Numerical risk assessment of high-velocity impact on a composite aircraft structure

Wagner, T.; Heimbs, S.

Airbus Central R&T, Materials X Germany, 81663 Munich, Germany


Abstract:
This study treats the modelling and simulation of high-velocity impact scenarios on a composite aircraft structure with Abaqus/Explicit. At first, experimental material characterisation of the relevant carbon-fibre epoxy material was conducted using coupon and element level experiments. For the element level, impact experiments on rectangular plates with a thickness of 2 mm, 6 mm and 12 mm were carried out and subsequently simulated. This numerical study uses different levels of detail to derive efficient but reliable modelling techniques for large-scale structural simulations. The developed finite element models are capable of adequately predicting the ballistic performance and delamination behaviour through the usage of stacked shell elements and cohesive contact formulations. Further modelling and simulation of a composite wing structure allows identifying critical load cases for impact prone areas on the larger scale. This study especially addresses the threat originating from a wheel fragment impacting the structure at high energy levels. Through the results, future design measures to respond to this impact scenario are proposed and investigated before expensive physical tests are performed.