



NASA SBIR 2019 Phase I Solicitation

S4.02 Robotic Mobility, Manipulation and Sampling

Lead Center: JPL

Participating Center(s): AFRC, ARC, GRC, GSFC, JSC

Technology Area: TA4 Robotics, Telerobotics and Autonomous Systems

Technologies for robotic mobility, manipulation, and sampling are needed to enable access to sites of interest and acquisition and handling of samples for in-situ analysis or return to Earth from planets and small bodies including Earth's moon, Mars, Venus, comets, asteroids, and planetary moons.

Mobility technologies are needed to enable access to steep and rough terrain for planetary bodies where gravity dominates, such as Earth's moon and Mars. Wheeled, legged, and aerial solutions are of interest. Technologies to enable surface mobility on small bodies such as through rolling, walking, and hopping are of interest. Ice penetration technologies reaching more than 1 km depth and enabling access to subsurface oceans are desired. Such technologies could include drills, melt-probes, and hybrid approaches. Manipulation technologies are needed to deploy sampling tools to the surface and transfer samples to in-situ instruments and sample storage containers, as well as hermetic sealing of sample chambers. Sample acquisition tools are needed to acquire samples on planetary and small bodies through soft and hard materials, including ice. Minimization of mass and ability to work reliably in the harsh mission environment are important characteristics for the tools. Design for planetary protection and contamination control is important for sample acquisition and handling systems.

Component technologies for low-mass and low-power systems tolerant to the in-situ environment, e.g., temperature, radiation, and dust, are of particular interest. Technical feasibility should be demonstrated during Phase I and a full capability unit of at least Technology Readiness Level (TRL) 4 should be delivered in Phase II. Proposals should show an understanding of relevant science needs and engineering constraints and present a feasible plan to fully develop a technology and infuse it into a NASA program. Specific areas of interest include the following:

- Mobility and sampling systems for planets, small bodies, and moons.
- Near subsurface sampling tools.
- Deep drill systems such as to enable access to subsurface oceans.
- Low mass/power vision systems and processing capabilities that enable fast surface traverse.
- Electro-mechanical connectors enabling tool change-out in dirty environments.
- Tethers and tether play-out and retrieval systems.
- Miniaturized flight motor controllers.
- Sample handling technologies that minimize cross contamination and preserve mechanical integrity of samples.

NASA continues to explore the solar system and future missions will perform in-situ exploration of solar system bodies. These missions could have mobility systems to access locations of scientific interest, manipulators for

assembly and deployment of instruments and tools, and sampling systems to acquire and transfer samples. Technologies from this subtopic could be utilized in these future missions.

Proposers should also note a related subtopic exists that is focused solely on lunar robotic missions (see Z5.05, "Enabling Rover Technologies for Lunar Missions", under the Space Technology Mission Directorate). With NASA's present emphasis on lunar exploration, Z5.05 is provided to help develop innovative lunar rover technologies for in-situ resource utilization and for developing more capable and/or lower cost lunar robots.

References:

- <https://mars.nasa.gov/programmissions/>
- <https://solarsystem.nasa.gov/>
- <https://www.nasa.gov/specials/ocean-worlds/>
- <https://science.nasa.gov/news-articles/ocean-worlds>