Farah Raed Alsafadi

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Education

North Carolina State University — USA
Ph.D. in Nuclear Engineering — January 2021-Present

Jordan University of Science and Technology — Jordan
B.Sc. in Nuclear Engineering, ABET-accredited program — July 2020

Graduation project title: "Effect of mesh refinement on the solution of the inverse uncertainty quantification problem for transient physics".

Research Interests

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

Professional Experience

Research Assistant — January 2021-Present
North Carolina State University

Teaching Assistant — January 2023-Present
North Carolina State University - Reactor Systems course

Intern — May 2022 - August 2022
Argonne National Laboratory

Internship project: "Digital Twin Development for Advanced Reactor System Based on Graph Neural Networks Using SAM Code Simulation". My primary responsibility involved generating training data by designing and simulating various reactor accident scenarios using the SAM code. Additionally, I 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.

Teaching Assistant — August - December 2022
North Carolina State University - Monte Carlo Methods and Applications course

Intern — June 2020 - September 2020
Jordan Atomic Energy Commission (JAEC)

Ongoing Projects

- Duke Energy Project: Using Machine Learning (ML) to Predict Locations with Crud Buildup in PWR. ML model will be trained to predict when crud growth occurs, this can be further used in core simulators to predict crud deposition based on core design.
- Deep generative modeling project: The objective is to evaluate the effectiveness of augmenting the training dataset by expanding an existing dataset using deep generative models. We aim to investigate whether this augmentation leads to improved accuracy in the predictions of the ML model. Additionally, we aim to assess its impact on quantifying uncertainties associated with the ML model's predictions using Bayesian Neural Networks (BNN).

Publications

- **Farah Alsafadi**, Xu Wu, Deep Generative Modeling-based Data Augmentation with Demonstration using the BFBT Benchmark Void Fraction Datasets, (under review, Nuclear Engineering and Design), 2023
- Aidan Furlong, **Farah Alsafadi**, Lauren Kohler, Xu Wu, Scott Palmtag, Andrew Godfrey and Stanley Hayes, Machine Learning-based Prediction of Crud Buildup Locations in Pressurized Water Reactors, Conference Paper for the American Nuclear Society Winter Meeting, 2023
- **Farah Alsafadi**, Xu Wu, Deep Generative Modeling for Augmentation of Steady-state Void Fraction Dataset in the BFBT Benchmark, Conference Paper for 20th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-20), 2023
- Yang Liu, **Farah Alsafadi**, Travis Mui, Daniel O'Grady, and Rui Hu, Digital Twin Development for Advanced Reactor System Based on Graph Neural Networks Using SAM Code Simulation, Conference Paper for 20th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-20), 2023
- **Farah Alsafadi**, Xu Wu, Data Augmentation with Generative Adversarial Networks, Conference Paper for the American Nuclear Society Annual Meeting, 2022
- Rabie A. Abu Saleem, **Farah R. Alsafadi**, Nadeen Al-Abidah, Effect of mesh refinement on the solution of the inverse uncertainty quantification problem for transient physics, Progress in Nuclear Energy, Volume 152,2022, 104360, ISSN 0149-1970
- **Farah Alsafadi**, Xu Wu, Quantitative Validation with Bayes Factor, Conference Paper for the American Nuclear Society Winter Meeting, 2021
- Ziyu Xie, **Farah Alsafadi**, Xu Wu, Towards improving the predictive capability of computer simulations by integrating inverse Uncertainty Quantification and quantitative validation with Bayesian hypothesis testing, Nuclear Engineering and Design, Volume 383, 2021, 111423, ISSN 0029-5493
- Xu Wu, Ziyu Xie, **Farah Alsafadi**, Tomasz Kozlowski, A comprehensive survey of inverse uncertainty quantification of physical model parameters in nuclear system thermal–hydraulics codes, Nuclear Engineering and Design, Volume 384, 2021, 111460, ISSN 0029-5493

Notable Courses

- **Verification and Validation in Scientific Computing** Fall 2021
- **Scientific Machine Learning** Fall 2021
- **Monte Carlo Methods and Applications** Fall 2021
- **Uncertainty Quantification for Physical and Biological Models** Spring 2022
- **Applied Bayesian Analysis** Spring 2023
- **Advanced Scientific Machine Learning** Fall 2023

Honors and Awards

- **Jordan Atomic Energy Commission Undergraduate Scholarship** 2015-2020

Voluntary and Leadership Experience

- **Outreach Officer** 2017
  Institute of Nuclear Materials Management (INMM) – JUST Student Chapter
- **Founding Member** 2017
  Nuclear Leaders Team – a scientific university club for public awareness
- **Founding Member** 2015
  Jordanian Nuclear Association – a university society for youth

Professional Development

- **Organizer of Workshop** August 2018
  "National Meeting on Nuclear Security and Nonproliferation NMNS", funded by Department of State's Partnership for Nuclear Security and CRDF Global
- **Organizer of Training and Table-top exercise** February 2018
  "Model Nuclear Security Summit", funded by Department of State's Partnership for Nuclear Security and CRDF Global
- **National Training** October 2018
  "Workshop on Small Modular Reactors Technologies and IAEA Integral Pressurized Water Reactor (iPWR) Basic Principle Simulator" organized by JAEC and IAEA
- **Training Course** October 2017
  "INMM ACSIS Introduction to Nuclear Security Short Course"
- **Workshop** June 2017
  "Nuclear Security and Safeguards Symposium" by the CRDF Global and INMM JUST Student Chapter
- **Workshop** May 2017
  "Short Course on Research Skills and Methods"

Technical Skills

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