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IMPROVING THE DURABILITY OF THE IRINGS WHEELS FOR CYCLIC LOADS

Abstract

In 2009, Radizszewski [1] et al introduced a new class of energy absorbing non-pneumatic, non-rubber wheel. The design consists of a metal 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.

At a critical wheel rotational velocity, the primary sustained acceleration experienced by the particles in the iRings wheel transitions from gravitational to centripetal. As the wheel nears its critical speed, the particulates begin to orbit the rim, held together by the chain mail. Normal forces no longer have a continuous path from the contact patch to the rim and must now be transmitted via particle collisions. Beyond this critical speed, the wheel exhibits an increase in stiffness along with a reduction in contact area with the soil. Below the critical speed, the particulate layer compresses to conform to terrain features. This property of the iRings wheel enables two desired operating scenarios: low speed/high traction for excavation, and high speed/high efficiency for astronaut transportation.

The iRings wheel has undergone 20km of accelerated fatigue testing in a full scale vehicle test on lunar analog terrain at an average speed of 15 km per hour. This represents the most extreme operating parameters the wheel will face. Several variations of the iRings wheel prototype were run on soft earth, sand and gravel. Based on the results, a more robust chainmail material and chainmail to rim interface design were chosen.