In-Space Additive Manufacturing using Asteroid-Mined Feedstock

Overview
Near Earth Object’s (NEO), such as asteroids, contain precious materials that NASA wants to use as raw material to additively manufacture long elements directly in space, rather than manufacturing them on Earth and launching the products into space. In order to print an extended length than what has already been done in space, the team demonstrated the use of deployable booms to extend the printer platform in the z-direction.

Objectives
The team developed a method for in-space 3D printing with asteroid-mined feedstock, demonstrated additive manufacturing with significant extension in one direction with the deployable boom concept, and identified materials for a suitable asteroid simulant.

Approach
- Had an initial meeting with sponsor and NASA employee to understand the project objectives
- Researched information about current in-space 3D printing methods and about asteroid mining
- Brainstormed various ways to print an extended length and used a Decision Criteria Evaluation Matrix to choose the best option (deployable booms)
- Brainstormed various ways to insert asteroid feedstock into the printer in zero gravity and used the Decision Criteria Evaluation Matrix to choose the best option (spring-loaded assembly)
- Met with our sponsor weekly to ensure the team was moving in the right direction
- Created designs using SolidWorks
- Purchased a 3D printer and modified it to show the deployable boom concept
- Purchased a large PEZ dispenser and took it apart to demonstrate the spring-loaded concept
- Collected materials that are commonly found in an asteroid to demonstrate the types of materials that would be used for an asteroid simulant
- Printed objects with the modified 3D printer to ensure that the concept was valid

Outcomes
- Compared to the first item that was printed in space (plastic wrench), this deployable boom concept can allow for a length up to one thousand times longer. Deployable booms are currently commercially manufactured up to 10m in length, but could be structurally sound up to 100m long.
- Delivered sample packets of materials that could be used in an asteroid simulant
- Suggested the use of LENS technology when actually carrying out the manufacturing process using asteroid feedstock in space