Paper ID: 99083
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IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

Author: Mr. Luis Fernando Favian Curiel
Universidad La Salle, Mexico

Mrs. Aimée Rincón
Universidad La Salle, Mexico
Mr. Axel Núñez Arzola
Facultad de Ingeniería-UNAM, Mexico
Mr. Itzcoatl Francisco Nuñez San Miguel
Facultad de Ingeniería-UNAM, Mexico
Mr. Alonso Espinosa de los Monteros Manrique
Universidad Nacional Autónoma de México (UNAM), Mexico

MODULUAR LUNAR ROVER

Abstract

Sustainable space missions require versatile and modular robotic systems that can adapt to various tasks in exploration and in-site resource utilization (ISRU). This project presents a modular lunar rover, designed to interconnect different specialized modules, optimizing its performance based on the assigned mission. The base version is an exploration rover, equipped with advanced geological recognition systems and enhanced mobility to navigate rough terrains. By incorporating additional modules, the rover can be transformed into a regolith collection unit, equipped with a cargo trailer designed to efficiently transport large volumes of lunar material. This trailer, slightly larger than the rover in dimensions, allows for the accumulation of regolith for subsequent processing in lunar bases. Additionally, other modules can provide real-time mineralogical analysis capabilities or support for construction missions. The rover's modular design enables flexible integration of new technologies and tools, ensuring its adaptability to future lunar exploration needs. Its ability to collect and transport materials makes it a key component in sustainable lunar colonization, reducing reliance on Earth-based supplies and enhancing lunar base autonomy. The adaptability of this rover extends to different environments, allowing it to operate efficiently in various lunar regions, from flat plains to cratered surfaces. Another crucial aspect of this rover is its ability to operate autonomously using an advanced artificial intelligence. Its sensor and data processing system allow it to assess terrain, identify safe routes, and analyze regolith composition without constant human intervention. Moreover, its robust and energy-efficient design ensures a long lasting operational lifespan, maximizing its utility in extended missions. The potential for future upgrades makes it an adaptable platform for long-term lunar exploration. This adaptability ensures that as new technologies emerge, the rover can be updated without requiring a complete redesign, making it a cost-effective and future-proof solution for sustained lunar operations. Additionally, the rover's power system, based on high-efficiency solar panels and lithium-sulfur batteries, ensures a reliable energy supply, extending its operational range and enabling night survival strategies. Its wheel design, constructed with graphene-reinforced materials, provides durability and resistance to extreme conditions, enhancing its mobility over various terrains. The modular approach allows mission planners to configure the rover for specific scientific, logistical, or construction-based tasks, ensuring its versatility for a wide range of applications. As lunar exploration advances, this rover will serve as an essential element for transportation, research, and infrastructure development, playing a vital role in establishing a long-term human presence on the Moon.