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HUMAN EXPLORATION USING REAL-TIME ROBOTIC OPERATIONS (HERRO) - A SPACE EXPLORATION STRATEGY FOR THE 21ST CENTURY

Abstract

This paper presents an exploration strategy for human missions beyond Low Earth Orbit (LEO) and the Moon that combines the best features of human and robotic spaceflight. This "Human Exploration using Real-time Robotic Operations" (HERRO) strategy refrains from placing humans on the surfaces of the Moon and Mars in the near-term. Rather, it focuses on sending piloted spacecraft and crews into orbit around exploration targets of interest, such as Mars, and conducting astronaut exploration of the surfaces using telerobots and remotely-controlled systems. 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. It also eliminates development of the numerous man-rated landers, ascent vehicles and surface systems that are required to land humans on planetary surfaces.

The propulsive requirements to travel from LEO to many shallow gravity well destinations in the inner solar system are quite similar. Thus, a single spacecraft design could conceivably perform a variety of missions, including orbit-based surface exploration of the Moon, Mars and Venus, and rendezvous with Near Earth Asteroids (NEAs), as well as Phobos and Deimos. Although HERRO bypasses many of the initial steps that have been historically associated with human space exploration, it opens the door to many new destinations that are candidates for future resource utilization and settlement. HERRO is a first step that takes humans to exciting destinations beyond LEO, while expanding the ability to conduct science within the inner solar system.

For orbital destinations, the crew would explore via teleoperation of robotic vehicles and systems pre-deployed on the surface. This closely approximates the cognitive 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.

In summary, the advantages of HERRO are:

- Broadens the range of destinations for near-term human missions;
- Reduces cost and risk through fewer man-rated elements and less complexity;
- Offers benefits of human-equivalent in-situ cognition, decision-making and field-work on planetary bodies;
- Provides a simpler approach to returning samples from Mars and planetary surfaces;
- Facilitates opportunities for international collaboration through contribution of robotic systems.