HUMAN EXPLORATION OF THE MOON AND MARS SYMPOSIUM (A5)
Long Term Scenarios for Human Lunar Presence (2)

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THE SCIENCE RATIONALE FOR FLEXIBLE PATH: A ROBOTICALLY-INTENSIVE, CREW-BASED EXPLORATION STRATEGY FOR THE 21ST CENTURY

Abstract

In 2009, the new U.S. Presidential Administration convened a special committee, led by former aerospace executive Norman Augustine, to recommend options for the future direction of human space flight. It was assumed that the U.S. President would select one of these options or a combination thereof, and use it as a basis for a new national space policy. One of the two preferred options – the "Flexible Path" strategy – differs substantially from the Moon and Mars-oriented paradigm that has driven U.S. investment in the past. It combines the best features of human and robotic spaceflight, and achieves the dual benefit of advancing capabilities in planetary science, while facilitating crewed voyages to exciting new destinations within the solar system. It refrains from placing humans on planetary surfaces at the bottom of large gravity wells, and instead concentrates on sending piloted spacecraft to in-space locations and to the surfaces of small planetary bodies. One potential near-term destination is lunar orbit, which is well within the capability of systems currently under development. With more sophisticated systems, it would be possible to send human explorers to several Near Earth Asteroids (NEAs), Mars orbit, Mars' two moons Phobos and Deimos, and conceivably Venus orbit.

For small planetary bodies and in-space locations, the spacecraft would rendezvous directly with the object of study. Operations would be conducted immediately from the spacecraft, without the need for dedicated landers and ascent vehicles. For orbital destinations, the crew would explore via teleoperation of robotic vehicles and systems pre-deployed on the surface. By eliminating the significant communications delay with Earth due to the speed of light limit, teleoperation provides scientists real-time control of rovers and other sophisticated instruments, in effect giving them a "virtual presence" on planetary surfaces, and thus expanding the scientific return at these destinations. This closely approximates the cognitive and decision-making advantages of having humans at the site of study, and unlike today's autonomous robotic missions, provides real-time command and control of operations and experiments. It is very similar to how oceanographers and other explorers use telerobotic submersibles to work in inaccessible areas of the ocean.

This paper lays out the scientific rationale for Flexible Path, and explains its chief advantages as an exploration strategy for the 21st Century, that is human-equivalent field-work on other planets; facilitated return of samples from the Mars and Venus surface; and expanded opportunities for international collaboration through contribution of robotic systems.