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SUSPENSION SYSTEM DESIGN AND ANALYSIS OF RASHID ROVER

Abstract

Planetary rovers are expected to play a significant role in future space missions where they should travel long distances over challenging terrains. Rashid Rover is the first developed mobile robot of the Emirates Lunar Mission (ELM). By the capacity limitation of the lander, Rashid has several limitations such as volume, mass, amount of energy, etc. However, in order to navigate, traverse a hostile terrain, and reach accurate science stations, Rashid must have a high degree of mobility and low-power-consumption technology.

The suspension system is the key issue of the degree of mobility. Based on existing rover drive architectures and suspension systems, there are several popular approaches that are commonly used. For instance, the six-wheel differencing suspension has six steerable wheels, allowing the rover to turn in place and avoid skid steering. Additionally, the complicated linkage suspension system gives the rover the ability to traverse obstacles much greater than the diameter of its wheels. Other rovers also use a differencing suspension, but only with four wheels and two rocker arms. This configuration can be done with four steerable wheels, or alternatively use a skid steering approach. This method boasts some benefits of the rocker-bogie system by providing a level of ground compliance; however, its main advantage is in its comparatively simple design, as it requires fewer wheels, axles, linkages, and motors. Traction of rovers' wheels can be accomplished through different ways such as using springs and dampers or free pivoting. Springs and dampers are frequently used for high-speed vehicles to absorb shock loads from driving over rough terrain. Besides, using springs and dampers will complicate the system along with increasing the mass.

Rashid Rover is a four-wheeled rover using skid steering, which can achieve the same goals as the six or eight wheeled mobility systems while having high reliability and mechanical simplicity. The mass, mobility performance, stability of Rashid, and the power consumption are the factors that drive the design of the suspension. This paper evaluates the design and performance of Rashid's suspension system that employs a passive differential gear rather than a rocker-type suspension system. Extensive testing show that the passive differential gear can stabilize the rover while traversing on rough terrains.