Department of the Navy SBIR/STTR Transition Program

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Topic # N132-101
Thick Composite Crack Analysis
Global Engineering Research and Technologies

WHO

SYSCOM: NAVAIR

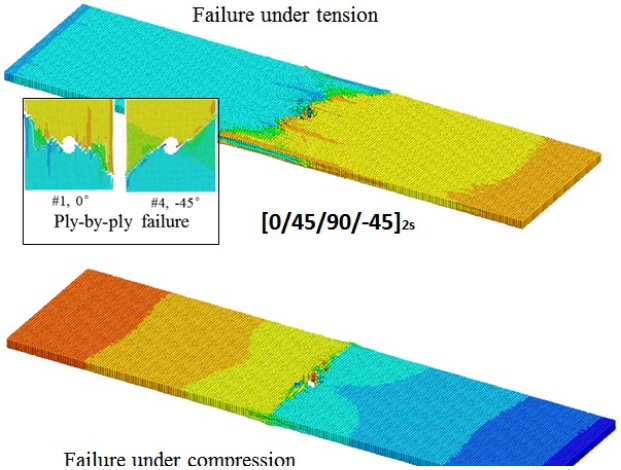
Sponsoring Program: PMA 276

Transition Target: PMA 261

TPOC:
(301)342-0297

Other transition opportunities: This technology has applications for Air Force, Army, MDA as well as Homeland Security.

Notes: Figure right, depicts loading conditions for a balanced and symmetric laminate, and ply-by-ply failure modes using GERT's peridynamic theory technology.



WHAT

Operational Need and Improvement: Composites continue to replace traditional metal parts with increasing frequency in defense aerospace applications.
The nature of damage initiation and its progression in composites creates more complicated internal loading than would be experienced in traditional, metal parts.
Their failure involves a progressive series of events with discrete failure modes such as matrix cracking, fiber-matrix shear, fiber breakage, and delamination.
The presence of such failure modes results in stiffness degradation; thus, leading to load redistribution among the layers and constituents.
As the Navy continues to incorporate more composite structure, accurate damage prediction using analytical methods continues to be an area where improvement is needed.
Traditional finite element analysis (FEA) is inherently limited for predicting failure modes especially in fiber-reinforced composites.

Specifications Required: Accurate computation of load redistribution and prediction of failure modes and strength of composite laminates.
Reduction in time and cost for material testing and characterization.

Technology Developed: GERT's technology enables accurate prediction of failure modes and strength of composite structures under complex loading conditions by using peridynamic theory.
Peridynamic theory removes the limitations of the existing computational methods such as the finite element method in capturing realistic failure modes.
Peridynamic theory enables multi-physics (deformation, heat diffusion, moisture diffusion, corrosion, etc.) modeling at different length and time scales in one computational domain.

Warfighter Value: GERT's technology helps predict life of rotorcraft composite components under various loading conditions including impact, penetration, and fatigue.
It accounts for effects of environmental conditions such as temperature, moisture uptake and corrosion on structural integrity and expected life of rotorcraft parts.

WHEN

Contract Number: N68335-15-C-0043 **Ending on:** October 31, 2015

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Prototype software for failure prediction due to mechanical loads	N/A	Validation/verification against available data	4	August 2015
Inclusion of environmental loads and manufacturing defects	Low	Validation/verification against available data	4	April 2016
Inclusion of cyclic loads	Low	Validation/verification against available data	4	August 2016
Interface with finite element method	Low	Analytical verification	4	January 2017
Graphical User Interface (GUI) for the sotware	Low	Beta-testing	5	June 2017

HOW

Projected Business Model: Licence 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 design and analysis of composite structures under general loading and environmental conditions.

Potential Commercial Applications: Failure prediction of composite parts in multiple industries including aerospace, electronics and nuclear.

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