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DESIGN AND ANALYSIS OF A NOVEL TREAD CONFIGURATION USING FINITE ELEMENT ANALYSIS FOR LUNAR ROVER WHEELS

Abstract

Lunar rovers are crucial to extend the range of surface exploration, especially with in-situ resource utilization becoming more feasible. The moon's surface is covered with a thick and soft layer composed of dust and rock clast. Hence, the tires' geometry largely influences lunar rovers' performance. This poses a risk of severe sinkage for rovers' wheels and reduces the tractive performance of the vehicle. Sinkage is one of the major concerns that can be further analyzed to improve movement performance. Moreover, it can be detrimental to lunar missions and may even bring the mission to a halt. Adequate tread configuration of lunar rovers' wheels plays a significant role in reducing sinkage. Finite element analysis (FEA) is an appropriate approach in tire-soil interaction modeling. Thus, this paper proposes a novel tread design configuration for lunar rovers. The lunar rover's wheel is designed with a novel tread configuration based on previous lunar rovers' tire configurations. As a result of the FEA simulation, the novel tread configuration reduced the wheel's sinkage. The performance of the novel wheel was compared with previous configurations used on real lunar rovers. The novel tread configuration showed promising results in terms of wheel sinkage, which can further increase reliability and reduce overall cost. The proposed tread configuration could be used as an effective design for future lunar rover missions.