How We Fit

Technical Approach

Key Goals

Key Accomplishments/Path Forward

Transitions to ARL, within CMRG and to other CMRGs

Contribution to MEDE Legacy

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Parametrically Homogenized Constitutive Damage Mechanics (PHCDM) Model for Woven Composites

Materials-by-Design Process

Mechanism-based Approach

Technical Approach

How We Fit

Materials-by-Design Process

Mechanism-based Approach

Technical Approach

Key Goals

• Conduct macroscopic problem using the calibrated PHCDM model for composite with various microstructures and study the effect of microstructural morphology on macroscopic failure behaviors
• Find the parametrically homogenized constitutive laws contain explicit representations of microstructural morphology, strain rate, material properties with PHCDM model
• Uncertainty Quantification of microstructural morphology, material properties on PHCDM model

Key Accomplishments/Path Forward

• The micromechanical models for woven composite with different geometry parameters can be used by any CMRG members to explore the detailed microscopic failure behaviors of woven composites under various loading conditions.
• The calibrated PHCDM models are implemented as UMATs for any FEM packages. They can be used by CMRG members to perform structural scale simulations in order to understand the macroscopic failure behavior.
• This multiscale framework for developing material constitutive models from micromechanics can also be applied for other material systems (such as metals) if such models are of relevance to other CMRGs.

Transitions to ARL, within CMRG and to other CMRGs

Contribution to MEDE Legacy

These microstructural morphology dependent PHCDM models are intended to overcome the limitations of prohibitive computational overhead associated with other homogenization methods through the introduction of thermodynamically consistent, reduced order forms with explicit dependence on characteristics of microstructural morphology, material properties and strain rates. It is conducive to the materials-by-design and optimizing armor performance.

This approach of building material constitutive models in multiscale can be applied to a variety of material systems and failure mechanisms, providing the community with a systematic way of understanding multiscale material failure behaviors.