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Damage Progression by the Element-Failure Method (EFM) and Strain Invariant Failure Theory (SIFT)

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The element-failure method (EFM) is a novel finite element-based method for the modelling of damage, fracture and delamination in fibre-reinforced composite laminates. The nature of damage in composite laminates is generally diffused and complex, characterized by multiple matrix cracks, fibre pullout, fibre breakage and delaminations. It is usually not possible to model or identify crack tips in the conventional fashion of fracture mechanics. The central idea of the EFM, on the other hand, is to model the damaged portions with partially failed elements, whose nodal forces have been modified to take into account the local damage modes. This has the additional benefit of unconditional computational stability compared to other methods such as material property degradation (MPD) models. Here, we present the application of EFM with a recently-proposed failure criterion called the Strain Invariant Failure Theory (SIFT) in the prediction of damage progression in a composite laminated structure, and show that the damage patterns are in very good agreement with experiments. It is also shown that the EFM is more versatile and general than the MPD method.

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