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THE EVOLUTION OF TELE-ROBOTICS ON ISS AND ENABLING OF UNMANNED ON-ORBIT
SERVICES

Abstract

On January 27, 2011, the Canadarm2, controlled by the on-orbit crew, successfully tracked and captured the 35,000 lb free floating Japanese H-2 Transfer Vehicle (HTV2) as it drifted within 10m of the International Space Station (ISS). After precisely guiding the HTV2 into its berthing port on the ISS, and while Astronauts unloaded food, water, clothing, spare equipment and experiments from inside the pressurized portion of the HTV2, outside the Space Station's Canadarm2 and Dextre robotic systems began the important task of unloading ISS spare parts from the HTV's unpressurized external carrier for transfer and stowage to an ISS Express Logistics Carrier (ELC). These tele-robotic operations, performed by ground operators in the United States and Canada, required extreme precision in combination with delicate force sensing and accommodation control and successfully demonstrated some of the most advanced robotic servicing tasks performed in space to date; from grabbing a large free-flying vehicle the size of a city bus, to the fine manipulation of small components. Together these operations, and the technology and operational techniques utilized to successfully complete them, lay the foundation for future advancements in remote operations and supervised autonomous robotics that will fully enable unmanned on-orbit servicing operations.

This paper reviews the critical mission role of the Canadian ISS robotics in the resupply and maintenance of the International Space Station by identifying the challenges experienced to date, and the future technology development advancements planned. These advancements are aimed at further streamlining and automating current tele-robotics operations with the overall goal of shifting a greater responsibility for control and monitoring of servicing robotics to ground control personnel, thereby freeing more on-orbit crew time towards other more scientifically rewarding ISS utilization activities.