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SPACE EXPLORATION SYMPOSIUM (A3)
Space Exploration Overview (1)

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VERIFICATION OF LANDING SYSTEM TOUCHDOWN DYNAMICS - A STATUS REPORT OF A GERMAN JOINT CO-OPERATIVE TEAM ON LANDING TECHNOLOGY

Abstract

One major milestone during the development of a landing system for robotic or manned exploration is the analyses and verification of the design on earth. Prerequisite for a successful verification is a realistic representation of the target landing site properties in a laboratory on Earth. In particular the lower gravitational acceleration as it is present on Moon, Mars, comets or asteroids is a key driver for the design of the landing subsystem with respect to landing stability issues.

Due to the fact that usually not all relevant environmental properties of the target landing site can be provided in one single and complete test, any verification approach has to be supported by adequate numerical analyses. Furthermore, numerical analyses using validated model can be an appropriate means for lowering costs and risks. Thus, another key topic for the verification of the landing stability of a landing system is the accurate analytical and numerical representation of the lander, the touchdown conditions and the landing site.

The Joint Team Co-operative "Landing Technology" with members from the DLR Institute of Space Systems and the Astrium GmbH, Bremen, is focussing on the development, evaluation and verification of experimental and analytical methods for the investigation of the touchdown dynamics and landing system design. Core element for the experimental investigation is the DLR Landing Mobility Test Facility (LAMA), which allows dynamic touchdown testing under a reduced gravitational environment using a six axis KUKA robot as active off-loading device. The test specimen for the investigation of the landing system is a representative Lander Engineering Model (LEM) designed, sponsored and equipped by the Astrium GmbH, Bremen. The design of the LEM is driven by today's European missions to Moon and Mars such as the ESA Lunar Lander and the ESA Mars Precision Lander.

The paper will present the latest achievements of the working group based on two drop test campaigns performed in 2010 and 2011 with the lander engineering model. The representativeness of the testing environment for touchdown dynamics on Earth and the analytical models will be critically discussed and evaluated with respect of today's needs in the running European programmes.