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Author: Prof. Giancarlo Genta
Politecnico di Torino, Italy

Dr. Fabrizio Impinna
Politecnico di Torino, Italy

WHEEL-GROUND INTERACTION IN PLANETARY ROVERS – TEST RIG AND PRELIMINARY TESTS

Abstract

All robotic rovers for planetary exploration and the vehicles used to carry astronauts on the surface of the Moon used wheels as running gear. The same applies to the majority of projects for future exploration missions, both of the unmanned and manned types. Dynamic modeling of wheeled vehicles is a common practice in automotive technology, and commercial codes are usually employed. Such dynamic modeling however requires the knowledge of the wheel-terrain interaction that is usually beyond that available for the specific type of wheels designed for planetary rovers, in particular when they operate on regolith like in the actual working conditions [1, 2]. Several analytical wheel-terrain interaction models have been discussed in detail in the literature but, although many tests were performed in the past (starting from the 1970s for the Apollo LRV missions) there is a substantial lack of experimental data. Test campaigns aimed at characterizing the behavior of the specific non pneumatic, elastic but sometimes rigid, wheels designed for planetary rovers operating on specific soils that simulate the terrain (the so-called planetary simulant) which can be found in the actual applications are required. The aim of the present paper is to describe a test rig that can be used to characterize the wheel-ground interaction under different operating conditions. The test device allows adjusting the wheel setup by means of the variation of the slip steer and camber angle guaranteeing the complete wheel characterization. As the wheel-terrain interaction can be tested using different soils the preliminary experiments have been performed on both an artificial hard surface and on a stimulant for Mars regolith.

References [1] Wang, Zhidan, and A. R. Reece, The Performance of Free Rolling Rigid and Flexible Wheels on Sand, Journal of Terramechanics, 2004, 41, p.347-360. [2] Carrier III, W.D., Lunar Soil Simulation and Trafficability Parameters, Lunar Geotechnical Institute, Tech. Rep, 2006.