Experimental assessment of Crashworthiness Capability of thin-walled CFRP tubes: using filament winding to enhance the energy absorption efficiency

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Abstract:

In the last decade, the use of fiber-reinforced composite materials has had a disruptive impact on the efficiency of both primary and low load-bearing structures for aerospace applications. The growing need to reduce CO2 emissions has led to a deep reconsideration of traditional materials in favour of a gradual yet unstoppable replacement across all components, including crashworthy structures. However, in this case, the energy absorption behaviour of composites cannot be reduced to plasticization phenomena but is driven by a wide set of factors mainly governing the formation of crack surfaces. For this reason, the design process may be more challenging.

In this work, a custom-built desktop filament winder was used to manufacture thin-walled tubes to be tested in axial compression. The unique layer architecture of the composite tubes used to produce the composite tubes was compared to a baseline, and an enhancement of the energy absorption capability was observed, thus suggesting a new route to follow for improving the performance of this class of structures.

Keywords: Crashworthiness, Filament winding, CFRPs, Thin-walled tubes