Advanced 3D Modeling, Animation, Compositing, and Special Effects
ITP 305x (3 Units)

Spring 2014

Objective

The purpose of this course is to extend techniques and builds upon theories introduced in the beginning animation course (itp215). This course provides the foundation for advanced animation construction, incorporation of and integration with external media, and techniques to automate and optimize development processes.

Concepts

In this course, students build upon fundamental techniques to create professional quality imagery and motion. Students learn advanced modeling techniques such as NURBS modeling, advanced surfacing techniques such as specularity and sequenced mapping, and advanced animation and special effects including controllers, effectors, dynamics, and multiple emitters. In addition, students will be introduced to productivity and optimization techniques such as scripting and expressions. Students will also be introduced to a variety of compositing methods.

Prerequisites

No prerequisite

Instructor	Lance S. Winkel
Contacting the Instructor	Office: OHE 530 H E-mail: winkel@usc.edu Tel: 213.740.9956
Office Hours	Office Hours and location. OHE 530 H. Hours TBD
Lab Assistants	TBD
Lecture	1.5 hours per week
Lab	1.5 hours per week

Required Textbooks

No required textbook

Website

Class materials are posted on the USC Blackboard website. https://blackboard.usc.edu/

Grading

Particle effects smoke / fire / shockwave sequence (20 points)
Rigid body collision / destruction sequence (20 points)
Six progress checks = 10 points each (60 total)
Giant Robot Model = 20 points
Giant Robot Finished Composite Scene = 20 points
Character Rigging and Animation Project = 20 points
Final project (Integrated dynamics, particles, rigid bodies, and animated robot animation) = 60 points
Attendance and Participation = 30 points (-10 points / absence)
Total = 250 points

Grading Scale

A 100-93
A- 92-90
B+ 89-87
B 86-83
B- 82-80
C+ 79-77
C 76-73
C- 72-70
D+ 69-67
D 66-65
F 64 or below

Policies

Projects: All projects and weekly assignments are due at the start of class and are considered late 1⁄2 hour after class begins. Only one project or assignment may be turned in late. All other late projects will NOT be accepted unless pre-approved by the instructor. With the instructor's approval, on time projects may be redone for additional credit but must be turned in by the following class session. The final project may not be turned in late.

Before logging off a computer, students must ensure that they have emailed or saved projects created during the class or lab session. Any work saved to the computer will be erased after restarting the computer. ITP is not responsible for any work lost.

ITP offers Open Lab use for all students enrolled in ITP classes. These open labs are held beginning the second week of classes through the last week of classes. Please contact your instructor for specific times and days for the current semester.

Incomplete and Missing Grades

Excerpts for this section have been taken from the University Grading Handbook, located at http://www.usc.edu/dept/ARR/grades/gradinghandbook/index.html. Please see the link for more details on this and any other grading concerns.

A grade of Missing Grade (MG) "should only be assigned in unique or unusual situations… for those cases in which a student does not complete work for the course before the semester ends. All missing grades must be resolved by the instructor through the Correction of Grade Process. One calendar year is allowed to resolve a MG. If an MG is not resolved [within] one

year the grade is changed to [Unofficial Withdrawal] UW and will be calculated into the grade point average a zero grade points.

A grade of Incomplete (IN) "is assigned when work is no completed because of documented illness or other 'emergency' **occurring after the twelfth week** of the semester (or 12th week equivalency for any course scheduled for less than 15 weeks)."

Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *Scampus,* the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://www.usc.edu/dept/publications/SCAMPUS/gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.

Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to your course instructor (or TA) as early in the semester as possible. DSP is located in STU 301 and is open from 8:30am to 5:00pm, Monday through Friday. Website and contact information for DSP http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu

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Course Outline

Week 1 – Introduction to dynamic geometry
- Rigid Bodies Overview
- Fields and dynamic movement
- Workflow, baking animation, and processing efficiency
- Modeling fractured surfaces
- Best practices for render quality (Hero) vs. dynamic stand-in (Stunt) geometry
- Visual sleight of hand

Assignment/Project

Rigid Body simulation of collapsing, destructing, or fracturing geometry. Model and dynamically process the sequence. Use at least 50 rigid solved objects. Bake the sequence out as keyframed animation.

Week 2 – Particle dynamics
- Understanding particle simulation and workflow
- Particle tools and concepts: emitters, unique attributes, lifespan, and shaders
- Defining look and behavior for particles
- Smoke, fire, rain, dust, sorcery, sparks, lasers, swarms, and other applications
- Particle disk cache
- Per particle attributes

Assignment/Project

Use particles to enhance and add impact to an animation scene. Examples will vary based on scene concept. You may use previous models and animation. Fire and smoke for rockets. Smoke or dust trails at an impact or following the pressure wave of a speeding vehicle. Venting from a reactor. Lasers and awesome stuff. Demonstrate lifespan, per particle attributes, particle shaders, and disk cache.

Week 3 – Advanced modeling theory
- Forms that work well with Polygons
- Forms that work well with NURBS
- Setting up a scene for modeling
- Image planes
- Mesh topology
- Quad's (4-sided) vs. Tri's (3-sided) vs. multi-sided faces

- 2-manifold vs. non-manifold polygon geometry
- Complicated meshes and Boolean modeling operations

Assignment

Giant Robot (Week 1 of 4) – Design and prepare a character design for the Giant Robot. Create a project folder, set up the scene and scale, and begin modeling the Giant Robot. Main shapes of entire character should be blocked in. Due week 4.

Week 4 – Modeling with NURBS
- NURBS (Non-Uniform Rational B-Splines)
- NURBS components (Control Vertices, Hulls, Spans/Sections, Curve Degree, Edit Points, U and V coordinates)
- Curve-based modeling concepts and techniques
- Complex extrusions and lofts
- Bi-Rails

Assignment

Giant Robot (Week 2 of 4) – Add details to the Giant Robot using multiple techniques including NURBS. At least five (5) detail structures should use NURBS geometry. Due week 5.

Week 5 – Modeling cleanup and texture implications
- Modeling workflows for NURBS and Polygons
- Conversion techniques
- NURBS to Polygons
- Polygons to NURBS
- Subdivision surfaces
- Best practices
- Preserving UV texturing coordinates throughout conversion

Assignment

Giant Robot (Week 3 of 4) – Finish and clean up the geometry of the Giant Robot character for group critique in class. Objects should be named cleanly in preparation for the next phases of the project. Due week 6.

Week 6 – UV unwrapping and texturing
- In class critique of the Giant Robot models
- UV Coordinates
- UV Projections and unwrapping
- NURBS vs. polygon UV coordinate space
- Exporting UV snapshots to Photoshop
- Materials Fundamentals

Assignment

Giant Robot (Week 4 of 4) – Unwrap the UV's of the Giant Robot, and assigning custom materials to each object. Create UV snapshots of each unwrapped object. Due week 7.

Week 7 – Automation and Movement
- Skeletons and hierarchies
- Rigging for hard surfaces and multi-object models
- Binding
- Preparing geometry for rigging and animation
- Review fundamental animation and performance principles
- Forward vs. Inverse Kinematics
- Hierarchies: Parent -> Child Relationships
- Skeletons and Joint Hierarchies
- Organizing a complex character (defining what and how things move)
- Creating a simple rig
- Range of motion and types of motion

Assignment
Giant Robot Rig (Week 1 of 3) – Cleanup models for rigging. Build a skeleton hierarchy to support the automation of the model. Bind the geometry. Due week 8.

Week 8 – Controlling Animation
- Controllers
- Driven Keys
- Connections
- Expressions, functions, and MEL

Assignment
Giant Robot Rig (Week 2 of 3) – Build all necessary controllers and secondary motion controls. Use expressions, set driven keys, and direct connections to manage these functions. Due week 9.

Week 9 – Constraints and Deformation
- Understanding animation constraints
- Tranformations
- Deformations
- Blending between multiple constraints

Assignment
Giant Robot Rig (Week 3 of 3) – Finish the rig. Refine any remaining control problems. Due week 10.

Week 10 – Visual Effects and Animation
- In class critique of the Giant Robot rigs
- Adding visual effects to animated scenes
- Shatters, explosions, and other types of effects
- Previs for VFX
- View previous successful projects

Assignment
Begin the Final Project. Details on Blackboard. Progress checks due each week. Due during final exam session.

Week 11 – Render Layers and Render Passes
- Rendering engines (Mental Ray, Renderman, VRay)
- Render Layers
- Render Passes
- Overview of file formats and their application
- R, G, B, A, Z, and other channels
- Bit depth (8, 16, 32), integer vs. floating point, compression, and color

Assignment

Final Project progress check due week 12.

Break a lit scene down into its constituent render contribution passes. Separate render passes for each major scene element (minimum: environment, subject object, and background). Each pass should also contain diffuse, specular, reflection, lighting, shadow, and GI passes.

Week 12 – Compositing
- Introducing the Nuke interface
- Node based compositing
- Read, merge, and write nodes

Assignment

Final Project progress check due week 13.

Using Nuke and the render passes from the previous assignment; reassemble the sequence to achieve the closest matching composite result. Once this is complete, use color correction and other layers to sweeten the sequence.

Week 13 – Compositing for dynamics
- Zdepth
- Particle render passes and special topics
- Black hole matte, ID channels
- Reasons to break out certain passes into a unique scene

Assignment

Final Project progress check due week 14.

Week 14 – Advanced dynamics
- Fluid dynamics
- nDynamics (nParticles, nCloth)
- Mapping fluids to particles
- The overburn technique

Assignment

Final Project progress check due week 15.

Week 15 – Final Rendering and Advanced Topics
- Final class critique

- Putting the finishing touches on a completed scene
- Rendering and post processing of a finished scene
- Review of dynamics tools based on needs of projects

Assignment

Pull out all the stops to finish this Final project! The final should be at least 15 seconds long and be composed of at least three shots. This is a chance for you to use camera, shot selection, character performance, lighting, and effects to create a finished portfolio quality piece. Final output should be QuickTime format, Sorensen 3 or H.264 codec. I would like to collect project folders as well. Final Project due for viewing and in-class critique at start of our arranged Final Exam session.

Final Exam/Project

- Final Project due at the start of the exam session. Critique and discussion will follow.

Date, Time, and Place

Wednesday, May 15, 2-4pm OHE 540