SDSU | College of Engineering Mechanical Engineering

Mechanical Engineering Seminar Series

April 15th, 2026, 11:00AM

Dean's Conference Room, E-203E

Title: Bistable Composites for Bioinspired Morphing Wings

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Abstract: Bistable composite laminates have emerged as an enabling platform for morphing structures due to their ability to transition between stable configurations with minimal actuation. Their practical implementation, however, is characterized by strong geometric nonlinearity and sensitivity to imperfections, posing significant challenges for analysis and design.

This seminar presents the development of a generalized finite element framework for bistable composite structures, grounded in Koiter's asymptotic postbuckling theory. The proposed approach integrates linear buckling analysis, imperfection representation through mode-shape superposition, and nonlinear analysis within a unified computational architecture. This framework enables consistent prediction of curing-induced bifurcation, equilibrium shapes, and actuation-driven snapthrough behavior.

To demonstrate its applicability, the methodology is implemented across multiple finite element platforms and applied to the design of bioinspired morphing wing concept. Parametric studies are conducted to investigate the influence of geometric and material parameters on stability characteristics and actuation requirements. The seminar will discuss the integration of physics-based modeling with computational design tools, the challenges associated with imperfection-sensitive structures, and the broader implications for multifunctional composite structures.

Bio: Sam Nakhla is currently a Visiting Researcher at the Woodruff School of Mechanical Engineering at Georgia Institute of Technology, and a Professor of Mechanical Engineering at Memorial University of Newfoundland, where he also holds a cross-appointment in the Faculty of Medicine. He earned his PhD in Aerospace Engineering from Georgia Institute of Technology. Prior to graduate studies, he gained industry experience in civil aviation and software engineering. He currently leads a research program focused on multiscale modeling, and material degradation by integrating physics-based and computational approaches to investigate multifunctional composites and aging, degradation, and failure mechanisms associated with corrosion and hydrogen embrittlement, with applications in aerospace, mechanical, and biomedical systems.

His research has been supported by major funding agencies in the United States, including the U.S. Office of Naval Research, the Georgia Space Grant Consortium, and the American Society for Composites, as well as by federal and provincial agencies in Canada, including the Natural Sciences and Engineering Research Council of Canada, and industry partners such as Bombardier and Suncor.