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Active Collision Avoidance for Planetary Landers

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Sponsoring Program(s)

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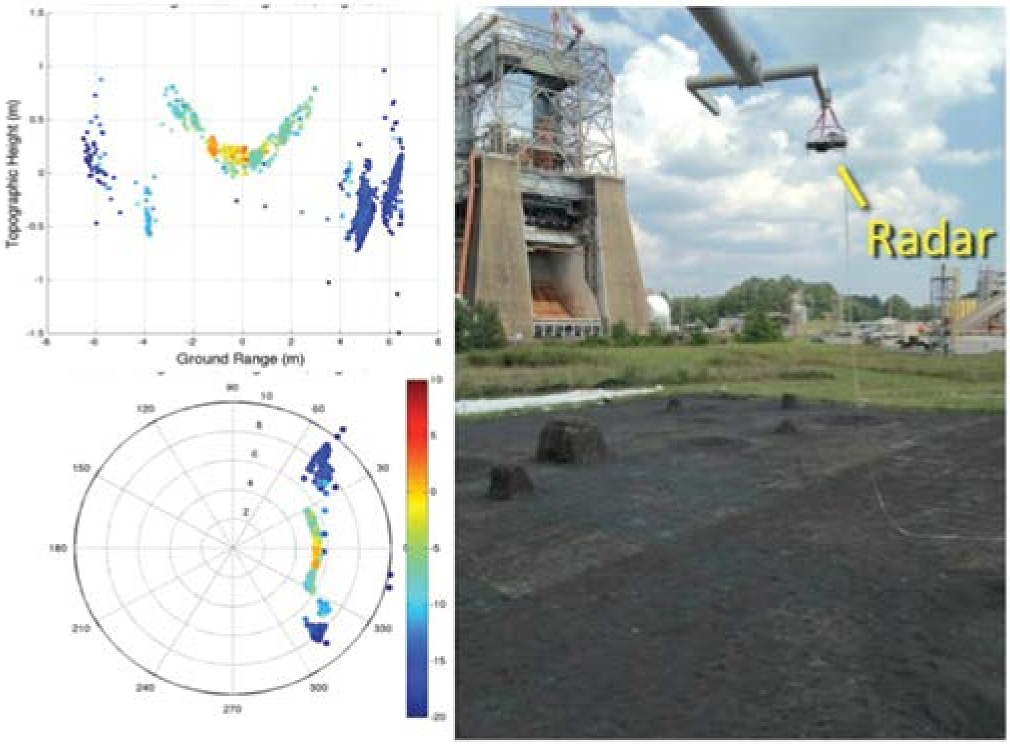
Project Description

The use of automotive radar systems are being evaluated for collision avoidance in planetary landers. Our focus is to develop a low-cost, light-weight collision avoidance system that overcomes the drawbacks identified with optical-based systems. We also seek to complement the Autonomous Landing and Hazard Avoidance Technology system by providing mission planners an alternative system that can be used on low-cost, small robotic missions and in close approach. Our approach takes advantage of how electromagnetic radiation interacts with solids. As the wavelength increases, the sensitivity of the radiation to isolated solids of a specific particle size decreases. Thus, rocket exhaust-blown dust particles, which have major significance in visible wavelengths, have much less significance at radar wavelengths.

Dust being blown by a lander's rocket exhaust at the MSFC Lunar Terrain Testbed.

Summer intern Morgan Minton holding the interferometric radar mounted on an aluminum backplate.



Radar reflectivity and topographic height measured by the radar in the lunar terrain field.
The radar unit is suspended from a boom.

Anticipated Benefits

The system under test, which is a commercially available unit used in automobiles for hazard detection, requires lower power and has smaller mass than alternative technologies being tested by NASA. It should also escape the limitations created by movement of the planetary regolith caused by the rocket exhaust of the approaching lander. It also takes advantage of the huge investments made in this technology by the automotive industry.

Potential Applications

Present-day robotic missions to other planets require superlative knowledge of the terrain in order to predetermine a landing spot that is relatively safe. Acceptable landing sites can be miles from the mission objective or mission objectives must be tailored to suit landing sites. Requiring precise, a priori knowledge of local terrain is often neither practical nor is it an efficient way of selecting landing sites for robotic missions. Future robotic exploration missions should be capable of autonomously identifying a safe landing target within a specified target area selected by mission requirements. Such autonomous landing systems must have three capabilities—'see' the surface, identify a suitable target, and land the vehicle. The interferometric radar technology being tested has the potential of providing the necessary information for autonomous lander control.

Notable Accomplishments

Preliminary tests of a commercial off-the-shelf automotive radar system were conducted. A low data acquisition system was developed for the radar based on a Raspberry Pi, and data processing and visualization software were developed. Preliminary tests with the radar were conducted at various locations including the NASA Marshall Space Flight Center lunar terrain field. Results from these tests show that radar can be used to generate topographic maps of surfaces such as the lunar terrain field. Further tests in FY 2015 with this system will be conducted to further characterize the radar and investigate the possibility of generating topographic maps in real time.