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DEVELOPMENT OF A MARSLANDER WITH CRUSHABLE SHOCK ABSORBER BY VIRTUAL AND EXPERIMENTAL TESTING

Abstract

Since the beginning of space exploration, probes have been sent to other planets or moons with the associated challenge of landing on these bodies. For a soft landing several damping methods like landing legs or airbags have been used. A new and potentially less complex and lighter way to reduce the shock loads at touchdown is the use of a crushable shield underneath the lander platform. This crushable shield is made out of an aluminum honeycomb core with a Dyneema® cover sheet. The design is particularly advantageous since no moving parts nor other mechanisms are required, thus making the shield very robust and fail safe. The only mission that is currently planned to use this technique is the ESA-mission "ExoMars" which is planned to start in 2016.

The development of such a crushable shock absorber implies and requires assessment of materials, manufacturing processes, the setup of a numerical simulation and the experimental validation in a test lab. In an independent research project (Marslander) a representative engineering mockup of a landing platform has been build and tested at the Landing & Mobility Test Facility (LAMA) to support the numerical simulation model with experimental data. The simulations are based on the Finite Element Method, which discretizes the structure into a defined number of elements, such that each element is assigned a set of equations describing the material properties and applied loads. The goal is to generate a simplified but still accurate model to predict landing scenarios by running Monte Carlo simulations.

Results of the above stated development and testing processes will be presented and discussed in this paper.

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