



NASA SBIR 2019 Phase I Solicitation

Z5.04 Technologies for Intra-Vehicular Activity Robotics

Lead Center: ARC

Participating Center(s): JSC

Technology Area: TA4 Robotics, Telerobotics and Autonomous Systems

Improve the Capability or Performance of Intra-Vehicular Activity Robots

To support human exploration beyond Earth orbit, NASA is preparing to develop the Gateway, which will be an orbiting facility near the Moon. This facility would serve as a starting point for missions to cis-lunar space and beyond. This facility could enable assembly and servicing of telescopes and deep-space exploration vehicles. This facility could also be used as a platform for astrophysics, Earth observation, heliophysics, and lunar science.

In contrast to the International Space Station (ISS), which is continuously manned, the Gateway is expected to only be intermittently occupied by humans – perhaps only 1 month per year. Consequently, there is a significant need for the Gateway to have autonomous capabilities for performing payload operations and spacecraft caretaking, particularly when astronauts are not present. Intra-Vehicular Activity (IVA) robots can potentially perform a wide variety of tasks including systems inspection, monitoring, diagnostics and repair, logistics and consumables stowage, exploration capability testing, aggregation of robotically returned destination surface samples, and science measurements and ops.

The objective of this subtopic, therefore, is to develop technologies that can improve the capability or performance of IVA robots to perform payload operations and spacecraft caretaking. Proposals are specifically sought to create technologies that can be integrated and tested with the NASA Astrobee or Robonaut 2 robots in the following areas:

- Sensors and perception systems for interior environment monitoring, inspection, modeling and navigation;
- Robotic tools for manipulating logistics and stowage;
- Operational subsystems that enable extended robot operations (power systems, efficient propulsion, etc.), increase robot autonomy (planning, scheduling, and task execution), or improve human-robot teaming (software architecture, remote operations methods, etc.).

The desired deliverables are prototype components or subsystems. Proposals must describe how the technology will make a significant improvement over the current state of the art, rather than just an incremental enhancement, for a specific IVA robot application.

The expected Technology Readiness Level (TRL) range at completion of the project is 4-5.

References:

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- <https://www.nasa.gov/astrobee>
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 - J. Crusan, et al. 2018. "Deep space gateway concept: Extending human presence into cislunar space", In Proceedings of IEEE Aerospace Conference, Big Sky, M
 - M. Bualat, et al. 2018. "Astrobee: A new tool for ISS operations". In Proceedings of AIAA SpaceOps, Marseille, France.
 - T. Fong, et al. 2013. "Smart SPHERES: a telerobotic free-flyer for intravehicular activities in space". In Proceedings of AIAA Space 2013, San Diego, CA.
 - M. Diftler, et al. 2011. "Robonaut 2 - The first humanoid robot in space". In Proceedings of IEEE International Conference on Robotics and Automation, Shanghai, China.