Cross Cutting Relative Navigation Technologies for Improved Landing Accuracy and Vehicle-to-Vehicle Rendezvous and Docking. Kevin Miller[1], Jim Masciarelli[1] and Reuben Rohrschneider[1], [1]Ball Aerospace & Technologies, Corp., 1600 Commerce St., M/S RA-5, Boulder, CO 80301. klmiller@ball.com.

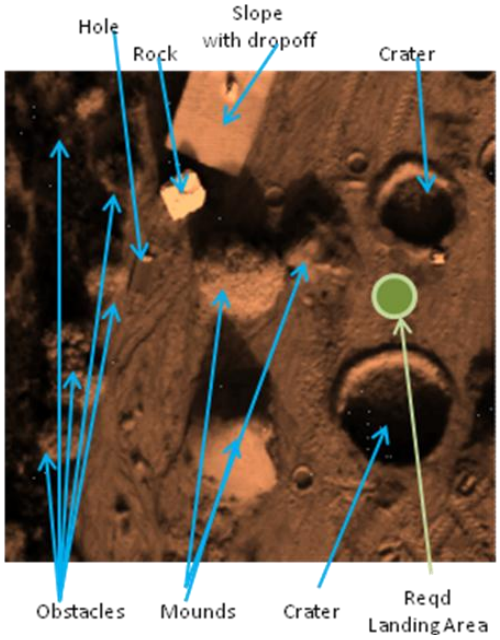
Introduction: Relative Navigation (RelNav) technologies and solutions are an enabling function of many of NASA's future mission architectures. Challenge areas including planetary surface precision landing as well as vehicle-to-vehicle Autonomous Rendezvous, Proximity Operations and Docking (ARPOD). Basic functional capabilities have been developed and in some cases, operated for decades, but recent design and test efforts have validated revolutionary improvements in functionality and performance levels of active and passive relative navigation sensors and processing, providing a pathway for advanced autonomous operations. Key technologies involved in addressing these functions include advanced lightweight active and passive sensors, as well as real time algorithms, software and processing.

This presentation reviews the current state of the art, including recent development and test progress, as well as future technology advancement plans.

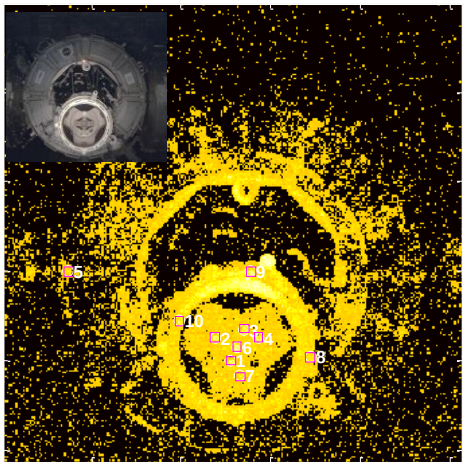
Cross cutting Technology: Recent development work demonstrates that critical technology required for precision landing systems also benefits other relative navigation applications, including vehicle-to-vehicle detection, orbit determination and ARPOD, as well as other commercial, DOD and NASA space and terrrestrial missions.

Precision Landing: Mid-term mission plans for planetary landings at Mars and other locales demand significant improvements in relative navigation capabilities. A key aspect of these improvements is the maturation of lightweight, low power sensors and real time hazard detection and safe landing site designation capabilities that support landing under any lighting conditions In particular, this presentation focuses on solutions for advanced precision landing solutions, highlighting sensor technology, as well as point cloud-processing, scene development and feature identification and tracking technology.

Vehicle to Vehicle ARPOD: Longer term program plans demand lightweight, low power systems for the detection and orbit determination of client vehicles and ultimately, execution of ARPOD between vehicles. There are a number of approaches that can be employed to accomplished this, including passive sensing systems, one-way active sensing systems or two-way active sensing systems. Furthermore, client vehicle characteristics can be integrated to enhance detection. However, technology advancements enabling precision landing have direct applicability to the ARPOD function. This presenation describes the design space and relevant technologies, as well as roadmaps from the current state of the art to landing applications and eventually ARPOD applications that require very lightweight, affordable low power solutions.



Key advances in sensors and algorithms enable precision landing with real time hazard detection and classification in a rapidly changing scene environment.



Advanced technologies provide centroid identification and tracking functions with full 3D imaging in a cluttered environment for unambiguous vehicle-to-vehicle navigation solutions under all lighting conditions.