SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (4)

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SYSTEMS ARCHITECTURE FOR THE CREW MISSION TRAINER

Abstract

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NASA needs to prepare astronauts for spaceflight training in nominal and emergency scenarios for missions in the post-Shuttle era. NASA will be retiring Space Shuttle training and operations along with the Shuttle by 2010, and the next astronaut class will train in new Constellation training facilities. The strategic plan to move from a winged, reusable space vehicle to an in-line rocket with a crew capsule at the nose has changed the crew flight environment considerably. Relatively benign flight regimes for the crew have now been replaced with scenarios that include severe flight conditions. Ground launches will produce considerable vibration, shock and acceleration, and capsule re-entry/landings could result in sustained load conditions of at least 7 Gs. A review of current Constellation training and operations architecture has indicated a potential gap in coverage for a full task trainer that simulates the most extreme conditions. In order to support future space vehicle training and operations, a concept was developed for a dynamic three degree of freedom (DOF), centrifuge-based crew flight trainer which simulates the full mission environment in all flight phases.

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The entire Crew Mission Trainer system consists of three elements: the 3-DOF simulator, instructor/trainer control station, and the facility which houses the training system. The simulator rotates about the base to provide centripetal G-forces, and the crew pod (capsule) is allowed to rotate freely in pitch and roll axes. Control stations are operated by instructors/trainers. The facility includes a briefing room, observation area, utility room, and maintenance and spares rooms. The new flight trainer is also expandable and reconfigurable. As missions change, the system can be adapted to thoroughly train the astronauts.

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For this concept, a rigorous systems engineering approach was used to create a fully integrated set of requirements, an architecture, and a concept of operations that meets the needs of NASA in the 21st Century. The result of the study is a novel trainer based on commercially available technology that has received attention from NASA mission training/operations engineers as a viable alternative to anticipated plans for Constellation training and operations architecture. The analysis brought into focus the need for

a trainer that simulates anticipated extreme environments. These include sustained positive and negative g-forces, with flight-like displays & controls and crew interfaces that will enable the crew to be prepared for all possible flight scenarios.