

NUCLEAR ENGINEERING RESEARCH SEMINAR

Multi-Scale Multi-Physics System Analysis of Advanced Reactor Transients: the Perspectives of SAM Code Development

ABSTRACT

This seminar will highlight advances in multi-scale, multi-physics system-analysis methods and their applications to advanced reactor safety analysis, with an emphasis on work conducted at Argonne National Laboratory. The presentation will begin with a brief overview of the System Analysis Module (SAM), a modern reactor-safety analysis code, followed by several modeling approaches and applications: (1) coupling one-dimensional system thermal-hydraulics codes with multidimensional computational fluid dynamics tools; (2) coupling one-dimensional fluid models with three-dimensional solid-structure models for prismatic gas-cooled and thermal-spectrum molten salt reactors; (3) multiscale modeling of pebble-bed cores with TRISO particle fuel to accurately predict coolant, pebble, and fuel-kernel temperatures; and (4) high-to-low-fidelity (Hi-2-Lo) methods for closure-model development and machine-learning applications in multiscale nuclear thermal-hydraulics simulations. The seminar will conclude by looking beyond the development of capable multi-physics codes to the creation of a governed analysis ecosystem, one that integrates uncertainty quantification, qualification evidence, and disciplined AI assistance, to accelerate the design and licensing of advanced nuclear reactors.



School of Nuclear Engineering

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3:30 PM | WTHR 200



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Dr. Rui Hu is the Manager of Safety and Engineering Analysis Department in the Nuclear Science & Engineering Division at Argonne National Laboratory. In present position, he provides technical leadership, and leads program coordination and development on reactor safety analysis, computational fluid dynamics, licensing and risk assessment, and reactor design studies. Dr. Hu also serves as the Deputy Technical Area Lead for Thermal Fluids for US DOE's Nuclear Energy Advanced Modeling and Simulation (NEAMS) program, and lead the development of the modern system analysis code SAM for safety analysis of advanced non-light water reactors. He has extensive experience in modeling and simulation of nuclear reactor systems and co-authored 150+ peer-reviewed publications. He received his PhD in nuclear engineering from MIT in 2010.