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Author: Mr. Efstratios Rigas
University of Patras, Greece

Prof. Vassilis Kostopoulos
University of Patras, Greece

DESIGN OF A MARS EXPLORATION MICROROVER CONCEPT FOR FUTURE MISSIONS WITH MODULARITY AND RECONFIGURABILITY CHARACTERISTICS

Abstract

Mars is one of the most prominent targets of space exploration and a major candidate for future colonization. Only in the year 2021, 3 space missions from different countries arrived at the red planet. Its ocean-filled past and evidence of contemporary water in liquid form are an encouraging sign of possible existence of life. Among the key means of exploration are autonomous research vehicles, also known as rovers. Rovers enable scientists to study Mars closely and conduct experiments in order to find answers to its greatest mysteries. Ideas and bold designs of rovers must be encouraged, as the future of humanity in these inhospitable parts of space can only begin with their distant exploration and better understanding. In this spirit, a modular microrover type vehicle is designed, aiming to search for water and collect samples. An iterative process of parallel subsystem design is followed, resulting in a 20.94 kg and 51.79 W microrover, with reconfigurable science compartment, that can traverse a wide range of soils for a period of 175 sols. A 300x140x80 mm module, with 20 W power and 3.1 kg mass allowance is available for the science equipment, that is interchangeable for different missions. Simplicity and modularity were applied in the rover design to reduce developing cost of new concepts, as reusability of the same model is achieved with modifications. Reconfigurability characteristics also help utilize the same vehicle for multiple roles such as transportation of materials, sample collection, habitat formation, exploration, science, and support for human activities. The significance of using numerous and multipurpose microrovers for future missions is highlighted, as rapid exploration, risk minimization and robotic labor are significant factors that will set the stage for human exploration.