July 23, 2015

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EVA Glove Sensor Feasibility III

Injury risk assessment of Extravehicular Mobility Unit (EMU) Phase VI and Series 4000 gloves during Extravehicular Activity (EVA) hand manipulation tasks

Abstract

Functional Extravehicular Mobility Units (EMUs) with high precision gloves are essential for the success of Extravehicular Activity (EVA). Previous research done at NASA has shown that total strength capabilities and performance are reduced when wearing a pressurized EMU. The goal of this project was to characterize the human-space suit glove interaction and assess the risk of injury during common EVA hand manipulation tasks, including pushing, pinching and gripping objects. A custom third generation sensor garment was designed to incorporate a combination of sensors, including force sensitive resistors, strain gauge sensors, and shear force sensors. The combination of sensors was used to measure the forces acting on the finger nails, finger pads, finger tips, as well as the knuckle joints. In addition to measuring the forces, data was collected on the temperature, humidity, skin conductance, and blood perfusion of the hands. Testing compared both the Phase VI and Series 4000 glove against an ungloved condition. The ungloved test was performed wearing the sensor garment only. The project outcomes identified critical landmarks that experienced higher workloads and are more likely to suffer injuries. These critical landmarks varied as a function of space suit glove and task performed. The results showed that less forces were acting on the hands while wearing the Phase VI glove as compared to wearing the Series 4000 glove. Based on our findings, the engineering division can utilize these methods for optimizing the current space suit glove and designing next generation gloves to prevent injuries and optimize hand mobility and comfort.