RESEARCH EXPERIENCES FOR TEACHERS – SUMMER 2022

Project #3: Additive Manufacturing

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1) Focus: 3-day training on fundamentals of additive manufacturing and hands-on training on selected technologies, including model generation, preparation, pre- and post-processes.

2) Lab training and integrated project:
This short course aims to empower teachers ability to identify and select proper additive method and post-processing techniques by considering part complexity, surface finish and tolerances, production time and costs. Participants will learn and experience two 3D printing technologies (*Fused deposition modeling* (FDM) and *Stereolithography* (SLA)) and compare them to the traditional polymer casting technique.

Figure 1. Additively manufactured parts by SLA (left) and FDM (right)

Participants will use CAD software to produce a digital model, convert to STL file, and perform model slicing. They will learn how to properly orient the part and select printing parameters considering the part strength, appearance, and the removal of support structures. They will use different post processes to finish the part, including mechanical/chemical polishing (for FDM) and post-UV curing (SLA). All finished parts will then be compared qualitatively in terms of surface finish, appearance, and overall manufacturing time.

3) Authentic research experience: Participants will gain basic additive manufacturing skills, understand the pros and cons of two common additive manufacturing methods (FDM and SLA).

4) Equipment:
- Fabrication: FDM printers, SLA printers, UV-curing station, fume hood, iso-thermal oven, heat plate.
- Metrology: Calipers, surface profilometer, digital microscope.

5) Expected outcomes: At the end of this training, the participants should:
- Be able to identify and describe common 3D printing technologies.
- Know basic 3D printer operations and post-processes.
- Understand the effects of model slicing, printing parameters, and part orientation.
- Have the first draft of curriculum integration

6) Scheduling: The training activities are scheduled as follow. Trainees will be grouped into two (Group A and Group B) to run these activities in parallel or together for the best learning outcomes.

Time	Topic	Location
Day 1 AM	Introduce lab safety and expected activities FDM concept, materials, and process parameters Free resources for CAD and slicing software	Conference room
Day 1 PM	Design a generic part with Fusion 360 Handle STL with slicing software CURA Set up parameters for printing Observe printing	Conference room Lab/Rapid Prototyping Studio
Day 2 AM	Introduce SLA/DLP concept, materials and process parameters, printing software Set up parameter setting for printing (the same part)	Conference room Lab/Rapid Prototyping Studio
Day 2 PM	Retrieve FDM parts and observe printing quality Optimize parameters and print again	Conference room Lab/Rapid Prototyping Studio
Day3 AM	Retrieve FDM parts Introduce post-processing techniques Practice on different techniques (vapor/sand polishing)	Conference room Lab/Rapid Prototyping Studio

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Day 3 PM	Retrieve SLA parts, clean and remove supports Collect all parts from FDM and SLA, compare the quality Report learning outcomes, feedback	Conference room