

A Sub Surface Sample Acquisition and Handling System for Mars Exploration

Progress report

Dale S. Boucher¹, J.R Richard², P.Fulford, M.Daly³, E. Dupuis⁴

1.Northern Centre for Advanced Technology Inc., Sudbury, Ontario, Canada

2. Electric Vehicle Controllers Ltd., Hanmer, Ontario, Canada

3. MD Robotics Ltd, Brampton, Ontario, Canada

4. Canadian Space Agency, St-Hubert, Québec, Canada

The Northern Centre for Advanced Technology Inc. (NORCAT) and Electric Vehicle Controllers Ltd. (EVC), in partnership with MD Robotics and under contract to the Canadian Space Agency, are developing an integrated drill, sample handler, and sample preparation system for sub surface sampling for exploration missions to Mars and other planetary bodies. The partnership brings to the table world leading expertise in space robotics and in mining technologies. This Sample Acquisition and Handling System (SAHS) is a tightly integrated package consisting of a drill, a sample acquisition sub-system, a sample manipulator sub-system, and a sample preparation sub-system.

The drill is responsible for propagating and stabilizing an access path to sub surface, as well as forming and extracting samples from the sample zone(s). The sample acquisition hardware manages the samples and delivers them to a common access point at surface for use by the sample handler and preparation system. The sample handler will perform triage on the samples brought back to the surface and distribute the samples to the sample preparation system or to analytic instruments.

The Drill Sub-system has been successfully tested to depths of over 2 meters through various stratified media, including dolomite, dust, sand, and basalt. Design and development to a Technology Readiness Level 4 (TRL-4) proof of concept machine was completed in March of 2002. This technology is being further developed to include a lander based deep drill capability of 20 meters and a low mass rover class drill to 1- 2 meters.

The sample retrieval hardware is under development. This piece of equipment will leverage technologies from the terrestrial deep drilling industry.

The Sample Manipulator is a 5 degree-of-freedom robot capable of acquiring core samples from the Drill Sub-system and distributing them between the sample preparation sub-system, the analytic instruments or sample storage.

The Sample Preparation Sub-system is a multi-purpose facility that is capable of assessing incoming core samples for features of scientific interest and of preparing the samples to ensure their compatibility to the science instruments.

Because a drill can produce more material than can be analysed, it is necessary to select which core or cuttings samples will be analyzed in detail. The samples are assessed through a triage system to determine their relative scientific value. If samples are deemed worthy of further scientific study, they are evaluated for level of consolidation. Consolidated samples are placed into a container and offered up to a cutter, polisher, and/or grinder. Unconsolidated samples are passed directly through to the grinder.