IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Interactive Presentations - IAF HUMAN SPACEFLIGHT SYMPOSIUM (IP)

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ADJUSTABLE IVA SPACESUIT ERGONOMICS – UPPER BODY MOTION ENVELOPE REFERENCE MODEL

Abstract

This paper is a summary of findings recorded during a year-long collaborative research effort between the Florida Institute of Technology's Human Spaceflight Laboratory and Embry-Riddle Aeronautical University's Spacesuit Utilization of Innovative Technology Laboratory focused on physical ergonomics using an adjustable intravehicular activity (IVA) Terra Spacesuit manufactured by Final Frontier Design. The main goal of this analog research was to generate a reference model for reach envelope that provides concrete numerical data about potential spaceflight participants' or astronauts' upper body motion. The reach envelope was mapped using an IR motion tracking system in unsuited, suited unpressurized, and suited pressurized configurations. A range of human research subjects have been tested and the adjustability of the spacesuit allowed for ergonomically diverse datasets. These datasets are analyzed for patterns and anomalies in their range of motion. A motion envelope reference model is generated by averaging the work envelopes of all the subjects tested. This model will help space vessel cabin and cockpit system developers and designers identify the optimum placement of controls and components. Their function during specific phases of the spaceflight may require either unpressurized or pressurized spacesuit operations. The reachability of the control input systems is the primary factor in their placement inside the cockpit. More importantly though, the vehicle controls, system input devices, and displays should be not only within the reach, but also within an executable/usable position and configuration. The reference model developed by this collaborative effort is thus addressing the needs of the commercial spaceflight transportation companies in the area of a space vessel architecture, human system integration, human centered design, operations, and/or human factors engineering.