This call for technology development is in direct support of the Human Exploration and Operations Mission Directorate (HEOMD). 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 Subtopic 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, mobility, and ground operations. This Subtopic addresses robotic manipulation and related technology needs associated with planetary surface systems infrastructure, interaction of humans and machines, mobility systems, payload and resource handling, and mitigation of environmental contaminations.

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 that improve handling and maintenance of payloads and assets.

Enable crew and ground controllers to better operate, monitor, and supervise robots.

Improve the transport of crew, instruments, and payloads on planetary surfaces, asteroids, as well as in space.

This includes:

- Robot user interfaces.
- Automated performance monitoring.
- Tactical planning software.
- Ground data system tools.
- Command planning and sequencing.
- Real-time visualization/notification.
- Software for situational awareness, as well as, subsystems to improve handling and maintenance of payloads and assets.
- Tactile sensors.
- Human-safe actuation.
- Active structure.
- Dexterous grasping.
- Modular “plug and play” mechanisms for deployment and setup.
- Standardized interfaces for structural loads & commodity transfer.
- Novel robotic manipulation methods.
- Small/lightweight devices to provide subsurface access and sampling.
- Small/lightweight regolith excavation, handling & delivery devices.
- Regolith anchoring methods for near Earth objects (neo).
- Subsystems to improve the transport of crew, instruments, and payloads on planetary surfaces, asteroids, and in-space.
- Hazard detection sensors/perception.
- Active suspension.
- Grappling/anchoring.
• Legged locomotion.

• Sub-surface locomotion.

• Robot navigation.

• Infrastructure-free localization.

Technology Readiness Levels (TRL) of 2 to 6 are sought.

Potential NASA Customers include:

• Software Robotics and Simulation Division (JSC-ER).

• International Space Station.

• Habitat Development Unit (AES Project).

• Multi-Mission Space Exploration Vehicle (MMSEV-AES Project).

• MPCV Orion Project.

• R2 (Robonaut Project).