DATA SCIENCE AND MACHINE LEARNING APPLICATIONS FOR COMPOSITE MATERIALS AND BIOMEDICAL ENGINEERING

Li-Wei Liu[1] and Grace Gu[2] and Seunghwa Ryu[3] and Zhao Qin[4] and Chia-Ching Chou[1] and Shu-Wei Chang[1] and Chi-Hua Yu[5]*

[1]National Taiwan University
[2]University of California, Berkeley
[3]KAIST
[4]Syracuse University
[5]National Cheng Kung University

MINISYMPOSIUM

Despite the technical importance of composite materials and structures, systematic design frameworks for them are limited because conventional optimization techniques face difficulties in handling the high-dimensional design space consisting of an astronomical number of material combination and configurations as well as a complex nonlinear response beyond the linear response regime. With the advancement of machine learning (ML) techniques, extensive efforts are underway to establish alternative data-driven design frameworks for finding the optimal microstructure, external shape, and processing condition of composite materials and structures. A key element to the efficient and successful design is the choice of appropriate ML models and design frameworks that are best suited to the properties of the target design space (size, number of variables, and variable ranges) and available training dataset (size, fidelity, and design space coverage). The aim of this mini-symposium is to foster and communicate the state-of-the-art on the data science and ML-basedmethods for the design of composite materials and related biomedical engineering applications. Topics of interests include but are not limited to the following:
1. Novel machine-learning algorithms for material designs and their comparisons
2. 3D-printed bio-inspired composites with complex microstructures, superior properties through optimization
3. Lightweight structural composites with optimized material usage for superior strength, toughness, fatigue life
4. Multifunctional composites with multi-objective ML-based optimization
5. Design, modeling, and synthesis of bio-inspired hierarchical composites
6. Prediction and design of the nonlinear responses of flexible composites
7. Optimization of processing conditions of composites for minimal manufacturing defects
8. Surrogate models based on machine learning methods for engineering applications
9. Data science applications for biomedical engineering