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EXTREME ENVIRONMENT CHALLENGES FOR PLANETARY ROBOTIC MISSIONS

Abstract

Many countries and their space agencies have laid out their 50 years roadmap for the planetary exploration and space missions using robotic and autonomous vehicles. These missions are proposed to target the planets, moons and small bodies in our solar system. In one or the other phase, the mission shall experience extreme environmental conditions. It will be extreme temperatures or pressures of both. Although, we have succeeded in sending out landers in Moon and Mars and posses sufficient technologies, however, it is important to address a wider perspective of environmental challenges and consider them before sending out a robotic mission into another planetary body. The environmental challenges have a greater impact on the robotic mission from its design, modularity and its validation which then would finally would lead to its production and packaging. Mostly, the efficiency and dynamics is dependent on the surface interaction parameters. The selection of optimal solutions for mobility and power systems truly depend on the local atmospheric conditions. In general, the models that contribute to the environmental factors are temperature model, radiation model, gravitation model and surface interaction model for efficient operation in surfaces. This paper will present a comprehensive review of the extreme environmental challenges for the planetary robotic missions and current technology readiness levels considering the past missions to terrestrial planets. It will help us to not only develop reliant technologies but also address the scientific questions and required infrastructure clearly. It is expected that this review would be helpful in conceptual mission design with technological requirements to enable them to identify priorities for the investments regarding the future technological needs for planetary exploration.