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TOUCHDOWN SIMULATION, TESTING AND VALIDATION OF A MARSLANDER DEMONSTRATOR

Abstract

As a neighbor of Earth, the planet Mars has become one of the most interesting planets in the field of space exploration. Exhibiting surface features such as volcanoes and rift valleys, it indicates the possible presence of geological activity. Exploration vehicles have been, and are currently designed and implemented to study the planet and to cope with the challenging surrounding environment. One of the most critical phases during the exploration mission is the complex landing of the vehicle, including sufficient shock attenuation and landing site precision. The design verification of such a planetary landing platform therefore requires the prediction of touchdown behavior, to detect possible risks at an early stage. Referring to Mars, physical tests cannot reproduce the mentioned surrounding or conditions, in which case simulations are the only alternative.

In collaboration with the project “Marslander”, a landing demonstrator consisting of an aluminum honeycomb sandwich structure has been numerically simulated using the explicit FEM tool LSDyna. The overall objective was the evaluation of touchdown predictability for various scenarios, which has been achieved by the comparison of test prediction analyses and physical test data. As the computation time is a major cost factor, the focus was set to the creation of a basic but still efficient numerical model, which could later be implemented to Monte Carlo Analyses. Leaning on a Building Block Approach, the materials have firstly been examined separately on component level for the numerical study of material and element parameters. Transferred to assembly level, focus was set on the validation of numerical impact behavior of a sandwich structure with existing test data. The results were finally implemented onto demonstrator level, and compared to the according test results.

This paper presents the development of a simple but efficient numerical model, able to predict the motion, deformation and generated force and shock values for various touchdown cases of a landing platform consisting of aluminum honeycomb.

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