[Aerospace Engineering]

Project Name:	**DISARM (Debris in Space Autonomous Removal Mechanism)**
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Project Description:

The buildup of space debris in LEO (Low Earth Orbit) is posing a threat to future space missions due to the catastrophic effects a debris collision would have on a healthy spacecraft. Since 2010, there has been over a 500% increase in payload launch traffic in LEO. This leads to an increase in fragmentation debris, spent rocket stages, and defunct satellites, all of which pose a massive threat to functioning spacecraft. An increase in the density of space pollutants increases the probability of collisions between objects, leading to a cascade in which each collision generates more debris. This is known as the Kessler effect. If we are to keep using LEO to expand our scientific horizons, a method to mitigate this problem must be developed. The main challenge of removing space debris is capturing the debris in the first place. This project explores a solution to this problem by creating a system that utilizes capacitor discharge stud welding to autonomously capture large, problematic space debris.

The DISARM (Debris in Space Autonomous Removal Mechanism) system is designed to be a single-use mechanism that can be attached to a parent satellite. While relying on the parent satellite as a form of attitude adjustment, DISARM is capable of choosing an adequate welding location, analyzing position data, and autonomously starting and stopping welding once relative velocity and displacement conditions are met. After analyzing the weld, DISARM will either initiate failsafe mechanisms and attempt to weld again or proceed with deorbiting the debris. After deorbiting it, the debris should burn up in the Earth's atmosphere.

Capacitor discharge welding was chosen for this project because it is the fastest and most reliable form of contact welding. Additionally, it holds up well in an orbital environment, which poses considerable hurdles for more traditional forms of welding. The extreme temperature fluctuations, intense sunlight, and high speeds were all challenges that had to be overcome during the development of this project.

DISARM is equipped with a linear actuator that extends the welding system towards the debris. Additionally, Lidar LITE V4 sensor is used to gather position data between DISARM and the target debris. Once contact is made, the three welding prongs are each deployed by a servo motor. This releases the stud and completes the capacitor discharge circuit. When the circuit is completed, three welds are formed between the debris and DISARM on each of the three studs. DISARM's linear actuator can retract to pull the debris closer to the parent satellite. The parent satellite can then deorbit the debris using means such as thrusters or drag sails.