RX21-32

Research Title

Synthetic Composite Microstructure Generation for Simulation-based Damage and Design Envelope Studies

Individual Sponsor

Dr. John Wertz, AFRL/RXCA
AFRL/RXC Bldg. 655
2977 Hobson Way
WPAFB, OH 45433
john.wertz.1@us.af.mil

Academic Area/Field and Education Level

Materials Science, Computer Science, or Applied Mathematics (MS or PhD)

Objectives

The objective of this effort is to develop algorithms, methods, or techniques that enable rapid generation of synthetic, additively manufactured (AM) composite structures with realistic material and geometric variability. Three fundamental challenges must be addressed. First, variability in formation parameters (such as layup or matrix/fiber material properties) and defect distribution (such as porosity, fiber misalignment, and voids) must be identified and quantified with respect to their relative influence on performance metrics. Second, appropriate spatial statistics must be selected to describe the stochastic distribution of those features within the host material. Third, computational methods must be developed to rapidly generate complex 2D/3D voxel-based geometries with representative defect features.

Description

Additively manufactured polymer composites have the potential to revolutionize low cost attritable structures in Air Force platforms, offering tailored properties at greatly reduced weight and cost. These advantages are diminished by insufficient knowledge of how formation and defect parameters affect performance and inspectability. The solution to this problem lies in integrated computational materials science and engineering (ICMSE): rapid expansion of the requisite knowledge-base via extensive computational studies on these topics. Enabling these studies requires a computational tool capable of generating accurate representations of complex AM composites with real defect distributions.

Research Classification/Restrictions

None.

Eligible Research Institutions

All DAGSI Institutions