CSCI 599 Digital Geometry Processing

Course Syllabus

Recommended preparation: This course is self-contained, however students should have solid background in linear algebra, numerical optimization, and C/C++ programming. While CS480, Computer Graphics is recommended, there are no prerequisites for this course.

Time: Spring 2014, TBD
Instructor: Professor Dr. Hao Li (hao.li@usc.edu, http://hao.li/)
Co-Instructor/TA: Dr. Chongyang Ma, Mikhail Smirnov
Office: SAL 244

Course Introduction

This course provides an introduction to digital geometry processing (DGP), a subfield of computer graphics. With polygonal meshes being the de-facto standard for 3D surface representation in digital worlds and the emergence of 3D scanning, realtime depth sensor, and printing technologies, DGP is gaining increasing importance in applications ranging from visual effects, interactive games, CAD, machine perception, robotics, engineering to biomedicine. This course will cover basic mathematical foundations for studying 3D surfaces from a discrete differential geometric standpoint and present the full geometry processing pipeline: from 3D data capture, mesh smoothing, surface reconstruction, parameterization, registration, shape analysis (correspondence, symmetry, matching), data-driven synthesis, interactive editing, to 3D printing. We will also illustrate this course with important applications and recent advances in this field. Similar to image processing for which inputs are 2D images or video, DGP involves treating 3D depth maps, point clouds, polygonal meshes and volumetric data and involves many techniques from linear algebra, differential geometry, signal processing, and numerical optimization. This course will offer practical coding exercises to understand basic geometry processing algorithms, and small projects where students will 3D scan and digitize their favorite objects, manipulate them, and reproduce them into the physical world.

Course Material

The reading material will be a combination of textbook, conference course, and research papers.
The textbook, Polygon Mesh Processing, can be purchased here:
http://www.crcpress.com/product/isbn/9781568814261
The conference course on geometric modeling based on polygonal meshes:
http://graphics.ethz.ch/Downloads/Publications/Tutorials/2008/Bot08a/eg08-tutorial.pdf
The conference course on computing correspondences in geometric data sets:
http://www.mpi-inf.mpg.de/resources/deformableShapeMatching/EG2011_Tutorial/

Grading

Homework: 40%
Class Participation: 20%
Class Project: 40%

Topics

Week 1: Introduction to Geometry Processing

Week 2: Surface Representation & Data-Structures

Week 3: Discrete Differential Geometry

Week 4: 3D Scanning & Smoothing

Week 5: Registration

Week 6: Surface Reconstruction

Week 7: Parameterization

Week 8: Remeshing & Decimation

Week 9: Deformation

Week 10: Shape Analysis

Week 11: Advanced Topic: Dynamic Geometry Processing

Week 12: Advanced Topic: Facial Performance Capture

Week 13: Advanced Topic: Data-Driven Synthesis

Week 14: Advanced Topic: 3D Printing

Week 15: Project Presentations

Statement for 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 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.

Statement on 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/.

Emergency Preparedness/Course Continuity in a Crisis

In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.

Please activate your course in Blackboard with access to the course syllabus. Whether or not you use Blackboard regularly, these preparations will be crucial in an emergency. USC's Blackboard learning management system and support information is available at blackboard.usc.edu.