A Novel Composite Modelling Approach for Woven Fabrics Applied to Leading Edge Inflatable Kites

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For several years in the maritime field, kites have been representing an innovative technology to reduce fuel consumption through auxiliary propulsion or to produce energy onboard [1]. Regarding the continuous increase of kite sizes, one of the main objectives is to determine if the Leading Edge Inflatable kite and its components will withstand the pressure field induced by the aerodynamic loading [2]. In that way, it is a priority to estimate the stress fields as close as possible to reality. Therefore, a fluid structure interaction method has been developed coupling a 3D Non-Linear lifting line model [3] with the Abaqus™ 2017 finite element software. In this framework, this study presents a woven fabric modelling technique as a composite orthotropic material on one hand, and a dedicated thin layers finite element technique devoted to weak bending properties for the structural analysis of the kite on the other hand. Starting from the kite geometry, the load distribution and the related stress field are estimated for a constant velocity straight flight case and are discussed. This enables the analysis of various parameters such as the buckling of the inflatable textile tubes, the Tsai Wu criteria for the textile canopy and for the inflatables tubes. It highlights that some parameters such as bridles and tether influence the results.