Paper ID: 54549
oral

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 2 (2B)

Author: Dr. Glenn Hines
National Aeronautics and Space Administration (NASA), United States, glenn.d.hines@nasa.gov

Dr. Farzin Amzajerdian
National Aeronautics and Space Administration (NASA), United States, f.amzajerdian@nasa.gov
Dr. John Carson
National Aeronautics and Space Administration (NASA), United States, john.m.carson@nasa.gov
Mrs. Michelle Munk
NASA, United States, Michelle.M.Munk@nasa.gov
Mr. Jeffrey Herath
National Aeronautics and Space Administration (NASA), United States, jeffrey.a.herath@nasa.gov
Dr. Walt Engelund
National Aeronautics and Space Administration (NASA)/Langley Research Center, United States, w.c.engelund@nasa.gov

LASER VELOCITY AND ALTITUDE SENSOR TECHNOLOGY FOR LUNAR ROBOTIC AND HUMAN LANDING SYSTEMS

Abstract

A coherent Doppler lidar has been developed to address the need for a high-performance, compact, and cost-effective velocity and altitude sensor for use onboard landing vehicles. Future robotic and manned missions to solar system bodies require precise ground-relative velocity vectors and altitude data to execute complex descent maneuvers and safe soft landing at a pre-designated site. This lidar sensor, referred to as Navigation Doppler Lidar (NDL), can meet the required performance of landing missions while complying with most vehicle size, mass, and power constraints. Operating from several kilometers altitude, the NDL can provide velocity and range precision with about 2 cm/sec and 2 meters, respectively, dominated by the vehicle motion.

In the absence of a GPS signal, past landing missions to planetary bodies relied on radar to provide the necessary data to execute descent and landing maneuvers. Radar limitations however, place unnecessary constraints on future landing vehicles adding risk to ambitious mission objectives. For this reason, we have developed and demonstrated the NDL as an alternative to radar sensors. The NDL offers several critical advantages compared to radar, including significantly higher precision with reduced size, weight, and power. In addition, the laser-based NDL sensor does not suffer from measurement perturbation from terrain features or signal ambiguity from transmitted side lobes; and it is far less susceptible to signal clutter, such as returns from the lander structure or jettisoned vehicle components such as heatshields. The higher quality data provided by the NDL will enable both a more precise navigation towards the designated landing site and a well-controlled touchdown (with greater stability and lower impact loads). This translates into lower fuel reserve, smaller leg span and reduced mass for a landing vehicle. Therefore, the NDL can potentially reduce the overall cost and risk of landing missions and enable new capabilities for planetary exploration missions including missions to the Moon, Mars, asteroids, and other planetary bodies.

This paper first provides a status of the ongoing technology maturation work directed toward space-flights in the near future. Then, the NDL technology infusion plan supporting near-term and long-term, robotic and human, missions to the Moon, Mars, and elsewhere will be discussed. A particular emphasis

will be placed on lunar projects being planned for launch in the 2020s. These projects include both NASA-led missions and lunar exploration ventures led by private industry and supported by NASA.