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Uncertainty identification related to thermoplastic composite materials under impact loading

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Thermoplastic composites have gained significance due to their superior properties and recycling potential. However, their mechanical performance is highly sensitive to the manufacturing process, commonly referred to as material uncertainty. In this study, thermoplastic composites of thermoplastic polyurethane (TPU) and Kevlar fabric (+45/-45) were produced via hot compression moulding, and their performance was evaluated under low-velocity impact tests. A ply-scale strategy was proposed for modelling the mechanical behaviour during the loading process, in which the uncertainty associated with thickness variation due to manufacturing was identified and modelled. Based on multiple impact tests on the composite panels and the numerical results, the effects of material uncertainty on strength and stiffness were analysed, emphasizing the importance of accounting for it in the design of thermoplastic composite parts.

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