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Numerical methodology to analyze the ice impact threat: application to composite structures.

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Abstract

Impacts on composites produce interlaminar failure (delamination) which is difficult to detect in common maintenance tasks, and affects the structural integrity. Therefore it is critical, for safety, to improve prediction tools in order to perform tolerant damage designs. The numerical modelling of impacts of deformable objects (such as ice) on composite panels is still a challenge. Not only the modelling of the laminate should be appropriate to reproduce its behaviour and failures, but the modelling of the deformable projectile should be capable to induce the corresponding response and damages. In this work a two-step numerical methodology is proposed for the study of ice impact. First, the deformable impactor is analysed, studying the impact process on a rigid target (a steel plate attached to a load cell). Once the deformable projectile behaviour is fully captured, the ice impact on a deformable target (a carbon/epoxy laminate) is studied. The composite material model takes into account intralaminar and interlaminar failure in order to reproduce the laminate behaviour. Different ice sphere diameters ($30, 40$ and $50mm$) and impact velocities ($50 - 250$ m/s) are considered in this study. All the results from the numerical simulations have been compared with the experimental results.

Keywords: Composite laminate; failure mechanism; delamination; Numerical

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