National Aeronautics and Space Administration

NASAfacts

Space Technology
Game Changing Development
Human Robotic Systems

Should humans and robots explore space together? There is a lot of debate on this topic in the spaceflight community, but the Human Robotic Systems (HRS) project develops systems and approaches that enable both human and robotic exploration.

Humans perform what humans do well: making decisions and solving problems based on experience. Robotic systems perform the tedious, dangerous and hazardous jobs and serve in apprentice roles to astronauts. This allows the crew to perform higher value, more critical tasks.

HRS is a thematic project within NASA Space Technology's Game Changing Development Program and focuses on mobility, manipulation and human systems interaction. The technology development approach employed within HRS is to reuse existing prototype systems or rapidly adapt existing component technologies as new NASA requirements emerge.

The HRS project provides a midlevel technology readiness level (TRL) infusion point for lower TRL projects and programs within NASA, including the National Robotics Initiative, NASA Innovative Advanced Concepts, NASA Space Technology Research Fellows, Small Business Innovative Research and Small Business Technology Transfer.

Technologies currently in the HRS portfolio include the following:

Technologies for Robonaut: Current products being developed by HRS will contribute toward Robonaut gaining mobility on the International Space Station (ISS). To become mobile, Robonaut will need a to handrail. HRS will contribute the set of climbing legs, which will be used on Earth to develop walking algorithms in gravity offload facilities. HRS will also contribute the battery that will be used as the ground-based leader. The leader battery will be used to safely test all battery operations on the ground prior to testing on ISS.

Robotic Technologies for Asteroid Missions: Developments for asteroid missions highlight the strategy within HRS to rapidly adapt existing technologies for new NASA requirements. HRS is currently adapting prior investment in robotic systems to prototype capture mechanisms for the Asteroid Redirect Mission. HRS has both primary and alternate capture missions under development.

Robonaut 2.

Soft regolith auger for the Asteroid Redirect Mission.

Technologies for Controlling Robots Over Time Delay: When commanding a remote robot, there is a delay between issuing a command and the remote robot receiving the command. A symmetric delay occurs between robot motion and being able to perceive it remotely. HRS is developing technologies to safely command remote robots

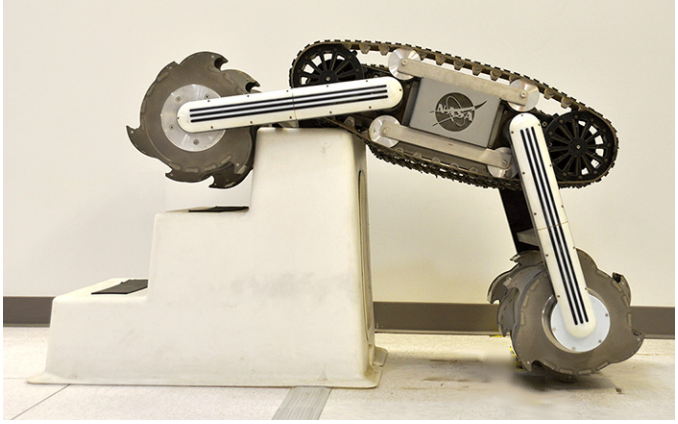
K10 robot with advance navigation sensing.

over time delays. Included in this development is the Robot Application Programmer's Interface Delegate (RAPID) robot data messaging system. In the summer of 2013, RAPID was infused as the messaging system for an ISS to ground (Earth) surface robot experiment as part of a Human Exploration Telerobotics project.

Extreme Terrain Mobility: The ability for astronauts and robots to travel in the extreme terrains encountered off-world has been highlighted as an enabling capability for NASA missions. HRS develops enabling technologies for extreme terrain mobility. Current development in this area includes the X1 lower-body exoskeleton, which can augment crew endurance or strength, and could also be used as a lightweight crew exercise device or to measure crew joint strength. On Earth, this same device is being used in research as an assistive walking device. Other developments include a hands-free jet pack that can be used for primary crew mobility, advanced navigation for surface telerobotics, and advanced rover technologies.

Robotic In-Situ Research Utilization Acquisition: Another enabling capability for NASA missions will be the ability to harness in situ resources, those native to in-space destinations. HRS has been developing technologies for reducing excavation forces, including the Regolith Advanced Surface Systems Operations Robot (RASSOR). HRS is also supporting the Lunar

X1 exoskeleton.



RASSOR is an excavating robot that can climb over a large obstacle, such as a boulder on the Moon.

Resource Prospector Mission with Exploration Ground Data Systems (xGDS) operating tools. xGDS is a tool used for planning, executing and archiving a variety of science and exploration missions.

The Game Changing Development (GCD) Program investigates ideas and approaches that could solve significant technological problems and revolutionize future space endeavors. GCD projects develop technologies through component and subsystem testing on Earth to prepare them for future use in space. GCD is part of NASA's Space Technology Mission Directorate.

For more information about GCD, please visit
http://gameon.nasa.gov/

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