Paper ID: 6989
student

SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

Author: Mr. Michele Faragalli
Neptec Design Group, Canada

Prof. Peter Radziszewski
McGill University, Canada
Dr. Damiano Pasini
McGill University, Canada

PERFORMANCE EVALUATION OF COMPLIANT LUNAR WHEELS IN LUNAR SOIL

Abstract

Future lunar surface exploration vehicles, which share similar design characteristics as earth based all-terrain manned and robotic vehicles, are unlikely to use rubber pneumatic tires due to the risk of material degradation and tire puncture. Alternative wheel materials and designs were explored in the late 1960's and early 1970's, and efforts have been recently renewed with the current focus of lunar surface exploration missions. The wheel development efforts have been largely trial and error and only a select number of publications have been found that characterize the performance of some metallic compliant wheels in soft soils. Furthermore, these publications relate to explicit wheel designs such as the LRV wire mesh wheel; whereas no agreed upon optimal non-rubber non-pneumatic wheel design topology exists. This work investigates the effects of the compliant lunar wheel design parameters on the trafficability and manoeuvrability performance of lunar surface vehicles by use of parametric terramechanics and kinetic models. A compliant wheel is synthesized into a set of design parameters, independent of the explicit wheel configuration. These design parameters include wheel diameter, width, and distributed vertical, torsional, and lateral stiffness. A sensitivity analysis is conducted to evaluate the effect of the design parameters on the performance of the vehicle. This will allow a thorough investigation of critical design parameters in developing optimal metallic compliant wheels for use both on the Moon and on earth based lunar analogue sites. For a given vehicle configuration and mission requirements, an trade-off from the optimal set of solutions of wheel design parameters are found, and a recommendation on optimal compliant wheel topology to meet the design parameter targets is made.