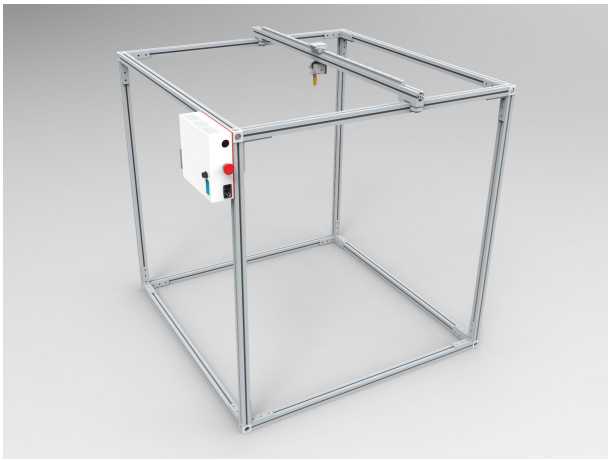
*[Capstone Category]*

**Project Name** **Big 3D Printer**

Team Lead: Rongxuan Ma, Marcell Tapaszto
Team Member(s): Fiona Swarr, Connor Clemente, Ryan Bowden, Skylar Lee, Sam Kaynor, Mohammad Althubaiti
Faculty Advisor(s): Dr. Ed L. Caraway, College of Engineering and Sciences, Florida Institute of Technology

Design Problem Statement:

The purpose of this project was to design a more accessible, large-scale 3D printer that is more power efficient and capable of faster printing than the currently available options.



Major Challenges:

- Stability of printer
- Thermal Design
- Print Speed
- Gantry system for large printer
- Power Efficiency
- Learning NX for Modal Analysis

Solution Methods:

The system is designed to run on a BigTreeTech mainboard with mounted motor drivers which is capable of controlling all motors that are on the system. The entire system is powered by a single 350W power supply, and max power draw is expected to be no more than 700W.

The frame is a cube made of aluminum extrusions. The mechanical solution for this project was to understand the vibrations that the system would incur at its modes: 128-138 Hz, 343-371Hz, 652-702Hz, and 1038-1116Hz and counter the amplitudes produced by the modes by installing corner brackets that supported and countered these vibrations. We were able to reduce the vibrations by an average of 0.904mm using 3in L-brackets installed on each of the corners.

The firmware used to drive the 3D Printer was Marlin 2. Once compiled, the firmware had to be configured to effectively run each of the components specific to this printer and its dimensions. The configuration process consisted of repeated measurements of filament extrusion and motor distance traveled in order to optimize the printer speed.

Data Analysis:

A modal analysis was conducted in order to determine the frequencies at which the system vibrated at its modes. This was conducted using NX for simulations of the outer frame, and it was determined that having different lengths for the dimensions of the frame as well as including support brackets reduced these vibrations to an amplitude that could be worked with if the frequencies of the system passed by these modes.

The measurements taken from the extruder with varying lengths of material were used to calculate the configuration settings for the extrusion motor, which included accurate steps per millimeter of extruded material.

Future Work:

- A thermal analysis of the extruder
- Manufacturing a nozzle
- Multi-motor z-axis with bed
- Thermal enclosure

Conclusion:

By utilizing a set of mechanical and electrical solutions, the magnification of additive manufacturing and therefore its introduction to new applications is possible.