SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Novel Concepts and Technologies for Enable Future Building Blocks in Space Exploration and Development (3)

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THE NEXT GENERATION CANADARM PROJECT – ENABLING FUTURE ROBOTIC SERVICING MISSIONS

Abstract

The use of robots to maintain, enhance and extend the life of exploration and commercial spacecraft is fundamental to achieving the goal of a sustainable and affordable space infrastructure. This is recognized by the Canadian Space Agency (CSA) and its various international partners, and reflected in strategic roadmaps such as the Global Exploration Strategy and the International Space Exploration Coordination Group (ISECG) Global Exploration Roadmap. Furthermore, significant flight robotic servicing heritage already exists, mostly in Low Earth Orbit, including from the Space Shuttle (Canadarm), International Space Station (Canadarm2, Dextre, Kibo Robotic Arm), and Orbital Express demonstration mission. To enable full robotic servicing missions, there are numerous challenges to address, including spacecraft location, spacecraft preparedness for robotic servicing, mission duration, number of spacecraft, stowage on smaller spacecraft, location of operators, and desired level of autonomy. To this end, the CSA initiated the Next Generation Canadarm (NGC) Project in 2009 to produce new prototypes for an end-to-end robotic on-orbit servicing system, capable of demonstrating a comprehensive complement of capabilities needed to service and refuel future prepared and unprepared spacecraft in in various orbits. Design Reference Missions (DRMs) were defined by the CSA requiring the following capabilities: (i) service both legacy (near-term) and next generation spacecraft (future); (ii) service families of spacecraft in the same or similar orbits; (iii) service spacecraft without impacting its operations; (iv) execute different servicing tasks without involving additional complex space vehicles. These DRMs were used as the basis for developing an NGC mission architecture, operations concept, and top-level requirements for a flight system with elements from spacecraft proximity operations and docking, small and large manipulator systems, tools for robotic tasks, fuel transfer systems, and ground control stations. In addition, a review of existing technologies with applicability to the DRMs was used as the basis for identifying path-to-flight technologies to advance such as compact end effectors, tools, joints, cameras, avionics, manipulator deployment systems with telescopic booms, docking sensors, propellant transfer systems, and an integrated robotic ground control station. This paper will describe the NGC DRMs, mission and flight system requirements, key design drivers and the recently completed NGC prototypes. Additionally, initial test results from utilization of NGC Test

Beds that showcase these prototypes will be presented, along with recommendations for how the NGC technologies and the NGC test beds can be utilized to realize future on-orbit servicing missions.