Left to Right: Rafael Almeida, John Kostal, Joshua Rubino, Professor Nejat Olgac

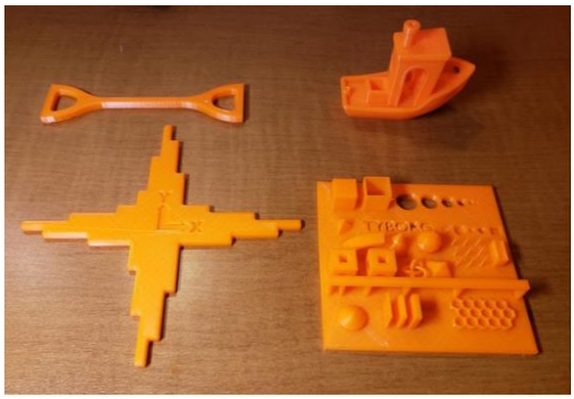
MECHANICAL ENGINEERING

TEAM: ME 29

SPONSOR: Naval Undersea Warfare Center

ADVISOR: Professor Nejat Olgac

Stabilizing a 3D Printer in a Dynamic Environment



The Naval Undersea Warfare Center (NUWC) is the United States Navy's main source of research and development, test and evaluation, engineering, and offensive and defensive weapons systems. 3D printing, an additive manufacturing process, is becoming increasingly desirable due to reduced cost and high accuracy capabilities for prototyping and production. In order to use such a device on naval vessels, technology will need to be implemented that allows additive manufacturing in a non-stationary environment subject to dynamic motion.

Given the high demand for precision parts and the fact that naval vessels spend weeks to months away from shore, 3D printing is an attractive alternative to stocking up on pricey replacement parts. Surface ships are subject to six degrees of freedom, that translation and rotation along and around the x-, y-, and z- axes. Three degrees of freedom have little impact on printing conditions, so pitch, heave, and roll are the focus for developing a stabilization system. The two sources of dynamic motion on a ship come from the low amplitude, high frequency vibration of machinery, and the varying motion caused by ocean waves. These two sources of motion must be tackled separately in order to produce an acceptable stabilization system.

The printer's stabilization system consists of three linear actuators programmed to counter the vessels heave, roll and pitch. Sensors along the base of the printer communicate the inclination of the base to the actuators. The actuators will then correct for this motion, and leave the printer in an upright position. Vibration isolators are mounted between the printer and the printer base to damp any external vibrations from inside the vessel. Tensile and dimensional accuracy tests are implemented to ensure homogeneity among parts in both static and dynamic operating conditions. This allows printed parts of complex geometries to be dimensionally accurate while being homogeneous and robust.