NASA SBIR 2017 Phase I Solicitation

Z5.01 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 external payloads on free-flying robots that operate in human environments and/or assist humans performing structured tasks. Current free-flyers include space robots, micro UAVs, quadcopters, etc. Applications of free-flying robots to space exploration include:

- Supporting deep-space human exploration spacecraft and habitats (operating inside or outside to support critical maintenance and monitoring functions).
- Supporting astronaut extra-vehicular activity (EVA) with scouting, follow-up sensing, and tool/sample delivery.

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. 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 2018. Proposals are sought to create payloads that can be integrated with small-scale free-flying robots, including (but not limited to) the following areas:

- *Sensors* - Compact sensors relevant to the scenarios listed above, including functions such as interior environment monitoring (e.g., air quality), interior/exterior structural inspection, free-flying navigation (obstacle detection and localization), 3D environment modeling, etc.
- *End Effectors* - Small, lightweight mechanisms that can be used for docking/perching, prodding/pushing, tool carrying, and deployment of RFID tags. This may include deployable structures, universal end-effectors (e.g., jamming granular gripper), devices incorporating gecko or electrostatic adhesion, and devices that can interact with handles, storage lockers, and small IVA tools. Note: complete robot manipulator arms are NOT being solicited.
- *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.).
- *Novel 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), spacecraft "caretaking" (routine maintenance and emergency response), and other use cases.

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 (e.g., in terms of power) may still target Astrobee, but may require special accommodations (e.g., independent power). 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.