SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – Part 2 (3B)

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MARS EXPLORATION SCIENCE ROVER PROTOTYPE FOR SCIENCE & SAMPLE RETURN

Abstract

The Mars Exploration Science Rover (MESR) program is part of the broader Exploration Surface Mobility (ESM) activity currently being undertaken by the Canadian Space Agency (CSA). The objective of this program is to develop an end-to-end prototype of a Mars science-class rover system, integrate this system with ESM science instruments and payloads, and perform analogue mission deployments to gain operational experience. MESR leverages and extends Canada's recent advances in exploration robotic systems.

The MDA-led MESR system primarily supports autonomous science prospecting and in situ geological analysis operations. The chassis and locomotion system was designed by Bombardier Recreational Products Centre for Advanced Technology (BRP-CTA), with excellent obstacle crossing and continuous steering from low curvatures down to point turns. A path-to-flight power system has been designed by the University of Toronto Institute for Aerospace Studies (UTIAS) Space Flight Laboratory, based on nanosatellite heritage. Onboard sensors include a scanning lidar, stereo, zoom, and belly cameras, a sun sensor, and a navigation-grade inertial measurement unit. These sensors provide excellent situational awareness to the ground operators, as well as enabling fully autonomous precision traverses to operator-selected sites of scientific interest, and generation of a world terrain map. Using innovations developed by the UTIAS Autonomous Space Robotics Laboratory, the MESR can visually learn a path and then repeat the traverse in either direction autonomously. The software architecture supports a Mars-representative command scheme, providing a mission scripting language and telemetry prioritization for use under lim-

ited communication windows and bandwidth constraints. Modularity and flexibility have been built into the architecture for future upgradeability. The rover control station has been designed to support analogue exploration missions either from the field or from a remote operations centre.

Completion of the MESR vehicle is anticipated for July 2012, with verification to be performed through a comprehensive test campaign conducted in representative outdoor environments, such as the Mars Emulation Terrain at the CSA headquarters. After successful commissioning of the rover, payloads will be integrated. The current planned suite of payloads includes a small manipulator arm, microscope, and mini-corer, all concurrently developed under CSA's ESM program. The integrated exploration system will then be deployed for an analogue mission in Mars-like conditions. Future work may include additional or upgraded software modules, integration with other ESM payloads, and further deployment in cooperation with the international space exploration community.