Objective
Advanced techniques for 3D animation and visual effects development; including 3D pre-visualization, match moving, dynamics, multi-pass rendering, and digital compositing.

Concepts
Camera and advanced photographic applications for 3D including:
- Camera tracking and match moving, high dynamic range image making, image based lighting, and global illumination.
- Advanced materials, lighting, and rendering techniques.
- Multi-pass rendering and node based compositing.
- Film, video, and chroma-keying for 3D.
- Pre-visualization and pipeline planning techniques.
- 3D asset creation, photorealistic texturing, and asset management.
- Color correction, optical effects, and advanced compositing.
- In addition to a series of weekly assignments, students will apply their knowledge to a final capstone project.

Prerequisites
ITP 215x

Instructor
Lance S. Winkel

Contacting the Instructor
E-mail: winkel@usc.edu
Tel: 213.740.9956

Office Hours
Varies by semester

Lab Assistants
TBA

Lecture
3 hours / week.

Course Structure
The course material will be structured around a series of projects. Each project will extend over several weeks with assignments / progress checks due each week. See the Grading criteria below.

The anticipated Course Outline contains a weekly breakdown of the lecture material and assignment due dates.

Required Textbooks
Digital Lighting and Rendering (2nd Edition) (Paperback)

Compositing Visual Effects (Paperback)

Optional Books
Maya Professional Tips and Techniques (Paperback)
Web Site  Class materials are posted on the USC Blackboard website. https://blackboard.usc.edu/

Grading  Twelve weekly assignments/progress checks = 10 points each (120 total)
Midterm - Finished Composite Project = 40 points
Final project = 60 points
Participation = 30 points
Total = 250 points

Grading percentages:
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 66-63
D- 62-60
F 59 or below

Policies  Participation: Class participation is an important educational component of this course. Students are expected not only to attend classes but also actively provide academic engagement, feedback, discussions and opinions. The course content and projects are closely tied together; excessive absences will severely and negatively impact the learning process. 
Student can miss up to two classes due to a documented medical emergency, religious holidays or family emergencies. Other absences will lead to a 10 point loss (per absence) out of the 250 points for the course.

Projects: All projects and weekly assignments are due at the start of class and are considered late ½ 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.

Academic  The use of unauthorized material, communication with fellow students
**Integrity**

during an examination, attempting to benefit from the work of another student, and similar behavior that defeats the intent of an examination or other class work is unacceptable to the University. It is often difficult to distinguish between a culpable act and inadvertent behavior resulting from the nervous tension accompanying examinations. When the professor determines that a violation has occurred, appropriate action, as determined by the instructor, will be taken.

Although working together is encouraged, all work claimed as yours must in fact be your own effort. Students who plagiarize the work of other students will receive zero points and possibly be referred to Student Judicial Affairs and Community Standards (SJACS).

All students should read, understand, and abide by the University Student Conduct Code listed in SCampus, and available at: [http://www.usc.edu/student-affairs/SJACS/nonacademicreview.html](http://www.usc.edu/student-affairs/SJACS/nonacademicreview.html)

**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 me (or to your TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. - 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.
3D Compositing and Visual Effects
ITP 360x (3 Units)

Course Outline

Week 1 – Introduction and Toolsets
- Introduction to the class and course syllabus
- Brief history of compositing and visual effects
- Deconstructing digital images and the rendering process
- Fundamental 3D and digital compositing principles
- Comparing the Combustion and After Effects compositing engines
- Pre-multiplied vs. non-pre-multiplied images

Reading: Compositing Visual Effects - Chapters 1 and 2

Project: Intro Project: Use the provided materials to generate a composite scene with animated layers attributes to enhance overall effect. Export to QuickTime in either the Sorensen 3 or H.264 codec. Due Week 2.

Week 2 – Photographic applications for 3D
- Deconstructing cameras and the photographic process
- Camerawork fundamentals
- Aspect ratios, standards, focus, and exposure principles
- Shooting and image processing for a background plate
- Discuss perspective and depth cues
- Setting up a background plate into a 3D scene

Reading: Digital Lighting and Rendering - Chapters 1 and 2

Project: Composite Effects Scene (Week 1 of 6): Take a photo of an environment to serve as a background plate for a composite scene. Acquire 3D assets to be composited together with the environment. Setup project folder and Maya scene file. Import 2D and 3D assets appropriately. Setup the background plate and then reverse calculate camera settings and position for accurate perspective. Render the vehicle separate from the background plate and composite them together as a QuickTime file. Due Week 3.
**Week 3** – Advanced photographic applications for 3D
- Texture gathering
- Limitations of standard low-dynamic range images
- Shooting and Processing High Dynamic Range Images
- Applications for HDRI in 3D

**Reading:** Digital Lighting and Rendering - Chapters 3 - 5

**Project:** Composite Effects Scene (Week 2 of 6): Reshoot environments or HDRI assets to support the photorealistic lighting of the scene. Fix any remaining perspective problems. Animate the 3D assets moving realistically in the scene. Re-render based on these changes and use the compositing program to export them as a QuickTime file. Due Week 4.

**Week 4** – Compositing 3D with Live Action
- Setup and matching of 3D lighting to a background plate
- Exporting multiple render passes and compositing for shadows
- Image based lighting and reflections
- Realistic materials

**Reading:** Digital Lighting & Rendering - Chapters 6 and 7

**Project:** Composite Effects Scene (Week 3 of 6): Apply lighting and materials to scene. Incorporate necessary tools and lighting techniques to achieve desired photorealistic effect. Render the lit and animated scene into separate passes: a 3D objects only pass, a shadow pass for where the 3D objects cast shadows against the environment, and the raw background plate. Composite together into a QuickTime file. Due Week 5.

**Week 5** – Multi-pass Rendering
- Using render layers to optimize multi-pass rendering
- Multi layer compositing principles and techniques
- Comparing basic effects and layered composite workflows
- Diffuse, color, shadows, reflections, and occlusion

**Reading:** Digital Lighting & Rendering - Chapters 7 and 11

**Project:** Composite Effects Scene (Week 4 of 6): Break down the 3D scene into the following distinct render layers: diffuse, color, background shadows, object shadows, specular highlights, reflections, occlusion, and background plate. Render the layers, and composite together into a QuickTime file. Due Week 6.
**Week 6 – Advanced Multi-Pass Rendering**

- Specialty layers and channels
- Z-Depth vs. Luminance depth
- Image bit depth, 8-bit vs. 16bit vs. floating point
- Object IDs and the power of custom render passes
- Node based compositing principles and techniques
- Color correction and post effects

**Reading:** Compositing Visual Effect - Chapter 3 and 4

**Project:** Composite Effects Scene (Week 5 of 6): Add depth, specific object ID, and specialty render layers to the scene. Render these layers and update the composite to make use of them. Use the depth channel to add depth of field and environment fog effects to the scene. Use additional layers to isolate, color correct, and apply post effects to distinct elements within the scene. Composite together into a QuickTime file. Due Week 7.

**Week 7 – Film, Video, Matting, and Chroma Keying**

- Deconstructing film, video, and digital video standards
- Aspect ratios, file formats, and frame rates
- Types of mattes and matting techniques
- Chroma Keying
- Making and mattes for 2D elements vs. 3D elements
- Rotoscoping and wire removal

**Reading:** Compositing Visual Effect - Chapter 11

**Project:** Composite Effects Scene (Week 6 of 6): Shoot or acquire, and then prepare at least two (2) 2D film or video elements for incorporation into the composite scene. Composite them into the scene along with at least one custom matte element (2D, 3D, rotoscoped, etc.) and when the composite is complete, export into a QuickTime final. Due as midterm Week 8.

**Week 8 – Matting Techniques for Particle Systems**

- In class review of Composite Effects Scenes (Review Midterms)
- Fundamentals for dynamic motion and animation systems
- Setting up mattes as image sequences
- Applying mattes to particle objects

**Reading:** Compositing Visual Effect - Chapters 5 and 6

**Project:** Discuss and hand out instructions for Final Project. Concepts and storyboards due Week 9.

**Week 9 – Dynamic Effects**

- Intermediate dynamic motion and animation systems
- Rigid body systems
- Simulating complex physical phenomenon
- Managing complexity for efficient feedback

**Reading:** Compositing Visual Effect - Chapter 7 and 8

**Project:** Final Project storyboard revisions, asset lists, and production plans due Week 10.
Week 10 – Advanced hard-surface surface construction and texture layout
- Modeling for architecture and from reference
- Modeling for dynamic geometry
- UV layout techniques
Reading: Compositing Visual Effect - Chapter 9
Project: Final Project progress check due Week 11.

Week 11 – Advanced organic surface construction
- Pipelines and production tools for ultra-high polygon modeling
- Normal mapping and detail modeling
Reading: Any assigned readings
Project: Final Project progress check due Week 12.

Week 12 – Advanced material techniques
- Creating complex textures and multi-texture materials
- Advanced rendering and shading nodes
- Procedural textures
- Renderer-specific and proprietary materials
Reading: Any assigned readings
Project: Final Project progress check due Week 13.

Week 13 – Production planning and management
- Organizing a production pipeline
- Managing assets
- Advanced project folder management and file referencing
Reading: Any assigned readings
Project: Final Project progress check due Week 14.

Week 14 – Special Topics (1 of 2)
- Special Topic subject to be determined
- Network and distributed rendering for multi-pass rendering
Reading: Digital Lighting & Rendering - Chapter 12
Project: Final Project progress check due Week 15.

Week 15 – Special Topics (2 of 2)
- Special topic subject to be determined
- Guest lecturer to be determined
Reading: Any assigned readings
Project: Final Project due for turn-in and in-class critique during Final Examination session.

Week 16 – Final

ITP 360 – Final Project:
Create an effects sequence of no less than 15 seconds and containing three to five consecutive visual effects shots.

Required Components:
The shots must incorporate each of the following:
- 3D assets
- 2D assets (images attached to geometric “cards” or particle
"sprites", animated textures, etc.)

• At least one seamlessly composited film or video asset
• At least one dynamic custom made dynamic visual effect (rigid bodies, particles, nucleus cloth, etc.)

Production Process:
Adhere to a project folder and implement a clean production workflow that includes the following techniques:
• Animation, camera, and lighting techniques necessary to complete each shot effectively
• High Dynamic Range Imagery for photorealistic lighting and reflection mapping
• Multi-pass rendering workflow to support advanced post and compositing
• Node-based or layer-based compositing tools as necessary to assemble the shots and rendered assets.
• Color correction and post tools as necessary to uniformly polish the final project

Assessment:
The Final project is worth 60 points.
Concept art and storyboards are due Week 9.
Storyboard revisions, asset lists, and production plans are due Week 10.
Progress checks are due each week leading up to the Final deadline.
The Final project will be graded based on:
• Demonstrated effort
• Complexity, range, and effective use of tools
• Quality of the finished product (performance, visual quality, etc.)