

University of Southern California
Daniel J. Epstein Department of Industrial and Systems Engineering

ISE 599: Advanced Topics in 3D Printing

Class Number 599, Units 3
Fall 2013

Course Syllabus

Course General:

The course meets Wednesday 6:30 ~ 9:10 pm.

Course Instructors:

Dr. Yong Chen, GER-201

Tel: 213-740-7829, Email: yongchen@usc.edu

Office Hours: Wednesday from 1:00 to 4:00pm or by appointment.

Course Description:

Rapidly advancing 3D printing or additive manufacturing (AM) technologies provide us a direct way of converting digital data into physical objects. Based on the AM processes, *rapid prototyping* (RP) and *rapid tooling* (RT) have been widely adopted as common practice in product development. In the past few years, advances in material, process, and machine development have enabled AM processes to evolve from the prototyping stage to direct product manufacturing. Such *rapid manufacturing* (RM) capabilities will revolutionize industries such as aerospace, defense, biomedical, and jewelry to name a few. Understanding the advantages and limitations of AM technologies is important for future engineers in developing new engineering systems and identifying emerging opportunities in developing products for mass customization.

This course aims to help graduate students in understanding the latest developments and critical challenges of 3D printing, and provide students with related techniques and practical experience in developing novel AM processes and applications. This is a PhD level course that will be offered every other year. The targeting audience of the course is the students in the ISE PhD program. The course will prepare the students for advanced careers related to advanced manufacturing.

The teaching of the course will use an active learning strategy. The students will read literatures, discuss current research problems, and identify possible contributes to the field. Three course projects, including a paper review project, a technology survey project, and an application development project, are planned throughout the semester. Through them, the students are expected to gain deep understanding of additive manufacturing and related technologies.

Prerequisites:

No formal prerequisites. Students are desired to take ISE511 and ISE510 before.

Textbook

Lecture notes will be given before classes.

Reference Books

- Bourell, Leu, and Rosen, *Roadmap for Additive Manufacturing*, NSF Workshop report, 2009.
- Gibson, Rosen, Stucker, *Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing*. Springer, 2009.
- Hopkinson, Hague, Dickens, *Rapid Manufacturing: An Industrial Revolution for the Digital Age*. Wiley, 2005.
- Gibson, *Advanced Manufacturing Technologies for Medical Applications*. Wiley, 2005.

Grading Policy:

The grading for the class will be determined using the following weights:

- Assignments..... 30%
- Literature review project..... 20%
- Technology survey project..... 15%
- Development project..... 25%
- Participation..... 10%
- Total Score.....100%

Problem Assignments: Students will be given ~2 weeks for each assignment, which will consist of solving problems that correspond to the materials covered in class.

Literature review project: The objective of the literature review projects is to help the students to learn how to identify and read literatures. Students will discuss the review topic with the professor. The project will be done with a presentation and a review report.

Technology survey project: The objective of the technology survey project is to help the students to understand potential applications and opportunities in various fields. Students will discuss the survey topic with the professor. The project will be done with a presentation and a survey report.

Development project: The objective of the development project is to help the students to gain hands-on experience of solving a problem related to 3D printing. Students will discuss the problem with the professor. The project will be done with a demonstration, a presentation, and a technical report.

Participation: Active participation in the class discussion is required and will be taken into account.

Academic integrity: “The Department of Industrial and Systems Engineering adheres to the University’s policies and procedures governing academic integrity as described in SCampus. Students are expected to be aware of and to observe the academic integrity standards described in SCampus, and to expect those standards to be enforced in this course.”

Disability Accommodation:

“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.”

Tentative Course Schedule:

Week #	Wednesday (6:30~9:10 pm)	Assignment	Reading / Project
1	Aug. 28 – Course Introduction • Course Overview • Basic principles • Research topic discussion	Assignment 1	Paper review project assigned
2	Sept. 4 – 3D content creating • Scanning		Literature review topic due.
3	Sept. 11 – 3D content editing • Design opportunities • CAD systems for additive manufacturing	Assignment 2	
4	Sept. 18 – Fabrication speed and improvements		
5	Sept. 25 – Additive processes beyond layers • Hybrid processes	Assignment 3	
6	Oct. 2 – <i>Literature review project presentation</i>		Literature review report due.
7	Oct. 9 – Technology impact on society and novel applications • Production economics • Applications on medical, retail, space, etc.	Assignment 4	
8	Oct. 16 – <i>Site visit: WESTEC</i> • LA Convention Center		
9	Oct. 23 – <i>Technology survey presentation</i>		Technology survey report due.
10	Oct. 30 – Material issues • Heterogeneous materials • Functional materials		Development Project Assigned
11	Nov. 6 – Rapid tooling and indirect processes		
12	Nov. 13 – Post processing for additive manufacturing		

13	Nov. 20 – Process and quality control in additive manufacturing • Accuracy, repeatability, etc. • Process viability and sensors	
14	Nov. 27 – Thanksgiving (No class)	
15	Dec. 4 – <i>Development Project Presentation</i> • Course review & evaluation	
16	Dec. 11 – Development Project demonstration (7pm)	Development Project report Due