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LUCID PROJECT: LUNAR POLAR SAMPLE RETURN MISSION VALIDATION AND DEMONSTRATION

Abstract

In recent years, the Lunar South Polar region has become more attractive to the international science and exploration community caused by the orbital data generated by the contemporary Lunar missions such as the Lunar Reconnaissance Orbiter. A renewed joint effort has started to emerge from ESA and ROSCOSMOS, materialising in new missions like the Lunar Polar Sample Return mission. This mission advocates to deliver a rover to the south pole of the moon, prospect volatiles and send them back to Earth. The LUCID (LUnar scenario Concept valIdation and Demonstration) activity demonstrates the operational scenario of this mission and investigates the needs of operating a rover in this scenario. This paper covers the mission scenario of the Lunar Polar Sample Return mission, the development carried out for the activity, the demonstration during the field test and the test campaign. In this mission scenario, due to the relative position of the moon and the Earth, the Line of Sight communication occurs only during half of the Moon orbit, which implies the requirement of a spacecraft relaying communications to Earth and on-board autonomy for the rover. Furthermore, prospect sites are located in permanently shadowed areas where navigation and awareness prevail challenging, hindering the operational scenario and leading us to the following questions: what does it take to operate a rover in Lunar near-pole conditions? What is the best situational awareness that can be implemented with present-day technology? How far can a rover traverse under these conditions per unit of time? In order to answer these questions, we have designed and executed a Field Test Campaign in the terrestrial analogue of the Lunar South Pole at Teide National Park located in Tenerife, Canary Islands, Spain. In this location, the mission scenario of the LPR will be reconstructed and we will address particular challenges such as the low angle illumination, representative communications, terrain characteristics, simulated ice sources and observability of the surroundings for both operational scenarios: short term autonomy and teleoperation.