

Farah R. Alsafadi

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EDUCATION

- North Carolina State University**, Raleigh, NC Expected: Jul 2025
Ph.D. in Nuclear Engineering
- North Carolina State University**, Raleigh, NC Dec 2023
Master of Nuclear Engineering
- Jordan University of Science and Technology**, Jordan Jul 2020
B.Sc. in Nuclear Engineering, ABET-accredited program
Jordan Atomic Energy Commission Undergraduate Scholarship

RESEARCH INTERESTS & AREAS OF EXPERTISE

- Generative artificial intelligence applications in nuclear engineering- scientific machine learning
- Inverse uncertainty quantification of computer models
- Uncertainty quantification and sensitivity analysis
- Verification and validation in scientific computing
- Modeling and simulation of reactor systems

PROFESSIONAL EXPERIENCE

- North Carolina State University** Raleigh, NC
Graduate Research Assistant Jan 2021-Present
Artificial Intelligence for the Simulation of Advanced Nuclear Systems Group
- Ongoing project: "Evaluating the Performance of Diffusion Models for Scientific Data Augmentation: a Case Study with Critical Heat Flux".
- Oak Ridge National Laboratory** Oak Ridge, TN
Graduate Research Intern - Nuclear Energy and Fuel Cycle Division May-Aug 2024
- Internship project: "Optimizing CFD Simulation Convergence Speed for Engineering Optimization of First Wall Protection Limiters".
 - Reduced the computational cost of the CFD simulations by mapping solutions from one case to be used as the initial conditions for other cases which can accelerate model convergence.
 - Created a reduced-order model of conjugate heat transfer in order to replace the CFD solver with a 1D heat balance equation of the pipe, which will further speed up the optimization process.
- North Carolina State University** Raleigh, NC
Graduate Research Teaching Assistant Jan-May 2023 & 2024
Reactor Systems course
- Argonne National Laboratory** Lemont, IL
Graduate Research Intern - Nuclear Science and Engineering Division May-Aug 2022
- Internship project: "Digital Twin Development for Advanced Reactor System Based on Graph Neural Networks Using SAM Code Simulation".
 - Generated training data by designing and simulating various reactor accident scenarios using SAM code.

- Created a heterogeneous graph of the gFHR system based on SAM code, enabling an accurate representation of the reactor system for subsequent simulations with Graph Neural Networks.

North Carolina State University
Graduate Research Teaching Assistant
Monte Carlo Methods and Applications course

Raleigh, NC
 Aug-Dec 2022

Undergraduate Intern
Jordan Atomic Energy Commission (JAEC)

Jordan
 Jun-Sep 2020

- Hands-on experience in physical and chemical analysis laboratories, gamma irradiation facility, radiation and secondary standard dosimetry laboratories, and neutron calibration laboratory.

PEER-REVIEWED JOURNAL PUBLICATIONS

1. **Alsafadi, F.**, Yaseen, M., and Wu, X. 2024. An Investigation on Machine Learning Predictive Accuracy Improvement and Uncertainty Reduction using VAE-based Data Augmentation. (under review at Nuclear Engineering and Design)
2. Liu, Y., **Alsafadi, F.**, Mui, T., O’Grady, D. and Hu, R., 2024. Development of Whole System Digital Twins for Advanced Reactors: Leveraging Graph Neural Networks and SAM Simulations. Nuclear Technology, pp.1-18.
3. **Alsafadi, F.**, Furlong, A. and Wu, X., 2024. Predicting Critical Heat Flux with Uncertainty Quantification and Domain Generalization Using Conditional Variational Autoencoders and Deep Neural Networks. (under review at Engineering Applications of Artificial Intelligence)
4. Furlong, A., **Alsafadi, F.**, Palmtag, S., Godfrey, A. and Wu, X., 2024. Data-Driven Prediction and Uncertainty Quantification of PWR Crud-Induced Power Shift Using Convolutional Neural Networks. (under review at Energy)
5. Akins, A., Furlong, A., Kohler, L., Clifford, J., Brady, C., **Alsafadi, F.** and Wu, X., 2024. ARTISANS—Artificial Intelligence for Simulation of Advanced Nuclear Systems for Nuclear Fission Technology. Nuclear Engineering and Design, 423, p.113170.
6. **Alsafadi, F.** and Wu, X., 2023. Deep generative modeling-based data augmentation with demonstration using the BFBT benchmark void fraction datasets. Nuclear Engineering and Design, 415, p.112712.
7. Saleem, R.A.A., **Alsafadi, F.R.** and Al-Abidah, N., 2022. Effect of mesh refinement on the solution of the inverse uncertainty quantification problem for transient physics. Progress in Nuclear Energy, 152, p.104360.
8. Xie, Z., **Alsafadi, F.** and Wu, X., 2021. Towards improving the predictive capability of computer simulations by integrating inverse Uncertainty Quantification and quantitative validation with Bayesian hypothesis testing. Nuclear Engineering and Design, 383, p.111423.
9. Wu, X., Xie, Z., **Alsafadi, F.** and Kozlowski, T., 2021. A comprehensive survey of inverse uncertainty quantification of physical model parameters in nuclear system thermal-hydraulics codes. Nuclear Engineering and Design, 384, p.111460.

PEER-REVIEWED CONFERENCE PAPERS

1. **Alsafadi, F.**, Furlong, A., and Wu, X. 2024. Prediction and Uncertainty Quantification of Critical Heat Flux - A Comparison Between Generative Conditional VAEs and DNN. In Proceedings of the 2024 Advances in Thermal Hydraulics (ATH 2024). Orlando, FL, USA, November 17–21, 2024

2. **Alsafadi, F.**, Yaseen, M., and Wu, X. 2024. Uncertainty Quantification and Improved Neural Networks Predictions using Data Augmentation by Variational Autoencoders. In Proceedings of the 2024 Best Estimate Plus Uncertainty International Conference (BEPU 2024). Lucca, Italy, May 19-24, 2024
3. Furlong, A., **Alsafadi, F.**, Palmtag, S., Godfrey, A., Hayes, S., and Wu, X. 2024. Predicting PWR Fuel Assembly CIPS Susceptibility with Convolutional Neural Networks: Performance and Uncertainty Quantification. In Proceedings of the International Conference on Physics of Reactors (PHYSOR 2024). San Francisco, CA, USA, April 21-24, 2024
4. Furlong, A., **Alsafadi, F.**, Kohler, L., Wu, X., Palmtag, S., Godfrey, A., and Hayes, S. 2023. Machine Learning-based Prediction of Crud Buildup Locations in Pressurized Water Reactors. In Transactions of American Nuclear Society. Washington, D.C., USA, November 12-15, 2023
5. **Alsafadi, F.** and Wu, X. 2023. Deep Generative Modeling for Augmentation of the Steady-state Void Fraction Dataset in the BFBT Benchmark. In Proceedings of the 20th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-20). Washington, D.C., USA, August 20-25, 2023
6. Liu, Y., **Alsafadi, F.**, Mui, T., O'Grady, D. and Hu, R. 2023. Digital Twin Development for Advanced Reactor System Based on Graph Neural Networks Using SAM Code Simulation. In Proceedings of the 20th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-20). Washington, D.C., USA, August 20-25, 2023
7. **Alsafadi, F.** and Wu, X. 2022. Data Augmentation with Generative Adversarial Networks. In Transactions of American Nuclear Society. Anaheim, CA, USA, June 12-16, 2022
8. **Alsafadi, F.**, Xie, Z., and Wu, X. 2021. Quantitative Validation with Bayes Factor. In Transactions of American Nuclear Society. Washington, DC, USA, Nov. 30 - Dec. 4, 2021

NOTABLE COURSES

- Verification and Validation in Scientific Computing
- Scientific Machine Learning
- Monte Carlo Methods and Applications
- Uncertainty Quantification for Physical and Biological Models
- Applied Bayesian Analysis
- Advanced Scientific Machine Learning
- Reactor Systems

VOLUNTARY AND LEADERSHIP EXPERIENCE

Treasurer Graduate student association	2023
<i>Graduate Student Association - North Carolina State University</i>	
Outreach Officer	2017
<i>Institute of Nuclear Materials Management- JUST Student Chapter</i>	
Founding Member	2017
<i>Nuclear Leaders Team - a scientific university club for public awareness</i>	

COMPUTATIONAL SKILLS

- Matlab , Python, R, Latex
- TRACE, MCNP, SAM, DAKOTA, OpenFOAM
- Linux operating system
- Tensorflow library for ML applications