

CSE 5541 (Approved): Computer Game and Animation Techniques

Course Description

Fundamental algorithms and mathematics in the production of computer animation and video games, emphasizing the control and rendering of animated characters.

Prior Course Number: CSE 683

Transcript Abbreviation: Comp Game Animatn

Grading Plan: Letter Grade

Course Deliveries: Classroom

Course Levels: Undergrad, Graduate

Student Ranks: Senior, Masters, Doctoral

Course Offerings: Autumn, Spring

Flex Scheduled Course: Never

Course Frequency: Every Year

Course Length: 14 Week

Credits: 2.0

Repeatable: No

Time Distribution: 3.0 hr Lec

Expected out-of-class hours per week: 3.0

Graded Component: Lecture

Credit by Examination: No

Admission Condition: No

Off Campus: Never

Campus Locations: Columbus

Prerequisites and Co-requisites: CSE 3901 or CSE 3902

Exclusions: Not open to students with credit for CSE 3541 or CSE 683

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
MS CSE	MS Computer Science and Engineering
PhD CSE	PhD Computer Science and Engineering

Course Goals

Be competent with basic interpolation techniques, speed control along a path, and automatic banking into curves along a path.
Be competent with forward and inverse kinematics or articulated linkages
Be competent with physics-based animation.
Be competent with behavioral animation.

Be competent with the generation and processing of sound in games and animation.
Be competent with the use of AI techniques in games.
Be competent with software architectures for computer games.
Be competent with the concept of a rendering pipeline and graphics state.
Be competent with hierarchical scene graphs and hierarchical animation.
Be familiar with computational issues associated with computer animation.
Be familiar with control devices for computer games and framework support for event notification.
Be exposed to computer animation production technology.
Be exposed to motion capture technology and its use in computer animation.
Be exposed to the history of animation and computer animation.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Overview, history, and foundation of computer games and computer animation	2.0							
Matrices and transformations	1.0							
Path-based animation; linear, cubic interpolation; splines, path following; acceleration, speed control; ease-in/ease-out; orientation rep., interpolation; quaternions, path following; Frenet Frame, banking, interpolation-based animation	3.0							
Hierarchical modeling and animation: inverse kinematics, other IK techniques	3.0							
Review of numerical integration	2.0							
Constrained motion: ground clamping, collision detection, constrained physics	1.0							
Review of physics: gravity, friction, rigid body, spring-mass systems, particle systems, collision response	3.0							
Human figure animation: anatomy, biomechanics	3.0							
Mocap, including visit to mocap lab; motion databases	2.0							
Behavioral animation: flocking, prey-predator model	2.0							
Crowd modeling: cellular and continuous models	1.0							
Flexible body animation: non-uniform scaling, spring-mass-damper systems, blend shapes	3.0							
Efficient and effective basic human motion modeling: reaching, grasping, walking/running, expressions, speech	3.0							
Sound: physically based, sound effects	2.0							
Rendering overview: models, textures, lights and cameras	6.0							
Overview of AI in computer games	2.0							
Scene management using octrees and cells and portals	3.0							

Representative Assignments

Write a program, using piecewise cubic interpolation, that passes through an arbitrary number of points in 3-space
Write a program that controls the velocity (speed and direction) of an object that smoothly traverses a curve based on time constraints at arbitrary points along the curves. Additionally, the object should bank into curves.
Write a program that animates a linkage based on given angles at given times.
Write a program that animates a linkage based on given positions and orientations of its end effector at given times.
Write a program that animates a rigid body using gravity while it collides and bounces off of obstacles.

Write a program that animates a particle system.
Write a program that animates a flock of birds using principles of flocking behavior.
Write a program that incorporates both sound and principles of AI into the flocking animation previously written.

Grades

Aspect	Percent
Lab assignments	60%
Midterm	15%
Final	25%

Representative Textbooks and Other Course Materials

Title	Author
<i>Computer Animation: Algorithms & Techniques</i>	Rick Parent

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.
*	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.

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