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EXPERIMENTAL RIDE PERFORMANCE OF A PARTICLE FILLED WHEEL USING HUMAN AND MICRO SCALE ROVERS.

Abstract

In 2009, a new class of energy absorbing non-pneumatic, non-rubber wheel was introduced.

The design consists of a fabric tire carcass filled with rigid spherical particles, mounted on a rim in a manner similar to its rubber analog. It was dubbed iRings in reference to the chain-mail tire material, chosen for space worthiness, durability, and traction on loose soil.

The wheel is the final reduction of most terrestrial and planetary vehicle drivetrains. For most manned rover designs, the wheel is compliant and serves as the interface between suspension and terrain.

The iRings wheel takes angular momentum imparted to it by the drivetrain and uses it to behave as an active suspension member.

Assuming a vehicle with minimal or no compliance save for its wheels, occupant comfort and stability are the limiting factors to speed. Therefore, as terrain becomes smoother one will drive faster.

As vehicle speed increases, the primary sustained acceleration experienced by the particles in the iRings wheel transitions from gravitational to centripetal, causing the wheel to stiffen. In theory, this passively endows the vehicle with high traction at low speeds and low rolling resistance at high speeds. However, testing has revealed that the wheel can only stiffen entirely provided the vehicle possesses the right power to weight ratio.

To identify this threshold, this paper will explore the ride performance of the iRings wheel at two scales: A 10 hp, 250 kg off-road vehicle equipped with 60 cm diameter iRings wheels and a 5 kg micro-rover scale tele-operated vehicle equipped with 20 cm diameter iRings wheels.