CSE 5545 (Approved): Advanced Computer Graphics

Course Description

Advanced topics in computer graphics; image synthesis, lighting and rendering, sampling and material properties, volume rendering.

Prior Course Number: CSE 782
Transcript Abbreviation: Adv Comp Grap Vis
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad, Graduate
Student Ranks: Senior, Masters, Doctoral
Course Offerings: Autumn
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: CSE 5541 or CSE 581
Exclusions: Not open to students with credit for CSE 782
Cross-Listings:

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.0901
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
BS CSE	BS Computer Science and Engineering
MS CSE	MS Computer Science and Engineering
PhD CSE	PhD Computer Science and Engineering

Course Goals

Be competent with software realizations of physically based ray tracing
Be competent with underlying physics of optical transport
Be competent with algorithms of light propagation including volume rendering
Be competent with signal processing and texture mapping
Be familiar with methods for efficient realization

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Introduction to Realistic Rendering and Literate Programming	2.0							
Geometry, Transformations, Shapes	4.0							
Acceleration Structures	5.0							
Color and Radiometry	2.0							
Sampling and Reconstruction	6.0							
Reflection Models, Texture	3.0							
Volume Rendering and Scattering	2.0							
Monte Carlo Methods	4.0							
Unbiased Light Transport	4.0							
Biased/Importance-Sampled Light Transport, Photon Mapping, Metropolis Light Transport, Irradiance Caching	8.0							
Project Presentations	1.0							

Representative Assignments

Getting familiar with physically based ray tracing software infrastructure
Realizing robust and efficient intersection acceleration structures
Camera models and ray sampling distributions
Effectiveness of importance sampling schemes

Grades

Aspect	Percent
Laboratories, Assignments	40%
Midterm	20%
Final Project	30%
Class Participaton	10%

Representative Textbooks and Other Course Materials

Title	Author
Physically Based Rendering	Matt Pharr, Greg Humphreys

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and engineering.
**	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
***	c	An ability to design a system, component, or process to meet desired needs.
*	d	An ability to function on multi-disciplinary teams.
***	e	An ability to identify, formulate, and solve engineering problems.
*	f	An understanding of professional and ethical responsibility.
**	g	An ability to communicate effectively.

Course Contribution		College Outcome
*	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
***	i	A recognition of the need for, and an ability to engage in life-long learning.
**	j	A knowledge of contemporary issues.
**	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

BS CSE Program Outcomes

Course Contribution		Program Outcome
***	a	an ability to apply knowledge of computing, mathematics including discrete mathematics as well as probability and statistics, science, and engineering;
**	b	an ability to design and conduct experiments, as well as to analyze and interpret data;
**	c	an ability to design, implement, and evaluate a software or a software/hardware system, component, or process to meet desired needs within realistic constraints such as memory, runtime efficiency, as well as appropriate constraints related to economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability considerations;
*	d	an ability to function on multi-disciplinary teams;
***	e	an ability to identify, formulate, and solve engineering problems;
*	f	an understanding of professional, ethical, legal, security and social issues and responsibilities;
*	g	an ability to communicate effectively with a range of audiences;
	h	an ability to analyze the local and global impact of computing on individuals, organizations, and society;
***	i	a recognition of the need for, and an ability to engage in life-long learning and continuing professional development;
**	j	a knowledge of contemporary issues;
**	k	an ability to use the techniques, skills, and modern engineering tools necessary for practice as a CSE professional;
***	l	an ability to analyze a problem, and identify and define the computing requirements appropriate to its solution;
***	m	an ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices;
**	n	an ability to apply design and development principles in the construction of software systems of varying complexity.

Prepared by: Raghu Machiraju