Peridynamic simulations of carbon fibre composites based on high-velocity impact experiments

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Abstract:

A study on peridynamic modelling of carbon fibre composites and their failure behaviour under high-velocity impact loads is presented. Acting as foundation of this study, coupon level experiments of a unidirectional carbon fibre reinforced plastic were conducted for material characterisation of intra- and interlaminar properties. Subsequently, a high-velocity impact test campaign on plates with different thickness (2 mm, 6 mm and 12 mm) was performed to assess different states of damage and ballistic limits. Based on these experiments, non-local peridynamic simulation models were developed which can overcome typical restrictions of conventional finite element simulations. They allow for interaction between intra- and interlaminar damage to better capture damage propagation within composite materials under impact loads. Especially rather complex delamination behaviour in the material is well predicted when compared to finite element simulations while being computationally competitive. This comparison to FE simulations of impact events highlights the advantages of the approach and shows its potential for later industrial applications.