MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures - Dynamics and Microdynamics (3)

Author: Mr. Sai Phanindra Darbha
Team Indus, Axiom Research Labs Pvt. Ltd., India, sphani4391@gmail.com

TOUCHDOWN STABILITY ESTIMATION OF AN UNMANNED SPACECRAFT ON LUNAR REGOLITH

Abstract

In this study, simulation methodologies are developed and bench-marked for estimating the touchdown stability of an unmanned spacecraft for soft landing on the lunar regolith. The finite element (FE) simulations of the lander impacting on the soft lunar soil have been carried out in Altair Hyperworks using RADIOSS solver, owing to its capability to handle the highly non-linear phenomena involved. The primary and secondary structs of our landing gear are equipped with crushable honeycomb to minimise the impact shock. MAT/LAW28 is used to model the crushable honeycomb in RADIOSS. The characteristics of the honeycomb material exhibited in the FE model have been experimentally validated with uni-axial compression tests carried out on three material specimens. The lunar regolith is modeled using MAT/LAW21, which consists of Drucker-Prager failure criterion with a planar end cap (Krieg, 1972). The input parameters for this model have been obtained from the soil compaction and shear tests carried out in-situ and on the lunar samples returned from Apollo and Luna missions (Carrier et al., Mitchell et al.). The lunar regolith properties have been validated by correlating the bearing strength of the FE model soil with the bearing strength of the actual lunar regolith observed in various lunar missions. Owing to the lunar regolith modelling and the high fidelity computations, the touchdown envelope obtained in this study provides a realistic estimate of the initial conditions required to ensure a stable touchdown on the lunar terrain, which is one of the most critical aspects of a lunar mission.