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Novel Concepts and Technologies to Enable Future Building Blocks in Space Exploration and Development (3)

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MARS PROSPECTOR: LEADING THE WAY TO IN-SITU RESOURCE UTILIZATION ON THE RED PLANET

Abstract

With the growing prospect of humans once again venturing beyond Earth orbit to establish planetary outposts, the identification and assessment of in-situ resources at planned destinations is paramount. Currently, opportunities for assessing such resources depend on space-agency planning and mission cycles that generally focus on science return rather than addressing a specific need. We present a novel concept for rapidly implementing a resource-prospecting orbiter using a spacecraft bus and instruments already at high technology readiness levels (TRL).

The Mars Prospector mission concept is focused on assessing known but not adequately characterized resources for utilization at future human landing sites on the Red Planet. The mission is designed around the spacecraft bus being built by the University of Colorado's Laboratory for Atmospheric and Space Physics (LASP) for the Emirates Mars Mission (EMM). Two primary instruments are a multi-band radar sounder that will assess the presence, depth, and concentration of buried water ice and an imaging spectrometer that will identify and map hydrated minerals amenable to extraction of water. All components are to be derived from existing hardware, reducing the risks and long development times normally associated with science-focused missions. In addition, by concentrating the mission goals on prospecting in well-defined areas, we will reduce the typical far-reaching requirements for planetary orbiters, thereby simplifying engineering, integration, and operations.

The multi-band radar is derived from current Mars sounders, modified to provide resolutions that are sub-meter vertically and sub-kilometer horizontally. These updates are intended to establish the lateral extent and resolve the top and bottom of buried ground ices thought to exist in large regions of Mars' northern plains. They also enable characterization of the debris and its thickness covering glaciers in the mid-latitudes of both hemispheres in locations accessible from future human landing sites.

The imaging spectrometer design will be focused primarily on identifying and mapping hydrated minerals, but it will also allow thermal measurements for assessing physical properties of surface materials. By narrowly constraining the instrument goals in this fashion, a number of current, relatively low-cost spectrometers could be adapted to provide the bandwidth, spectral and spatial resolutions, and accuracy needed for these purposes.

The Mars Prospector mission concept is modular, allowing different instruments to be affixed to the LASP/EMM bus. This feature opens the door for potential follow-on missions to the Moon, back to Mars, or to small bodies of interest for resource assessment and prospecting.