Graduate Student Research Seminar
Fall 2024

Developing reduced order models for gas bubble formation in irradiated metals using integrated phase field modeling and Koopman operator theory

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3:00 pm (EST) – 132 Fluor Daniel Building

Abstract
Irradiation damage in materials is prevalent in nuclear components, posing significant risks in the safety and reliability of nuclear reactors. Phase field models offer a versatile framework for modeling irradiation damage in materials at mesoscales. Such high fidelity method has been used to model the formation of fission gas bubbles superlattice, a microstructure array occurs at certain irradiation conditions (dose, dose-rate, and temperature). To overcome the high computational cost of phase field modeling, Koopman operator theory is applied to create reduced order models, allowing for instantaneous simulations of fission gas bubble behaviors. These low fidelity models are integrated into machine learning methods to predict the formation window of gas bubble superlattice, and then validated by the high fidelity phase field models and experiments. For this presentation, we present our results of using phase field models of irradiation damage along with standard and enhanced dynamic mode decomposition (DMD/eDMD) methods in reducing the computational costs of high-fidelity simulations.

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