IAF SPACE POWER SYMPOSIUM (C3)
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INNOVATIVE SOLUTIONS FOR THE POWER SUBSYSTEM OF LUNAR VEHICLES

Abstract

Exploring the Moon is today one of the priorities of space agencies, as shown by the large-scale Artemis Program. Their objective is not only to conduct scientific experiments on the lunar surface but also to create a permanent lunar base that will be used to prepare astronauts for further expeditions, toward Mars for instance. Even if NASA has gained some experience with the Lunar Roving Vehicle (LRV) during Apollo missions, lunar mobility for manned missions remains a crucial challenge that must be mastered to allow efficient and safe exploration of our natural satellite.

Within the frame of the "Move on the Moon" contest organized by CNES (French Space Agency), a 10-students team from ISAE-Supaero have been working for a year to elaborate an innovative solution for a mobility system on the Moon to transport one astronaut. The project OBELIX, named in the spirit of ASTERIX (first French satellite ever launched), proposes a novel approach for designing the rover's power subsystem, based on several innovations described in the paper. The methodology used to design the OBELIX power subsystem is the following: after having performed a state of the art review of existing solutions, creative techniques are used to extend the range of possibilities and thus to find innovative solutions. Then, tradeoffs analyses are made to reduce the number of proposals and to select the best solutions. Finally, during the design phase, technical studies are performed to size the power subsystem and to assess its performances and limitations.

The new approach proposed in the framework of the OBELIX project is to design the power subsystem, taking into account reconfigurability and modularity constraints. The strength of this innovative approach

is the flexibility of the system: the rover is compatible with hardware and operational changes, so that its capability can be adapted to the mission requirements. One of the key innovations proposed in the paper is the battery swapping, which is an example of a modular system. This technique initiated by the car industry, consists of exchanging a battery with a low state of charge (SOC) level with another one at its full capacity, allowing a break time of the rover less than 30 minutes. This paper tackles other examples of reconfigurability and modularity solutions, but also the lunar dust problem, a critical issue that these technical innovations will face.