Incorporating Additive Manufacturing (AM) Technologies into the Undergraduate Design Curriculum

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Introduction

The Computer Aided Design (CAD) curriculum at UAH, as well as other dedicated graphic design courses, do not typically explore the realization of CAD models as part of the design process. While consideration of the design is absolutely necessary in industrial manufacturing, so are the materials and methods used to create them. The authors propose the consideration and design-focused incorporation of additive technologies (such as 3-D printing and 3-D scanning) into undergraduate design and graphics courses; this will allow the students to explore design concepts, particularly those at the intersection of technology and art, more effectively. In addition to exploring forms and shapes, the students can better understand material selection, fabrication, affordances and constraints. This would enhance the real-world applicability of design education and make technical design a more inclusive discipline, open to more types of learners.

Objectives and Approach

The objective of this project is to explore the introduction of AM processes early-year students, both in engineering and the in arts and humanities. This implementation is intended not only to create useful designs to practical problems, but to also promote problem solving and critical thinking skills in design students. This will involve three steps:

- Introduce AM materials and processes across various colleges and disciplines
- Ultimately produce usable 3D printed tactile designs for practical use
- Inspire creative careers and areas of research in art and engineering disciplines

Design Process Case Study: Cup Holder

Problem

Figure 1: Cup holders in a vehicle proved to be problematic as they were too big

Solution

Figure 2: 3D printed cup holders using PLA material keep drinks from spilling while driving. The polylactic acid (PLA) material kept its form as it fit the dimensions of the original vehicle dimensions

Figure 3: Design process to solve cup holder problem

Basic modeling

Conceptual design

Solution

Final design

Fabrication

- Multiple holders were created to fit the dimensions of various drinks
- To further increase the use of the holder outside of the vehicle, an external holder was made
- Even though the cup holders were to serve one purpose, but there is room for additional functionality
- The modeling was done using the SolidEdge ST10 3-D modeling software
- Fabrication was done using fused deposition modeling (FDM) out of PLA
- One cup holder required about 9 hours to print and cost approximately $4 for materials and power

Conclusions

- Trial and error may be necessary for long AM processes
- Curriculum should include multi-step processes as illustrated
- AM applications may aid in future career decisions for students
- Research areas in materials and structural integrity can open up to students not just in AM, but in Civil Engineering as well
- Art students can create tactile versions of their art in addition to 3D models in CAD software

On-going Work

- Continue to do research on how exposing 3D printing to early college students impact career choices
- Future research can include reducing the time needed to print
- Consider other materials and methods used to print
- Implement 3D printing in user-experience (UX) design research
- Discover and apply basic art and engineering principles to increase printing efficiency