

Topic: N10B-T050

Materials Research & Design

MULTI SCALE MODEL OF PIN-REINFORCED FOAM CORES

Aircraft and other aviation components have contours for aerodynamic performance using composite sandwich structures for high strength-to-weight ratio. MR&D is exploring these complex sandwich structures through the development of a multi-scale material model tailored for the design of pin-reinforced foam cores capable of near net shape fabrication to meet critical performance needs. MR&D's role as an industry leader in providing design/analysis services for the advanced materials community provides the necessary experience to develop such a complex material model. Future vertical lift aircraft are expected to be the immediate beneficiaries of such a development. Such a solution will greatly improve the development of pin-reinforced foam cores capable of achieving strength-to-weight ratios not capable with heritage solutions. To reduce risks, MR&D is validating the model with a variety of fabrication and experimental tasks.

Technology Category Alignment:

Rotary Wing Vehicles

Fixed Wing Vehicles (includes UAS)

Propulsion and Extreme Environments

Modeling, Simulation & Test Infrastructure

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SYSCOM: NAVAIR

Contract: N68335-17-C-0066

 Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68335-17-C-0066

Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2017-718

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WHO

SYSCOM: NAVAIR

Sponsoring Program: PMA-299,
PMA-261

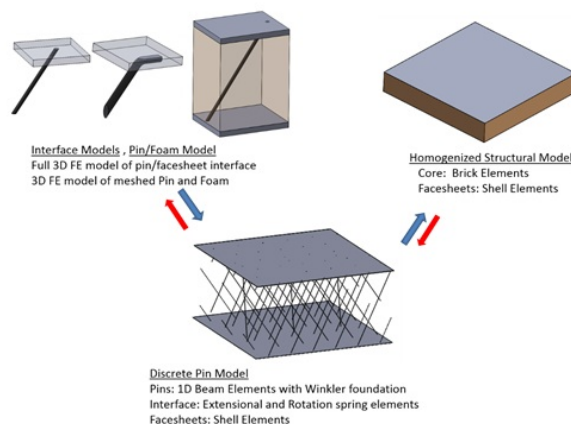
Transition Target: Future Vertical
Lift

TPOC:
(301)342-9351

Other transition opportunities:

The successful development of a multi-scale model for pin-reinforced foam cores will be of direct interest to material fabricators and material integrators which currently utilize honeycomb structures.

Notes: Sequential Multi-Scale
Model of Pin-Reinforced Foam Core
for Use in Lightweight Composite
Sandwich Structures



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WHAT

Operational Need and Improvement: Lightweight, structurally efficient military aircraft employ components that rely heavily on honeycomb sandwiches due to their high stiffness-and strength-to-weight ratio. However, honeycomb sandwiches are difficult to fabricate over complex contours and are prone to water ingress resulting in performance degradation. The honeycomb material is difficult to shape, which limits the aerodynamic efficiency of the aircraft structures. Furthermore honeycomb properties are uniform so the weight of the structure is controlled by peak loads and critical locations. Both of these issues (shape and weight) can be addressed by developing a multi-scale material model capable of efficiently designing sandwich structures that employ pin-reinforced foam core.

Specifications Required: Innovative high fidelity modeling tool is sought that can be used to design structures with pin-reinforced foam cores, specifically X-Cor™ and K-Cor™, thus reducing the reliance of testing based point designs for structures made of these material.

Technology Developed: A high fidelity modeling tool is developed for X-Cor™ and K-Cor™ that can be used for constructing engineered structures meeting critical design parameters.

Warfighter Value: The value for developing an accurate multi-scale model for pin-reinforced foam cores lies in giving confidence in the design of advanced aircraft structures with high strength-to-weight ratio requirements. The alternative may result in the unnecessary trial and error approach which will likely require multiple rounds of fabrication and experimentation tasks

WHEN

Contract Number: N68335-17-C-0066 **Ending on:** April 20, 2019

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Multi Scale Model – Theoretical and Design Tool Development	Low	Successful Correlation with Available Data	2	November 2017
Multi Scale Model - Design Tool Optimization	Low	Apply multi-scale model to variety of foam core materials and successfully correlate with newly measured data	3	January 2018
Synergistic Multi Scale Model – Design Tool	Med	Data is automatically passed between the scales in a back and forth (two way) manner	4	April 2019

HOW

Projected Business Model: MR&D's anticipated business model for the developed multi-scale material model will be to work with material fabricators currently developing pin-reinforced foam cores in order to assist them in producing optimized foam structures capable of meeting their customer's needs.

Company Objectives: Although MR&D is not the owner of the material that is being evaluated with the developed multi-scale material model, the framework for such a tool would be of interest to any material fabricator looking to develop lightweight composite sandwich structures.

Potential Commercial Applications: Lightweight composite sandwich structures would be of direct interest to manufacturers of commercial air- and rotorcraft. The successful development and demonstration of a multi-scale material model will directly benefit such applications by providing a powerful tool capable of efficiently designing materials to meet operational design requirements.

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