

NUCLEAR ENGINEERING RESEARCH SEMINAR

Applied AI for Nuclear Engineering: From Bayesian Inverse UQ and Deep Generative Modeling to LLM-Enabled Nuclear Reactor Operator Training

ABSTRACT

This seminar presents recent research from the ARTISANS (Artificial Intelligence for Simulation of Advanced Nuclear Systems) group at North Carolina State University on applied artificial intelligence for nuclear engineering. Our work integrates uncertainty quantification (UQ) and scientific machine learning (SciML) to improve predictive modeling and decision support in high-consequence systems. First, we introduce a Bayesian inverse UQ framework that leverages machine learning surrogates to quantify model parameter uncertainties using experimental data while rigorously accounting for multiple sources of modeling uncertainty. Second, we present advances in deep generative modeling for data augmentation to address data scarcity in nuclear applications, with a case study in critical heat flux. Finally, we discuss early development of CORA (Cognitive Operator Readiness Assistant), an LLM-enabled system designed to enhance nuclear reactor operator training at NC State's PULSTAR facility. Together, these efforts illustrate how physics-informed AI can enhance predictive fidelity, accelerate learning from limited data, and support next-generation nuclear workforce development.



School of Nuclear Engineering

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3:30 PM | WTHR 200



**Dr. Xu Wu, Associate Professor
North Carolina State University**

Dr. Xu Wu is an Associate Professor of Nuclear Engineering at North Carolina State University. His research focuses on uncertainty quantification, Bayesian inverse problems, scientific machine learning, and deep generative modeling for nuclear engineering applications. He received his B.S. in Nuclear Engineering from Shanghai Jiao Tong University in 2011 and his Ph.D. in Nuclear Engineering from the University of Illinois at Urbana-Champaign in 2017. Prior to joining NC State in 2019, he worked as a Postdoctoral Research Associate in the Department of Nuclear Science and Engineering at MIT. Dr. Wu is Principal Investigator of the ARTISANS research group at NC State. He was awarded the DOE Office of Nuclear Energy Distinguished Early Career Program in 2024. He was a recipient of the 2026 American Nuclear Society (ANS) Landis Young Member Engineering Achievement Award and 2026 ANS Thermal Hydraulics Division Bal-Raj Sehgal Memorial Award.