14th HUMAN EXPLORATION OF THE MOON AND MARS SYMPOSIUM (A5)
Near Term Strategies for Lunar Surface Infrastructure (1)

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FOOTPAD-TERRAIN INTERACTION TESTS WITH THE ROBOTIC LANDING AND MOBILITY TEST FACILITY (LAMA)

Abstract

Since the start of ESA's "NEXT Lunar Lander" program the development of a landing vehicle for moon or other planetary bodies has become focused. In the Framework of ESA's "Landing System Development" the German Aerospace Centre (DLR) performed a series of tests to study the interactions between a landers footpad and the surface of a celestial body during touchdown. This paper will give an overview of the actual development status and the results obtained from the test.

For a future Moon Lander the development of a lightweight and save landing gear is essential for the success of the mission. To size the Footpads a hardware test campaign is needed to evaluate the behavior of the dynamic interaction with the soil during touchdown. The produced data serves as a basis for correlation with the multi-body simulation tools. A further objective is to optimize size and shape of the pad. The footpads have to be big enough to ensure a stable stand and to avoid that the lander is subsiding to deep into the soil. On the other side the footpad has to be as small as possible caused by mass requirements. With these tests it is possible to built up a parametric model and simulate further designs to get to a lightweight landing gear subsystem.

To measure and correlate the occurring energy effects, the simulated touchdown had to be split up in two test modes. The first one investigated the momentum exchange at the initial impact. Therefore a footpad with a specific mass, represented by an overlaying barrel filled with sand, has been dropped from a robot flange to impact the soil either vertically or at an inclined angle. The second test mode simulated the slideout phase. A landing leg adapter was attached to the robot flange with the footpad slightly touching the ground and pulled through a soil bin at a constant velocity, with the footpad maintained either at constant depth of penetration or under conditions of constant vertical load.

The LAMA facility basic configuration consist of an 6-axis industrial robot system with an additional rail track system for horizontal movement, a controller and a soil bin containing the planetary soil simulant.

The tests could demonstrate the shape dependence of the footpad with the soil and gave an indication which pad shape might be the best. The correlation fits for a few cases which implies refinements for the current simulation.