Project title: Computational analysis of damage evolution in fiber-reinforced composites

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Project description

The link between microstructural statistics and damage evolution within polymer-matrix composites (PMCs) is still not well understood. Central to this Air Force-sponsored project is understanding how the level of heterogeneity in the fiber distribution (e.g. the presence of fiber clusters and matrix-rich regions) affects the failure response of a transversely-loaded, unidirectional carbon/epoxy composite.

Starting from a micrograph, microstructural details are reconstructed (Figure 1a) using image processing techniques. A series of statistical measures are obtained from this data (Figure 1b). Multiple virtual instantiations of the microstructure are then created using the different statistical measures as optimization objectives. The damage evolution of these virtual models will then be investigated by performing mesoscale simulations (Figure 1c) using a specially developed Interface-enriched Generalized Finite Element solver that incorporate an isotropic damage model to account for matrix damage and a cohesive zone model to capture fiber/matrix debonding.

In this project, you will gain experience with computational scientific research and get the opportunity to perform mesoscale simulations using a novel finite element method.

![Figure 1 (a) Image reconstruction of carbon/epoxy specimen, (b) Weibull fit of fiber nearest neighbor distances, (c) mesoscale composite simulation.](image)

Student background and expected research activities

We are looking for two motivated individuals with interests in computational mechanics, composites, and statistics. As the students will perform multiple simulations using the in-house nonlinear finite element MATLAB code, experience with MATLAB is desired.

Points of contact:

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