Real-Time 3D Printing Error Detection and Correction

Makinen, William (School: West Springfield High School)

Recently, the popularity of Additive Manufacturing (AM) processes such as Fused Filament Fabrication (FFF) has increased exponentially, due to their potential to construct complex objects much more accurately and efficiently than subtractive manufacturing. These unique capabilities could truly revolutionize the manufacturing industry. Unfortunately, successful, high-quality components can currently only be ensured using accurate, expensive FFF machines while manually monitoring the print process. These high costs compared to their relatively low output has kept them from becoming an economically viable option for professional fabrication. A closed-loop system using sensor feedback could achieve comparable results while using lower-cost components. The purpose of this work was to install sensors on a FFF machine to create a closed-loop AM system capable of monitoring the printing process in real time. Several sensors were used to initially characterize the FFF process, after which it was determined that a load cell mounted under the print bed and a webcam would be able to create the most robust error detection system. The data from these sensors is analyzed by Java programs to detect imperfections and other non-conformities in each print. If one is detected, the software will first modify the print parameters in an attempt to remedy the detected issue. If this fails, the print will then be declared a failure, and notify the user. The system proved to be a success, and can consistently detect and remedy artificially introduced failures. It has the potential to be developed further to cheaply bring fully closed-loop systems to additional of FFF processes, allowing for hobbyist options to be streamlined and for adaptation to industrial production.

Awards Won:

Fourth Award of $500

National Aeronautics and Space Administration: Honorable Mention