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OPTIMIZATION, DESIGN, FABRICATION, AND EXPERIMENT OF THE FOLDABLE WHEEL OF THE LUNAR ROVER.

Abstract

This paper presents an optimized foldable wheel shape design for lunar rovers, which has been fabricated and experimentally tested. The primary challenge in designing lunar rovers is the need for them to be lightweight and compact, given the limited payload capacity of launch vehicles. The rover's wheels are one of the primary factors that contribute to its weight and volume, and optimizing their design can significantly impact the rover's overall efficiency and effectiveness. Foldable wheel structures have emerged as a promising solution to the challenge of compactness in rover wheel design. In this study, we optimized the foldable wheel's shape and size using FEA simulations to determine the optimal configuration for maximum strength and stability. The simulations considered various factors, including the wheel's material properties, structural design, and the impact of the lunar environment on the wheel's performance. The fabrication process used advanced materials and additive manufacturing techniques to ensure the final product's durability and lightweight. The materials used in the wheel's construction were selected for their high strength-to-weight ratio and their ability to withstand the extreme temperature variations and radiation exposure that lunar rovers encounter. We then conducted a series of experiments on the foldable wheel shape, including structural testing to assess its strength and stability under various loads and environmental conditions. The tests evaluated the wheel's performance in actual lunar conditions, subjecting it to simulated lunar terrain conditions, including slopes, rocks, and craters. We also tested the rover's mobility and performance in various terrains and slopes to evaluate the wheel's effectiveness in actual lunar conditions. The tests involved driving the rover over simulated lunar surfaces, including regolith, boulders, and craters. The tests evaluated the wheel's ability to maintain traction, stability, and mobility over various terrains and slopes. Overall, our results demonstrate the feasibility and effectiveness of the optimized foldable wheel shape for lunar rovers. The foldable design enables compact storage during transportation, and its high strength and stability ensure reliable performance during lunar missions. This research contributes to the development of more efficient and effective lunar exploration technologies. The optimized foldable wheel shape has several advantages over traditional rigid wheels. Its compactness enables rovers to traverse narrow passages and tight spaces that would otherwise be inaccessible. Furthermore, the foldable design reduces the overall volume of the rover, increasing its payload capacity for other scientific equipment.