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DESIGN OF A DIFFERENTIAL SYSTEM FOCUSED ON REUSABILITY AND PAYLOAD HOSTING CAPABILITIES FOR A ROVER BASED ON ROCKER-BOGIE LOCOMOTION MECHANISM

Abstract

This study aims to design a complete differential system for a space rover that adopts arocker-bogie mobility system following the related applicable documents in the mechanical fields in terms of the design and construction of a geared transmission system.

The design process is focused both on a transmission mechanism and on an external structure that connects the two halves of the mobility system. The parts are developed using a custom-made MATLAB code for the calculus implementation for a preliminary design of the gears and the shafts. The design is then verified through the software MitCalc. The external structure is studied through a finite element analysis on Hexagon MSC Nastran with Patran. After the production and assembly phases a performance test campaign has been conducted to verify the correct functioning of the transmission mechanism under operative movement velocity and mechanical tests on the external structure under the application of different loads, both in static and dynamic conditions, verified by inspection or using specific tools when needed, to confirm the correctness of finite element analysis studied in the design phase.

The idea behind the project is to develop a system that permits the rover to be a strongly modular developing platform, avoiding the more classical differential bar coupled to this kind of mobility system, which puts strong constraints on what could be the effective buildable area around the mechanical structure of the rover. Adopting this design, the usable volume around a less constrained central core can be maximized in order to host bigger external payloads in different positions of the rover. In these terms, when used as an astronaut assistance rover, thanks to the mechanical structure that guarantees this modularity, it presents many possibilities of reuse in a different configuration with different payloads.

This work is developed in the environment of the DIANA student team from Politecnico di Torino, which took part in different competitions such as the Rover Challenge Series, connecting different student teams from all over the world and students from different engineering areas with the main focus to design a working prototype of a space rover.