Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2018-721

Topic # N161-010
Novel Method to Utilize Multi-scale Physics-based Technique for Crack Path Determination in Fiber-reinforced Composites
Global Engineering Research and Technologies

WHO

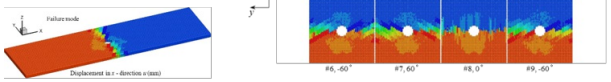
SYSCOM: NAVAIR

Sponsoring Program: PMA 275

Transition Target:

TPOC:
(301)342-0297

Other transition opportunities:
Global Engineering Research and Technologies' methodology has applications for Air Force, Army, MDA as well as DHS



Notes: Figure above depicts displacement in x-direction under compression in a [60/0]60]3s laminate after failure

WHAT

Operational Need and Improvement: As composites with superior features are increasingly replacing traditional metal parts in defense aerospace applications, accurate prediction of damage initiation and progression in aerospace structures is crucial, for failure of those structures could have catastrophic consequences and lead to loss of life and material. There is no existing analysis capability that can predict all possible failure modes in composites under multiaxial loading conditions and multiple-load paths. Experimental evaluation of damage that is not visible involves expensive specialized equipment, and may not be fully satisfactory in visualization of internal damage. Component level structural testing and analysis of advanced composites is prohibitively expensive and time consuming. Instead, using robust and accurate computational tools complemented by experiments at key stages is a viable and cost effective option.

Specifications Required: Accurately predicting initiation of matrix cracking, fiber breakage and delamination as well as their propagation paths in laminated composites under static and cyclic loading conditions representative of the service conditions including the effects of moisture and temperature.

Technology Developed: A software tool to predict failure initiation, mode and propagation in fiber-reinforced composites is being developed by Global Engineering Research and Technologies (GERT) using a peridynamic (PD) modeling approach. The tool and the methodology will accommodate quasi-static and fatigue type failures. The methodology will encompass the effects of features at different scales. Additionally, the method will take into account the effects of temperature and moisture on fracture of fiber-reinforced composites

Warfighter Value: GERT's technology helps predict the structural integrity and service life of composite components under various loading conditions in various harsh environmental conditions.

WHEN

Contract Number: N68335-18-C-0077

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Integration of macro-, meso- and micro-scale analysis in GERT software and ANSYS framework	Low	Analytical verification	4	November 2018
Formulation of a Peridynamics fatigue model for constant and variable amplitude loads	Low	Analytical verification	4	January 2019
Integration of Peridynamics with isogeometric analysis	Low	Validation/verification against available data	4	January 2019
Implementation of the Peridynamics fatigue model in a stand-alone GERT software and ANSYS	Low	Beta-testing	5	December 2019
Implementation of the Peridynamics with isogeometric analysis in GERT software and in ANSYS framework	Low	Beta-testing	5	June 2020
Technology demonstration - Peridynamics interfaced with ANSYS	Low	Beta-testing	5	January 2021

HOW

Projected Business Model: License the software to government agencies as well as the prime contractors. Integration of GERT's technology into existing software provided by prime integrators.

Company Objectives: Develop a simulation tool that is the hallmark of predictive tools in the prediction of crack initiation and propagation in composite structures under general loading and environmental conditions.

Potential Commercial Applications: Prediction of failure initiation and propagation of composite parts in multiple industries including aerospace, electronics and nuclear.

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