47th STUDENT CONFERENCE (E2)
Student Team Competition (3-GTS.4)

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MICROMETEOROID IMPACT DETECTION AND SUPPRESSION FOR ISS EVAS

Abstract

The high-velocity impacts of Micrometeoroid and Orbital Debris (MMOD) to spacecraft bodies are a major concern for habitable environments in Low-Earth Orbit (LEO). One consequence of these MMOD impacts is the development of sharp edges on the exterior of the International Space Station (ISS), particularly in areas that could be traversed during astronaut Extravehicular Activities (EVAs). These sharp edges can be dangerous because they are able to cut parts of the spacesuit and are small enough to escape visual detection. Therefore, it is necessary to design a solution that: (1) efficiently detects the location of these sharp edges so they can be avoided by astronauts, and (2) effectively suppresses sharp edges, making them safe for future EVAs.

The Illinois Space Society from the University of Illinois at Urbana-Champaign will present the design, manufacturing, and testing results of a sharp edge detection and mitigation device for the exterior handrails of the ISS. The Micrometeoroid Impact Detection and Suppression (MIDAS) device will mitigate the dangers of MMOD impacts on three of four faces on the ISS handrails. This tool was created in response to the NASA Micro-g NExT Sharp Edge Detection and Removal/Covering Challenge. MIDAS

is a multipurpose and reusable mechanism that detects sharp edges using Velcro and permanently covers the sharp edge with Kapton tape.

MIDAS unifies detection and covering capabilities into a single tool that is fully operational with the use of one hand. MIDAS consists of a perforated tape dispenser, ergonomic handle, and a Velcro-covered removable component that is molded to the shape of the handrails on the ISS. By solely using mechanical force, MIDAS accomplishes the challenge objectives in a simple and versatile package with a reliable and safe design.

Results from several underwater adhesion and simulated sharp edge detection tests have indicated that the device concept succeeds underwater. The team has experimentally determined an approximately constant coefficient of friction of Velcro as it slides along an aluminum rail with varying mass. This guarantees that astronauts will be able to detect a sharp edge and confidently mitigate the hazard at wide spans of application loads. A manufactured prototype is currently under development, and the tool will be tested in NASA's Neutral Buoyancy Laboratory in Houston, TX from June 3-6, 2019. Results from this test experience and a device prototype will be shared at the IAC presentation.