NASAfacts

Space Technology
Game Changing Development
Human Exploration Telerobotics 2

Overview

The purpose of the Human Exploration Telerobotics 2 (HET2) project is to mature telerobotics technology to increase the performance, reduce the cost, and improve the success of human space exploration. To do this, HET2 will develop a new robot, the Astrobee free-flying robot, and mature Robonaut 2 to off-load routine and repetitive work from astronauts and extend and enhance crew capabilities. HET2 will test these robots in laboratories on the ground and on the International Space Station (ISS).

Motivation

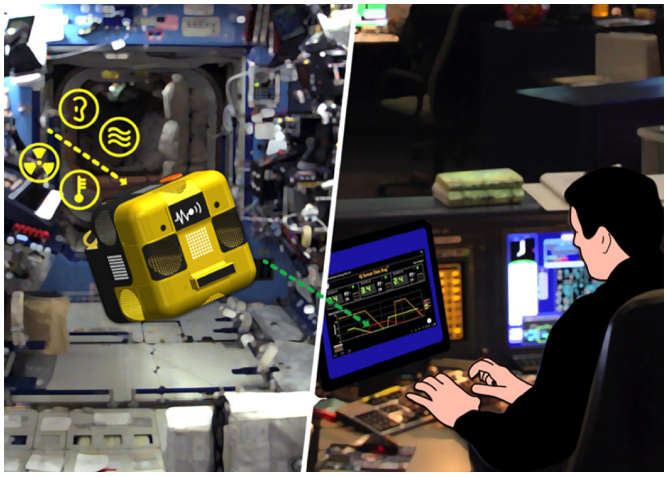
Future human space missions in Earth orbit, to the Moon, and to distant destinations offer many new opportunities for exploration. Astronaut time will always be in short supply, consumables (e.g., oxygen) will always be limited, and some work will not be feasible or productive for astronauts to do manually. Remotely operated robots, however, can complement astronauts by performing this work under remote supervision by humans from a space station, spacecraft, habitat, or even from Earth.

Today, astronauts on the ISS not only conduct science activities, but also perform a variety of tasks required for ISS housekeeping and in-flight system maintenance. The remote monitoring and operation of many ISS systems by ground control has become an accepted practice during the past decade for certain ISS tasks. In terms of telerobotics, however, these tasks are limited to coarse positioning maneuvers of external payloads/structures using manipulator arms, such as the Space Station Remote Manipulator System (SSRMS).

However, other types of robots, particularly free-flyers and dexterous humanoids, offer significant potential to perform a greater variety of tasks. These tasks include routine, repetitive or simple but long-duration work, such as conducting environment surveys, taking sensor readings, monitoring crew activities or performing routine maintenance. Thus, the central focus of HET2 is to develop, test, and demonstrate how advanced telerobots, which can be operated by ground controllers on Earth and by astronauts in space, can effectively and efficiently carry out these tasks.

Astrobee

Since Fall 2014, we have been developing the Astrobee free-flying robot. This new robot will build upon technology and lessons learned from the “Smart Synchronized Position



Artist’s concept of the Astrobee free-flying robot performing a mobile sensor task.

Hold, Engage, Reorient, Experimental Satellite" (Smart SPHERES) robot. Astrobee will be designed to address a variety of scenarios including mobile sensor (e.g. imagers or sound level meters), automated logistics (e.g., mobile inventory), and free flying robotic test bed.

Astrobee will develop and test robot technologies required for autonomous operations, mobility, and remote operation by ground controllers, and human-robot interaction with crew. These technologies include propulsion, robot user interface (proximal and remote), supervisory control, payload interface, and navigation.

The Astrobee system objectives are to:

- Provide a microgravity robotic research platform for the ISS.
- Perform mobile camera tasks in the ISS U.S. On-orbit Segment (USOS).
- Perform mobile sensor tasks for environment monitoring and logistics in the ISS USOS.

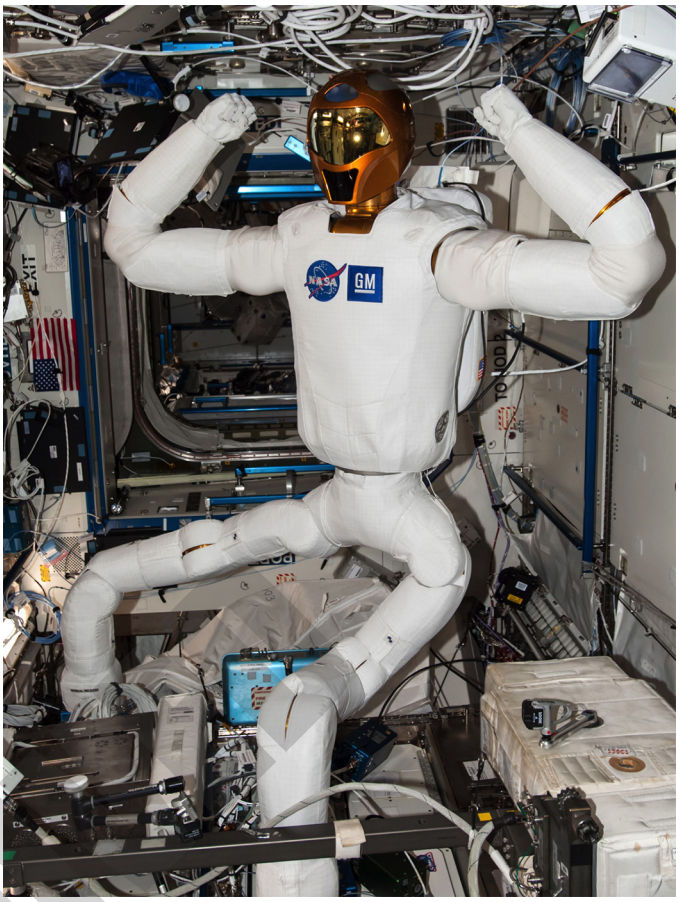
Robonaut 2

Robonaut 2 (R2) has been onboard the International Space Station since launching aboard space shuttle Discovery on the STS-133 mission in February 2011. It is the first humanoid robot in space, and although R2's primary job for now is demonstrating to engineers how dexterous robots behave in space, the hope is that, through upgrades and advancements, it could one day venture outside the space station to help astronauts make repairs or additions to the station or perform scientific work.

R2 was recently upgraded with robotic legs, more powerful computing capabilities, and a vastly improved software control and safety system. These improvements will allow Robonaut to move around the ISS, allowing engineers to develop technologies needed for robotic maintenance and servicing of space station structures and systems. Some tasks envisioned for R2 include inspection, inventory, vacuuming air filters, and cleaning handrails. These are all essential tasks currently completed by human crew.

Acknowledgments

The Intelligent Robotics Group at NASA's Ames Research Center in Mountain View, CA, manages the HET2 project.



R2 with robotic legs inside the ISS.

The project involves research and development at Ames; NASA's Johnson Space Center in Houston, TX; and the agency's Jet Propulsion Laboratory in Pasadena, CA. The NASA Game Changing Development Program (Space Technology Mission Directorate) and ISS SPHERES Facility (Human Exploration and Operations Mission Directorate) provide support for this work.

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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