2025 Fall Statistics Seminar Series

School of MATHEMATICAL AND STATISTICAL SCIENCES Clemson University

Dr. Feng Ye

Department of Industrial Engineering
Clemson University

Wednesday, September 10, 2025
11:15 am – 12:05 pm
Martin Hall, Room M-103
Zoom: Zoom Link

Physics-Guided Data Science Modeling - An Example from Offshore Wind Energy Systems

Abstract

Advancements in data science and machine learning models is revolutionizing many fields. Yet, bridging those advancements to engineering applications poses significant challenges related to how those models generalize and adhere to the underlying principles and motivating physics of engineering systems. This presentation highlights recent efforts to bridge the physical and data-driven paradigms by constructing physics-guided data science models for improved offshore wind energy forecasting and operation. In the first part of the talk, I will present a multivariate statistical method based on an integro-difference equation model for spatio-temporal wind energy forecasting. Embedded within the statistical model, an advanced deep learning architecture acts as a "physics extractor" to dynamically estimate physically meaningful kernel parameters from high-dimensional operational data that is difficult to process using standard statistical machinery. In the second part of the talk, I will present a machine-learning-based approach for wind energy modeling that is characterized by a physically motivated covariance function that unleashes the power of machine learning while guiding the data learning process to adhere to the physical principles of wind field formation and propagation. These models inherit the merits of both data science (modern AI/ML, statistics) and physics (physical models, first principles), offering inherent interpretability, uncertainty quantification, and accurate predictions to support intelligent operations in renewable energy systems.

About the Speaker

Feng Ye is an Assistant Professor in the Department of Industrial Engineering at Clemson University. He received his Ph.D. in Industrial and Systems Engineering and an M.Sc. in Statistics from Rutgers University–New Brunswick. The overall topic of his research work is to formulate statistical and machine learning methods to improve the forecasting, operations and maintenance of wind energy systems. His research aims to advance the integration of physics, statistics, and modern AI/ML by constructing physics-guided data science models for improved renewable energy forecasting and operation. He is the winner of the QCRE Best Student Poster Competition at the 2024 IISE Annual Conference, the Best Paper of the Energy Systems Track at the 2023 IISE Annual Conference, and the Best Student Paper Competition of the Sustainability Track at the 2022 INFORMS Annual Meeting. He is also a recipient of the New Jersey Wind Institute Fellowship and the Outstanding Graduate Student Award from the Rutgers ISE Department. He is a member of INFORMS, IISE, and IEEE.