Paper ID: 41877
student

45th STUDENT CONFERENCE (E2)
Student Conference - Part 2 (2)

Author: Mr. Baptiste Chide
ISAE-Supaero University of Toulouse, France

OPTIMIZING THE SCIENTIFIC RETURN OF MARBLL, THE MARS BOUNDARY LAYER LIDAR EXPERIMENT DEVELOPED TO PREPARE THE FUTURE OF MARS ‘EXPLORATION

Abstract

The Mars Boundary Layer Lidar (MARBLL) is a remote sensing instrument concept which will provide, for the first time, wind profiles from the surface of Mars. The NASA Decadal Survey highlighted that the measurement of wind is a critical parameter to design the Entry- Descent-Landing (EDL) phase for future sample return mission and for human exploration of Mars. For instance, it is mentioned in the ESA Schiaparelli Anomaly Inquiry that the main contributor to the saturation of the Inertial Measurement Unit (IMU) of the Schiaparelli lander could be the presence of unforeseen convective winds in the Martian boundary layer. It is necessary to precisely probe this layer in order to constrain models and to adjust specifications of sub-systems. MARBLL will probe the boundary layer winds of Mars up to 5 km of altitude. This experiment is based on a Doppler wind Lidar: an infrared beam emitted by a space qualified laser is backscattered by the dust particles that remain in suspension in the atmosphere. This backscattered light has a Doppler shift due to the dust particle motion in the radial direction. Light is collected by a telescope and analyzed by a Mach-Zehnder interferometer developed in-house. This innovative concept relies on a differential measurement of the Doppler shift that makes the detection robust to any variation in frequency of the laser.

With the concept validated thanks to terrestrial campaigns, it is now mandatory to qualify the MARBLL instrument for space and Martian environment and to ensure the data can be exploited so that the expected performances are met. In this study we present the method used to extract the main parameters impacting the measurements, in the design and in the data process. We tested the instrument in a thermal vacuum chamber to certify that it is robust to large changes in temperature expected in space environment. We conducted new tests in laboratory to optimize the calibration of the instrument. Furthermore, we assembled a new bench to test the acquisition part of the instrument, in order to characterize the detectors. It enabled us to gain knowledge in the photodiodes’ response and to identify noise sources in the detection unit, a task necessary to improve the data processing algorithm. The conditions explored during these tests are also of great interest for concepts currently studied by the space industry to be embedded in Earth observation missions.