8090

COURSE DESCRIPTION

The art and science of lighting and shading for effective computer-graphic imagery; these include the mathematical, physical, and perceptual elements that contribute to synthesis of a desired look. Shading languages, advanced rendering tools, global-illumination effects, and production of both photorealistic and stylized imagery. Prerequisite course: DPA 8070.

CONTACT

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14:00 - 16:00 W,
15:30 - 16:30 T Th,
or by appointment.

Class: 14:00-15:15 T Th
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TEXTS

Real-Time Rendering, 4th edition, by Akenine-Möller et al.

Advanced Global Illumination, 2nd edition by Dutre et al.

Course website contains resources as well as suggested reference texts and links to online material and research papers.

GRADING

Assignments	80%
Tests	20%

ASSIGNMENTS

Assignments consist of applied projects including development, primarily in shader languages, as well as surfacing, lighting, and rendering for production using industry tools. Each includes both technical and aesthetic objectives.

LEARNING OUTCOMES

1. Explain how light transport is modeled by various synthetic rendering algorithms.
2. Explain light and material interaction as it relates to surfacing and rendering assets.
3. Differentiate approaches to rendering for varying applications.
4. Develop models that approximate the appearance of real-world surface materials.
5. Synthesize images that reflect accurate visual interpretation of concept and reference images.
6. Critique the techniques used in and visual effectiveness of synthesized images.

TOPICS

Fundamental skills for understanding and working in production shading and rendering; history and approaches to rendering; models of light transport; global-illumination algorithms; shading languages; patterns, noise, and material properties; interactive rendering; production rendering using path tracing; surfacing in applications such as Mari, Substance Painter, Maya, and Unreal Engine; basic lighting techniques; basic volume rendering; basic non-photorealistic rendering.

TENTATIVE ASSIGNMENTS

- Develop GLSL fragment shaders to produce various visual properties and match a given concept.
- Complete surfacing, lighting, and rendering of interactive assets with Unreal Engine 4.
- Develop material shader code for physically based rendering.
- Complete surfacing, lighting, and rendering of assets using a global-illumination production renderer such as Pixar's *RenderMan* or Solid Angle's *Arnold*.
- Plan, art-direct, and produce a cohesive rendering and shading project of choice.

POLICIES

Unless special circumstances are involved, more than three absences may result in class failure. Students are individually responsible for keeping current with course material and assignments.

Class announcements supersede posted material.
Academic honesty in all work is required for a passing grade.
This syllabus and course materials may be subject to change with reasonable notice.

BOILERPLATE

As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity.

It is university policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities. Students requesting accommodations should make an appointment with Disability Services (656-6848) to discuss specific needs within the first month of classes. Students should present a Faculty Accommodation Letter from Student Disability Services when they meet with instructors. Accommodations are not retroactive and new Faculty Accommodation Letters must be presented each semester.

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Tentative Schedule

AUGUST	**23**		
	Mathematical and conceptual basics.		
	28	***30***	A01: Fundamentals Review
	History and general approaches to rendering.		
SEPTEMBER	**04**	***06***	A02: Basic Shading in GLSL
	Shading languages and basic reflectance models.		
	11	***13***	A03: Patterns and Noise in GLSL
	Techniques for generating patterns and noise.		
	18	**20**	
	Material property maps and layers.		
	25	***27***	A04: Simulating the Real in GLSL
	Deferred rendering and advanced shader methods.		
OCTOBER	**02**	**04**	
	Interactive rendering asset workflow and tools.		
	09	***11***	A05: Scene in Unreal Engine
	Physically based rendering in interactive applications.		
	16	**18**	
	Physics of light transport.		
	23	***25***	A06a: Ptex Portrait or A06b: The Real Re-visited
	Reflectance and scattering models.		
NOVEMBER	**30**	**01**	
	Global illumination rendering in production.		
	FALL BREAK	**08**	A07: Authoring a BxDF
	Survey of lighting for production.		
	13	**15**	
	Introduction to volume rendering.		
	20	***THANKSGIVING***	
	Introduction to non-photorealistic rendering.		
	27	**29**	A08: Still Life in RenderMan
DECEMBER	**04**	**06**	
	Production Renderers.		
	Final Exam 8-10:30	***13***	A09: Directed Project

Tentative Assignments

A01: Fundamentals Review

Terminology, mathematics review, and preparation for rendering and shading calculations.

A02: Basic Shading in GLSL

Implement "ambient," diffuse, and specular components of material shading using a traditional Blinn-Phong model in GLSL or other more recent shading model.

A03: Patterns and Noise in GLSL

Implement specific concept images using various mapping functions and patterns in GLSL such as checkerboards, waves, Perlin noise, or fractal Brownian motion.

A04: Simulating the Real in GLSL

Model and complete texture layout of a real-life sample of a complex material phenomenon in Maya then surface procedurally using GLSL to match original.

A05: Scene in Unreal Engine

Create a cohesive scene for interactive rendering using given assets. Complete texture layout as needed. Create materials with Substance Painter and Designer as well as the Unreal Engine Material Editor. Light and render using Unreal Engine.

A06a: Ptex Portrait

Using a Ptex workflow in Mari and RenderMan RIS, surface and render a scanned face or character model from Scan the World using classic portrait-lighting styles.

A06b: The Real Re-visited

Re-visit the surfacing, lighting, and rendering of your earlier object but with the added capabilities of a global-illumination-based production renderer.

A07: Authoring a BxDF

Write a custom material shader for a path tracer to be used in rendering an asset of choice.

A08: Still Life in RenderMan

Surface, light, and render a scene using the KitBash Medieval Scene for Pixar's RenderMan Challenge with RenderMan RIS using your own surfacing and lighting under multiple conditions.

A09: Directed Project

Choose from a variety of options such as an advanced scene, the face of a human character, an advanced GLSL shader implementation, a more advanced RenderMan BxDF function, or volume rendering using PVR.