48th STUDENT CONFERENCE (E2)
Student Conference - Part 2 (2)

Author: Mr. Jesús Manuel Muñoz Tejeda
Imperial College London, Spain

EXPERIMENTAL VALIDATION AND REFINED ANALYSIS OF THE NEW RAY TRACING METHOD FOR STUDYING THE ENVIRONMENTAL BEHAVIOUR OF NANOROVERS IN THE MOON'S SURFACE

Abstract

During recent years, robotic exploration of Moon has exponentially increased with innovative space missions. Being the Moon the nearest celestial body from Earth, substantial effort is being devoted to carefully study and assess the viability of building a lunar's space station. By doing so, other bigger goals such as Mars or other planets' exploration could be carried out.

However, Moon's harsh environment imposes severe requirements for any mechanical/electronic device to remain fully functional in any long-term mission. Exposure to space radiation and inhospitable thermal conditions are the important factors to account for any practical design.

Lunar Zebro's mission is heading the race for deploying the world's smallest and lightest rover on the surface of Moon. The concept validation of single rover is of crucial importance, as it will be the launching pad for deploying a swarm of those nanorovers thereafter. Then, they will get connected in a network, acting as a single device and performing scientific missions analyzing data from remote points on Moon's surface.

An innovative ray tracing method to evaluate thermal environmental of Lunar Zebro mission rover was presented in IAC-2019. This method was able to analyze those rovers from the thermal/radiation point of view during ground testing, launch and in lunar ambience, way faster than any other commercial software. The current study is the continuation of this work with detailed thermal analysis and refined studies. Furthermore, the method used is validated with experimental tests conducted at Delft University of Technology (TUDelft) facilities, qualifying Lunar Zebro nanorovers for a successful deployment.

In this paper, the experimental set up used is deeply explained, with the goal of simulating thermal conditions similar to lunar ambiance and being easily replicated for other Moon's missions. Results obtained should serve as a baseline for other small devices deployed in the Moon's surface. They are a precise guide of, not only how to evaluate and validate their behaviour, but also what to expect from them in advance. A comparison has been drawn between analytical calculations and experimental data obtained during tests. Using these data, the method is refined and further analysis are presented. Specifically, the complete thermo-mechanical behaviour of the nanorover is shown. The ultimate goal is the environmental survability assurance of those nanorovers when being deployed. Their validation supposes a paramount breakthrough in the space swarm robotics' field, achieving the successful performance of the lightest nanorovers ever deployed in the Moon's surface.