CUF-based Multiscale Analysis of Failure of Composite Laminates

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The detection of failure onset and progression in composites requires the proper modeling of various mechanical behaviors at various scales. Furthermore, the necessity of virtual models of large structures and the nonlinear nature of failure demand computational efficiency without accuracy penalties. Over the last years, a set of modeling strategies based on refined structural theories has been developed via the Carrera Unified Formulation (CUF). Such developments range from Equivalent Single Layer (ESL) and Layer-Wise (LW) models for the macro- and mesoscale to the component-wise modeling of microscale. The computational efficiency and accuracy stem from the use of 1D or 2D models, node-dependent kinematics (NDK) and global-local strategies providing the complete 3D stress state necessary to capture failure in critical locations such as free-edges. The coupling with well-known models for micromechanics, progressive failure (including non-local methodologies based on peridynamics) and multiscale analyses led to promising outcomes with multifold reductions of computational times.