

Canadian Autonomous Landing and Lunar Exploration Technologies

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Abstract. In coming decades, planetary exploration will change its focus from remote observation to robotic in situ exploration, sample-return missions and eventually human missions. Two Canadian companies have combined 30 years of heritage in terrestrial and space technologies to provide new capabilities in space, including autonomous landing and exploration technologies for lunar exploration. MDA is the world leader in space robotics, a key element of the Canadian Space Program for the last two decades with over \$2-billion CDN of total investment. Robotic arms designed and built by MDA are used on virtually all flights of the Space Shuttle and the three robotic systems comprising the Mobile Servicing System - SSRMS, MBS, and SPDM - have been designed and built for the International Space Station. Optech is the world leader in terrestrial lidar systems with 30 years of technology heritage. A strategic partnership of MDA and Optech was formed in 2002 to provide unique space lidar solutions for space operations and planetary exploration. Now as robotic exploration moves in earnest beyond Earth orbit, strategic technologies are being developed by Optech and MDA that will allow Canada to expand its world leading position in space sensors and robotics to become a dominant provider of robotic exploration systems and missions targeted at the Moon, Mars, asteroids, and beyond.

The key requirements for successful planetary exploration in topographically diverse areas include a spacecraft capable of precision landing and hazard avoidance. Since 2001, Optech and MDA, together with the Canada Space Agency, have been developing a hazard avoidance system capable of actively identifying safe landing sites during descent and providing navigational information to spacecraft GNC systems. The autonomous planetary landing system is being designed to support landings on large or small planetary bodies, with or without atmospheres, and apply active safe landing algorithms based on spacecraft landing safety parameters.

This paper provides an overview of Canadian activities currently underway in the area of Autonomous Landing and Lunar Exploration Technologies. Application of these space robotic lidar systems to numerous lunar mission phases is discussed, from orbit, descent and precision landing through surface traverse, target selection and in situ science investigation.