

# Carleton University

Department of Mechanical and Aerospace Engineering

Graduate Webinar Series

Tuesday October 12<sup>th</sup>, 2021, 1:00 - 2:00 PM EDT

## **NanoScaffold – Enhanced Composites for Next Generation Light Aircrafts**

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#### **Abstract**

Multiscale Integrated Technology Solutions (MITS) LLC, a Purdue University Startup, has successfully incorporated a nano-scaffold enhanced (NSE)-Carbon Fiber Reinforced Polymer (CFRP) prepreg material as an alternative to conventional CFRP for aircraft structural systems subjected to impact energy and high strain rate loads. In comparison to conventional CFRP, the proposed NSE-CFRP composite offers significantly higher interlaminar and curved beam strength and increased fatigue life due to enhanced energy absorbency. A model-based generative machine learning approach that optimizes nonlinear structures subjected to impact load has been coupled to the NSE-CFRP composite. The designed system can better distribute the internal energy density from the impact load, increase toughness, tailor the 3D force-displacement response to impact, and increase the life of the lightweight composite system. To demonstrate the technology and concept viability, a composite wheel system was developed for SRAM. The focus of this project was on the design, optimization, and manufacturing of a wheel system providing a foundation to support the structural loads utilizing an enhanced carbon fiber epoxy prepreg system with hybrid unidirectional and fabric reinforcements. The goal of a total weight saving of more than 25% was achieved.

#### **Bio**

Dr. Dalir is the CEO and Co-Founder of Multiscale Integrated Technology Solutions (MITS) LLC, a Purdue University Startup. He is also an Associate Professor in the Department of Mechanical and Energy Engineering with dual appointment in Motorsports Engineering Program. He was the Technical Director of the Syracuse Center of Excellence for Analysis and Design as well as an Associate Professor in the Department of Mechanical and Aerospace Engineering at Syracuse University from 2015-2017. Dr. Dalir served as a Senior Airframe Structures Engineer at Bombardier Aerospace from 2011-2015. He was a Post-doctoral Research Associate at Polytechnique Montreal from 2009-2011. Dr. Dalir obtained his Ph.D. from the Department of Mechano-Micro Engineering at Tokyo Institute of Technology in 2009. Dr. Dalir's research interests have revolved around different topics in the area of mechanical, automotive and aerospace engineering. Dr. Dalir has been involved on research proposals totaling \$15.2 million (\$7.5 million as PI; \$7.7 million as Co-PI), from National Science Foundation (NSF), Air Force Research Laboratory (AFRL), Indiana Economic Development Corporation (IEDC), Indiana Elevate Nexus, Indy Car, SRAM, Gurit, and Citizens Energy Group with several other collaborations in place with Dallara, Carrier Corporation, Honda, University of Maine, Syracuse University, and MIT.