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Space Structures - Dynamics and Microdynamics (3)

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REFINED MODELING TECHNIQUES FOR THE COUPLED LOAD ANALYSIS OF SPACE STRUCTURES INCLUDING THE DAMPING EFFECTS

Abstract

Spacecrafts and satellites undergo to high mechanical loads during the launching phase. The accurate prediction of the interaction between the launcher and the payload is mandatory for the structural design of both the components. The analysis of the forces at the interfaces of different parts is usually refereed as coupled load analysis, CLA, and in the last decades, many numerical tools have been developed to solve this problem. Classical approaches, one for all the Craig-Bampton, reduce complex finite element models using condensation and coupling techniques that allow the complex dynamic of the considered structures to be described with few degrees of freedom. These models have been successfully used for undamped structures but are not able to predict the effect of the structural dumping if present. The development of enhanced analysis approaches could lead to more performing structures and could reduce the test campaigns devoted to design verification. The present paper presents an innovative modelling technique able to keep the computational cost of the CLA affordable without the use of condensation techniques, that is, preserving the capability to predict the effects of the dumping dynamic response of the structure. The approach is based on the capabilities of the refined one-dimensional models derived in the frameworks of the Carrera Unified Formulation. These models can predict the three-dimensional response of complex space structures with a fraction of the computational costs of classical models since they are based on a one-dimensional formulation. The use of the Node Dependent Kinematic approach allows to refine the kinematic model locally to increase the accuracy where required or to connect models with different kinematic. A generic launcher with a payload has been studied in the present paper, and the forces at the interface have been investigated. The results for the undamped structures have been compared with those from classical approaches as assessment of the numerical tool; then, the present modeling technique has been used to investigate the effects of structural damping on the dynamic response of the structures.