Astrobee: A Free Flying Robot Enabling Technology Demonstrations

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ABSTRACT

The Astrobee Project has developed next-generation free-flying robots to operate inside the ISS. Three Astrobee Free Flyers reached the ISS in April 2019 and are currently hosting a variety of users while completing the commissioning phase. Commissioning is scheduled to complete in July 2020.

Astrobee's primary objective is to provide a highly flexible and capable free-flying robotic research platform to enable future guest scientist investigations. However, Astrobee is also demonstrating the feasibility of intra-vehicular robots (IVR) for performing key caretaking functions within future exploration vehicles as part of NASA's Moon-to-Mars exploration strategy. IVR capabilities will be especially vital during uncrewed mission phases. For example, current plans call for the lunar Gateway to be uncrewed >85% of the time.

Astrobee's baseline implementation supports *free-flying camera* and *sensor survey* use cases. Astrobee guest scientists can deploy software updates and hardware payloads to extend its capabilities. Current guest scientists are demonstrating a wide variety of new technologies, including *RFID logistics* (RFID Recon project), *high-resolution mapping and anomaly detection* (ISAAC project), *propellant-free mobility* (Astrobatics project), *space debris rendezvous and grappling* (REGGAE, Gecko Gripper and ROAM projects), *visual guidance systems* (SVGS project), and *acoustic monitoring* (SoundSee project). These demonstrate many of the potential uses for Astrobee for research and for IVR caretaking functions. Astrobee is also continuously improving its navigation robustness, general flight software maturity, and ISS interior maps, both through the baseline Astrobee operations and with the help of the ISAAC project

Future guest science experiments currently in development could demonstrate *cargo transfer*, *fault isolation*, *free flyer and stationary robot collaboration*, *microgravity fluid transfer*, and *new docking mechanisms*, among others.

This presentation will focus on 1) Final results of Astrobee commissioning activities 2) Astrobee's current users and significant achievements 3) possibilities for using Astrobee for future investigations.