Paper ID: 13009
oral

HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Joint Session on Human and Robotic Partnerships to Realise Space Exploration Goals (3-B3.6)

Author: Prof. Giancarlo Genta
Politecnico di Torino, Italy, giancarlo.genta@polito.it

DYNAMIC MODELLING OF PLANETARY ROVERS

Abstract

Planetary rovers are a key asset in most planetary exploration and exploitation missions. They may be small automatic machines that carry instruments to perform a wide variety of studies, vehicles able to carry astronauts equipped with their space suits, automatic machines able to perform tasks like digging, grading, etc, or huge human carrying vehicles provided with a pressurized habitat where humans can live and work in a shirt-sleeve environment. In all cases, it is predictable that the running gear of these machine will be based on wheels, at least in the near future, so that planetary rovers can be assimilated to wheeled vehicles Dynamic modelling of wheeled vehicles is a common practice in automotive technology, and commercial codes are usually employed. There is no difficulty, at least in principle, in using the codes developed for automotive vehicles for the dynamic simulation of wheeled rovers designed for planetary exploration: a rover, is after all nothing else than a wheeled vehicle, even if of an unusual type. The main differences are the reduced value of the gravitational acceleration, the different kinematics of the suspensions and the model of the wheel-ground interaction that may require some changes. The main applications of these models are:

- simulating the response of the vehicle to a given ground profile and to the control imputs supplied by an automatic control system, a teleoperator or a human riding on the rover in case of human carrying vehicles.
- evaluating the control strategy of the suspensions, in case of active or semiactive suspensions, and to design the relevant control system,
- simulating the high-level trajectory control strategy in case of robotic rovers and
- training the operators in case of human controlled devices.

Some problems were encountered in using commercial vehicle dynamics codes for the simulation of the dynamic behavior of planetary rovers, mainly because of the very low speeds, much lower than those usually encountered in motor vehicle simulations. In particular some difficulties were experienced due to lack of convergence of the relevant integration algorithms. The aim of the present paper is performing numerical simulations of some rover models of different types and to compare the results obtained using commercial codes and a code purposely written for very low speed machines.