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STUDY OF THE LATERAL DYNAMICS OF A LARGE PRESSURIZED LUNAR ROVER: COMPARISON BETWEEN CONVENTIONAL AND SLIP-STEERING

Abstract

A pressurized, long range, lunar rover is a large vehicle, designed to operate in a particularly hostile environment with extremely high safety requirements. Even if operating at moderately low speed, the rover must have a good lateral (or directional) behavior: this requirement is made more strict by the low lunar gravity that reduces the interaction forces between the wheels and the ground, reducing the maximum longitudinal and lateral accelerations of the vehicle. A mathematical model of the ‘all-wheel dynamic model’ type for a general multi-axle vehicle is built. Contrary to the usual automotive practice, no linearization is introduced, to allow the study of the behavior on trajectories with very narrow radius, even tending to zero (turning on the spot). The model allows two different strategies to be investigated: conventional independent steering (of the kind used on the Apollo LRV), and slip steering. In particular, the slip steering strategy is studied in detail to evaluate the feasibility of this approach to trajectory control that seems very promising, in particular in low gravity conditions. A pressurized rover can be operated manually by the on-board humans (like the Apollo LRV, manual mode) or controlled remotely by humans on the Moon surface (teleoperated mode), but the final goal is providing the vehicle with a more or less ample autonomy to reduce the work load of the astronauts (autonomous mode). The model allows to simulate the effect of different control strategies, testing the effects of the control parameters, by introducing suitable models of the human operators, of the human-machine interface or of the autonomous controller.