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

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A NEW TEST FACILITY FOR VISION-BASED HAZARD DETECTION AND AVOIDANCE SYSTEMS FOR PLANETARY LANDING MANEUVERS

Abstract

This paper reports the project and setup activities of a new test facility for autonomous optical navigation systems for planetary landing maneuvers, at the Aerospace Science and Technology Department of Politecnico di Milano (PoliMi-DAER), to rise the low TRL of such a technology. The next generation of space landing systems will require an even higher level of both absolute and relative precision, together with a high degree of autonomy and Hazard Detection and Avoidance (HDA) capabilities, unattainable by traditional navigation systems. Vision-Based Navigation is a promising technology to answer the challenge. Due to scarceness of affordable and complete datasets from real missions, most of the vision-based navigation algorithms developed so far rely on synthetic images. The effectiveness of this approach can be confirmed only by validation through experimental data. More, since the performance of each subsystem affects the others, the overall system performance can be assessed only by connecting the single parts in loop simulations. Therefore, to further enhance the visual navigation system technology readiness level, to set up a facility to run experiments represents the natural step forward. The facility here presented is a Hardware-in-the-Loop environment, intended to qualify both HW and SW breadboards up to TRL 4, with possible future enhancements to qualify flight models to TRL 5-6. The first facility exploitation is going to deal with HDA algorithms verification and validation, currently under development at PoliMi-DAER, for Lunar landing maneuvers. The facility setup includes a 2.4 meters wide scaled 3D model of the lunar surface, with the role to simulate the terrain geometry; a 7DoF Mitsubishi PA-10 robot arm, designed to carry the navigation sensors suite and simulating the lander dynamics; a lighting system and a dimming system, in order to exclude external light and provide a fully controllable illumination environment. The sensor assembly is mounted on the end effector of the robot, that can be moved over simulated lunar terrain, with realistic lighting conditions, in order to simulate lunar landing maneuvers in a scaled environment. The facility is suitable to provide a relevant environment, with slight modifications, also for the case of Mars, Asteroids and other moons of the Solar System. The design and trade-off activities for the new facility are here presented; the facility setup, and the test plan scheduled for functional verification and first testing are explained in detail.