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Author: Mr. Richard Rembala
MDA, Canada, richard.rembala@mdacorporation.com

Mr. Paul Fulford
MDA, Canada, paul.fulford@mdacorporation.com
Dr. Yves Gonthier
Canadian Space Agency, Canada, yves.gonthier@canada.ca

DEEP SPACE EXPLORATION ROBOTICS FOR IMPROVED CAPABILITY, UTILIZATION, AND
FLEXIBILITY ON A CISLUNAR HABITAT

Abstract

The exploration of space is a highly visible endeavor, a powerful driver for scientific and technical innovation, a magnet for world-class talent, and an incentive for youth to pursue careers in science and technology. Today, international space agencies are collecting and planning for future human missions beyond low Earth orbit in the 'Proving Ground' – the space in the vicinity of the moon – in preparation for future human-robotic missions to Mars and outward into our solar system.

Space robotics have played a necessary and important role in our past and present human space flight missions and will play an even more important role as robots and humans explore space beyond low Earth orbit. A Deep Space eXploration Robotics (DSXR) system concept, funded by the Canadian Space Agency (CSA), is presented as a potential contribution to future international beyond LEO human space exploration missions to satisfy the mission need for capture, berthing and relocation of visiting vehicles and modules, support external logistics and maintenance, perform inspections of the habitat and visiting vehicles, as well as offer support to Extra-Vehicular Activity (EVA).

This paper will present both the technical and business case aspects of a DSXR. The DSXR concept is a self-relocatable manipulator that can move around the external surfaces of its host vehicle using a low-profile end-effector that can interface with habitat fixtures as well as a variety of tools (or secondary end effectors) to support different operations. The specialized tool suite includes a Tool Caddy that enables the manipulator to relocate around its host vehicle while carrying payloads and tools, a Small Dexterous Arm that enables the robotic system to conduct automated vehicle inspection, repair, and logistics management, and a Free-Flyer Capture Tool to support the automated capture and berthing of logistic supply vehicles.

This paper will also present the business case for the Government of Canada; a value assessment in accordance with the key stakeholder mandates and needs that has ultimately shaped the design of DSXR.