SPACE OPERATIONS SYMPOSIUM (B6)
Human Spaceflight Operations Concepts (1)

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DEVELOPMENT AND VERIFICATION OF GROUND-BASED TELE-ROBOTICS OPERATIONS CONCEPT FOR DEXTRE

Abstract

The Special Purpose Dexterous Manipulator (Dextre) is the latest addition to the on-orbit segment of the Mobile Servicing System (MSS); Canada's contribution to the International Space Station (ISS). Launched in March 2008, the advanced two-armed robot is designed to perform various ISS maintenance tasks on robotically compatible elements and on-orbit replaceable units using a wide variety of tools and interfaces. The addition of Dextre has increased the capabilities of the MSS, and has introduced significant complexity to ISS robotics operations. While the initial operations concept for Dextre was based on human-in-the-loop control by the on-orbit astronauts, the complexities of robotic maintenance and the associated costs of training and maintaining the skills required for Dextre operations demanded a reexamination of the old concepts and the development of new approaches in order to utilize the capabilities of Dextre safely and efficiently, while at the same time reducing the costs of on-orbit operations.

This paper will describe the development, validation, and on-orbit demonstration of the operations concept for ground-based tele-robotics control of Dextre. It will describe the evolution of the new concepts from the experience gained from the development and implementation of the ground control capability for the Space Station Remote Manipulator System. It will discuss the various technical challenges faced during the development effort, such as requirements for high positioning accuracy, force/moment sensing and accommodation, failure tolerance, and complex tool operations, and the novel operational tools and techniques developed to overcome them. The paper will also describe the work performed to validate the new concepts on the ground as well as on orbit. The paper will also discuss the results and lessons learned from the on-orbit checkout and commissioning of Dextre using the newly developed tele-robotics techniques and capabilities.