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EXPERIMENTAL AND NUMERICAL INVESTIGATION OF BOOM STRUCTURES MADE BY SPREADING TOW TECHNOLOGY

Abstract

Based-spread tow fabric composites have the potential of reducing structural mass while increasing structural performance of a composite structures. The aim of this work is to investigate the groundbreaking spreading tow technology, and in particular the bending properties of the material, to realize boom structures. Indeed, the boom flexural behavior influences both the efficiency of packing during transport into orbit and the load bearing capability in working configuration. A comprehensive experimental and numerical study has been carried out to evaluate the advantage of spread tow fabric over standard tow fabric in the flexure loading scenario. The elastic properties of both composites were evaluated and compared through the multiscale finite element analysis. From an experimental point of view, boom structures were fabricated using both spread tow fabric and standard fabric typically adopted for these structures. Composite laminates were made of two layers with an anti-symmetrical stacking sequence (45), so that they exhibited the unique behavior of bistability. The matrix used for both composites was an aerospace grade epoxy in order to narrow the investigation to the implications of the choice of fabric. Samples were cut from the fabricated boom structures and tested. In particular, three-point bending tests, platen folding tests and dynamic mechanical analysis (DMA) were performed. Numerical and experimental results show the superior structural properties of based-spread tow fabric booms.