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PRELIMINARY DESIGN OF LUNAR VEHICLE FOR ASTRONAUTS TRANSPORTATION

Abstract

A new interest for Moon exploration has arisen amongst public and private organizations. For the first time since the USA Apollo program, our natural satellite is, yet again, the target of new large exploration programs by NASA and CNSA, in partnership with private companies (like SpaceX for NASA's Moon lander). However, a main detail differentiates the Artemis program from the Apollo one: the will to set up a permanent lunar base on the surface, to serve as a future intermediate step between the Earth and Mars. In this vision of a more sustainable space exploration, the lunar mobility is a key issue that introduces the need of a vehicle able to transport astronauts on the Moon's surface. Such a system should be light, fast, able to carry an astronaut and its equipment, and easily maintainable.

Within the framework of the "Move on the Moon" challenge, a contest organized by the French Space Agency (CNES) between national universities, the team of 10 engineering students from ISAE SUPAERO worked for several months to answer such a need. Taking into account the typical complexity of space systems, the subsystems design was tackled by subteams of 2 to 3 students, under the coordination of a project manager and a system engineering subteam. The OBELIX system (OBject Enabling Lunar In-situ eXploration), named in the spirit of ASTERIX (first French satellite ever launched), thus proposes a reconfigurable innovative and easily rechargeable locomotion system, to move on the surface of our natural satellite.

With the heritage of NASA's Lunar Moon Vehicle, this paper presents the technical preliminary design (phase A) of an electric rover able to transport a single astronaut in its spacesuit, and operate in the

constraining lunar environment. OBELIX itself introduces two new innovative concepts to answer the use cases requirements mentioned above. The first one is a battery swap system that eases the replacement of the discharged batteries by charged ones and increases the rover's autonomy and versatility. In order to facilitate the wheels maintenance and extend the vehicle's lifetime, the second innovation consists in a modular wheel design composed of standardized parts along its circumference. Finally, and to validate the feasibility of such new systems, a thermal, electrical, and mechanical study supports the battery swap technology, while the mobility system was mechanically certified by a range of tests.