



NASA SBIR 2016 Phase I Solicitation

H6.01 Robotic Systems - Mobility, Manipulation, and Human-System Interaction

Lead Center: JSC

Participating Center(s): ARC, JPL, KSC

The objective of this subtopic is to create autonomous systems and robotic technologies (hardware and software) to 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 (tele-operation to supervised autonomy), over multiple spatial ranges (shared-space, line-of-sight, on orbit, and interplanetary), and with a range of time-delay and communications bandwidth. Additionally, in order to build robotic systems that are cheaper, lighter, and more energy efficient than traditional devices based only on rigid assemblies, it is important to develop soft robotics technology for mobility and manipulation.

The software, avionics, and robotics elements requested within this topic are critical to increasing autonomy and system reliability; reducing system vulnerability to extreme radiation and thermal environments; and supporting human exploration missions with robotic assistants, precursors and caretaker robots. As key and enabling technology areas, autonomous systems, avionics, and soft robotics technologies are applicable to broad areas of technology use, including heavy lift launch vehicle technologies, robotic precursor platforms, utilization of the International Space Station, and spacecraft technology demonstrations performed to enable complex or long duration space missions. All of these flight applications will require unique advances in autonomy, software, robotic technologies and avionics. The exploration of space requires the best of the nation's technical community to provide the technologies, engineering, and systems to enable human exploration beyond LEO, to visit Asteroids and the Moon, and to extend our reach to Mars.Â

Proposals are sought to research and develop the following:

- *Mobility* - Subsystems to improve the transport of crew, instruments, and payloads on planetary surfaces, asteroids, and in-space. This includes: hazard detection sensors/perception; active suspension; grappling/anchoring; legged locomotion; robot navigation; infrastructure-free localization and sensors for deformable, flexible or active elastic mobility components.
- *Manipulation* - Subsystems to improve handling and maintenance of payloads and assets. This includes: tactile sensors; human-safe actuation active structures; dexterous grasping; modular plug and play mechanisms; mechanisms for deployment and setup; small/lightweight excavation devices; novel manipulation methods; and actuators and/or sensors for active tension control (including tendon-based manipulation and dynamic tensegrity).
- *Human-system interaction* - Subsystems that enable crew and ground controllers to better operate, monitor and supervise robots. This includes: robot user interfaces; automated performance monitoring; tactical planning software; real-time visualization/notification; software for situational awareness and modeling/simulation software for soft robotics (including design of highly compliant and/or underactuated

dynamic systems).