Paper ID: 63765
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IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures) (2)

Author: Dr. Alfonso Pagani
Politecnico di Torino, Italy, alfonso.pagani@polito.it

Prof. Erasmo Carrera
Associazione Italiana di Aeronautica e Astronautica (AIDAA), Italy, erasmo.carrera@polito.it

GLOBAL/LOCAL AND ADVANCED MULTI-SCALE SIMULATION OF COMPOSITE TRAC BOOMS

Abstract

The prediction of the actual stress fields in thin laminated deployable booms and the characterization of the failure onset represent challenging topics. The geometrical complexity, the large rotations involved during deployment and the multiple length scales which are involved in the problem lead to a severe trade-off between accuracy and computational costs. Consequently, to keep the size of the numerical problem below a certain limit, the employed FEM simulations make generally use of classical laminate elements, which cannot provide, for example, interlaminar stress solutions through the stack of plies or strains at fibre-matrix scale with enough accuracy. In this context, the present work proposes the use of a novel global/local methodology which combines the use of commercial FEM software tools and advanced multi-scale simulations based on the Carrera Unified Formulation (CUF). In essence, global analyses of TRAC booms are carried out by using a well-known FEM simulation environment and classical laminate elements. As a second analysis step, critical spots of the structural domain are investigated through accurate local models with 3D capabilities that stem from individual shell elements. The local analysis exploits refined laminated theories accounting for layer-wise deformations at the play level and a refined kinematics model with geometrically exact mapping at the micro-scale. The numerical results show that the proposed simulation method is computationally efficient and can be effectively used to predict failure onset and stress singularities arising close to free edges and the bonded interfaces of deployable composite longerons.