Rover and Sub-Surface Explorer Research & Development in NASA's Planetary Exploration Program*

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Abstract

In the last several years, since the successful 1997 deployment and operation of the Sojourner rover on the surface of Mars, NASA has entered a new era of space exploration, where the emphasis is on in-situ exploration of planetary surfaces by means of a new class of robotic systems. For example, advanced sample return rovers with demonstrated technology far beyond Sojourner are in preparation for Mars sample return missions within the next five years. In response to challenges in the more distant horizon, robots capable of autonomous reconfiguration for all terrain navigation, and for multi-robot cooperative operations within robotic outposts, are R & D topics of intense interest. Robotic outposts are relatively new mission concepts that aim to establish a permanent robotic presence on planetary surfaces, to conduct extensive science operations using multiple surface robots, and to pave the way for eventual human presence by the robotic deployment and assembly of the infrastructure necessary for subsequent human missions. Robotic outposts are anticipated for missions in the 2005-2015 time period. Another important R & D topic is that of deep drilling using robots. The goal of this research is to demonstrate technology to search the Mars sub-surface for water and signs of past life, using autonomous robotic systems that can penetrate 10's and even 100's of meters below the surface. Important concurrent applications of this drilling technology occur for mission concepts under development to acquire and return samples from asteroid and comet surfaces and sub-surfaces. This paper presents an overview of the robotic surface systems research being supported by NASA, including investigations at universities, NASA centers, and other major centers for robotics research. The paper includes the results of terrestrial demonstrations that have been conducted to establish technology readiness for currently planned missions about to fly, as well as developments under way for more futuristic missions to be implemented later in the next decade.

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