NASA SBIR 2018 Phase I Solicitation

Z5.03 Payload Technologies for Free-Flying Robots

Lead Center: ARC

Participating Center(s): JPL, JSC

Technology Area: TA4 Robotics, Telerobotics and Autonomous Systems

The objective of this subtopic is to develop technology that can be integrated as payloads (software and/or hardware) on free-flying robots, which operate in human environments and/or assistÂ humans. Current free-flyers include space robots, micro UAVs, quadcopters, etc. Applications of free-flying robots to space exploration include:Â

- Supporting the caretaking of human spacecraft and habitats by autonomously performing critical maintenance and monitoring functions.
- Supporting astronaut activity (intravehicular or extravehicular) with survey, preparation, real-time support (e.g., tool/sample delivery), and follow-up work.

Â On the International Space Station (ISS), for example, the SPHERES robots have shown how free-flying robots can perform environment surveys, inspection, and crew support.Â In addition, STMD is currently developing the "Astrobee" free-flying robot to perform mobile camera, mobile sensor, and microgravity robotics testing on the ISS starting in mid-2018. Proposals areÂ sought to create payloads that can be integrated with small-scale free-flying robots, including the following areas (in order of interest):Â

- *Human-Robot Interfaces* - Payloads that facilitate communication and coordination between humans (local and remote) and AFFs. This includes displays (3D screens, projectors, etc.), signaling devices (light indicators, sound generation, etc.), and human monitoring (activity recognition, gaze/motion tracking, etc.).
- *Operational Subsystems* - Payloads that can be used to enhance the performance or the capability of AFFs for future deep-space exploration missions. This includes subsystems for extended AFF operations (power systems, efficient propulsion, etc.), supporting crew (e.g., mobile health monitoring), routine maintenance, emergency response, and other use cases.
- *Sensors* - Compact sensors relevant to the scenarios listed above, including functions such as interior environment monitoring, interior/exterior structural inspection,Â free-flying navigation, 3D environment modeling, etc.
- *End Effectors* - Small, lightweight mechanisms that can be used for docking/perching, prodding/pushing, tool carrying, etc. This may includeÂ deployable structures, universal end-effectors (e.g., jamming granular gripper), devices incorporating gecko or electrostatic adhesion, and devices that can interact withÂ handles, storage lockers, and small IVA tools. Note: complete robot manipulator arms are NOT being solicited.

Â Proposers are encouraged to target the development of these payload technologies to the Astrobee free-flying

robot. For Astrobee, payloads should ideally be less than 1 kg in mass, consume less than 5 W electrical power (5 VDC @ 1 A), interface via USB 2.0, and stow within a 10x10x10 cm volume. Payloads that exceed these specifications may still target Astrobee, but may require special accommodations. 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 free-flying robotic application.