NASA SBIR 2011 Phase I Solicitation

X7 Human-Robotic Systems

This call for technology development is in direct support of the Exploration Systems Mission Directorate (ESMD). The purpose of this research is to develop component and subsystem level technologies to support robotic precursor exploration missions. To that end, it is the intent of this Topic to capitalize on advanced technologies that allow humans and robots to interact seamlessly and significantly increase their efficiency and productivity in space. The objective is to produce new technologies that will reduce the total mass-volume-power of equipment and materials required to support both short and long duration planetary missions. The proposals must focus on component and subsystem level technologies in order to maximize the return from current SBIR funding levels and timelines. Doing so increases the likelihood of successfully producing a technology that can be readily infused into existing robotic system designs. This research focuses on technology development for the critical functions that will ultimately enable surface exploration for the advancement of scientific research. Surface exploration begins with short duration missions to establish a foundation, which leads to extensible functional capabilities. Successive buildup missions establish a continuous operational platform from which to conduct scientific research while on the planetary surface. Reducing risk and ensuring mission success depends on the coordinated interaction of many functional surface systems including power, communications infrastructure, and mobility and ground operations. This topic addresses technology needs within three subtopic areas:

- Mobility systems.
- Dexterous manipulation.
- The interfaces that facilitate productive and seamless interaction between humans and robots.

Subtopics

X7.01 Human Robotic Systems - Human Robot Interfaces

Lead Center: ARC

Participating Center(s): JPL, JSC

The objective of this subtopic is to create human-robot interfaces that improve the human exploration of space. Robots can perform tasks to assist and off-load work from astronauts. Robots may perform this work before, in

support of, or after humans. Ground controllers and astronauts will remotely operate robots using a range of control modes, over multiple distances (shared-space, line-of-sight, in orbit, and interplanetary), and with a range of time-delay and communications bandwidth.

This subtopic seeks to develop new technologies that enable crew and ground controllers to better operate, monitor and supervise semi-autonomous robots. Of particular interest is software that improves robot operator productivity, situational awareness, and effectiveness.

Proposals are sought that address the following technology needs:

- Crew telerobotic interfaces. User interfaces that enable crew to remotely operate and monitor robots from inside a flight vehicle, habitat and/or during an extra-vehicular activity (EVA). User interfaces must be appropriate and relevant for use with near-term flight systems.
- Robot performance monitoring software. Software tools that enable remote monitoring of robot performance, detection of anomalies and contingencies, assessment of robot utilization and situational awareness of remote robot operations.
- Robot tactical planning software. Software tools that enable efficient, rapid handling of contingencies during robot tactical operations. This may involve a combination of embedded and user interface modules.
- Robot ground data systems. Systems and software for robot command planning and sequencing, telemetry processing, sensor/instrument data management, and automating ground control functions.

This subtopic does not solicit proposals for direct teloperation (e.g., joystick-based rate control), telepresence, or immersive virtual reality subsystems or systems.

X7.02 Human-Robotic Systems - Mobility Subsystems

Lead Center: JSC

Participating Center(s): ARC, JPL

The objective of this subtopic is to create human-robotic technologies (hardware and software) to improve the exploration of space. Robots can perform tasks to assist and off-load work from astronauts. Robots may perform this work before, in support of, or after humans.

Ground controllers and astronauts will remotely operate robots using a range of control modes (teleoperation to supervised autonomy), over multiple spatial ranges (shared-space, line-of-sight, in orbit, and interplanetary), and with a range of time-delay and communications bandwidth.

Proposals are sought that address the following technology needs:

- Subsystems to improve the transport of crew, instruments, and payloads on planetary surfaces, asteroids, in-space; and improve handling and maintenance of payloads and assets. This includes hazard detection sensors/perception, active suspension, grappling/anchoring, legged locomotion, robot navigation, and infrastructure-free localization. As well as, tactile sensors, human-safe actuation, active structures, dexterous grasping, modular "plug and play" mechanisms for deployment and setup, small/lightweight excavation/drilling devices to enable subsurface access, and novel manipulation methods.