Xu Wu

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Research group: Thttps://www.ne.ncsu.edu/artisans/

Research Interests & Areas of Expertise

• Computational Science and Engineering

- Uncertainty Quantification and Sensitivity Analysis
- Calibration, Validation and Data Assimilation
- Reduced Order Modeling
- Bayesian Inverse Problems
- Scientific Machine Learning
- Data-driven Modeling
- Deep Generative Learning
- Digital Twins

• Nuclear Engineering

- Multi-physics Coupled Simulation
- System Thermal-Hydraulics
- Advanced Nuclear Reactors

Education and Training

Postdoctoral Research Associate, Department of Nuclear Science and Engineering	
Massachusetts Institute of Technology, Cambridge, MA, USA	2017 - 2019
• Project: Evaluation of Economic Benefits of Accident Tolerant Plants through Risk-Informed	Approaches
Ph.D., Nuclear, Plasma and Radiological Engineering University of Illinois at Urbana - Champaign, Urbana, IL, USA	2013 - 2017
• PhD thesis title: Metamodel-based Inverse Uncertainty Quantification of Nuclear Reactor under the Bayesian Framework	Simulators
M.S., Nuclear, Plasma and Radiological Engineering	
University of Illinois at Urbana - Champaign, Urbana, IL, USA	2011 - 2013
• MS thesis title: Coupling of System Thermal-Hydraulics and Monte Carlo Method for a Thermal-Hydraulics-Reactor Physics Feedback	Consistent
B.S., Nuclear Engineering and Technology	
Shanghai Jiao Tong University, Shanghai, China	2007 - 2011
Research and Work Experience	

Assistant Professor	North Carolina State University
Department of Nuclear Engineering	07/2019 - present

• Principal Investigator of the ARTISANS (ARTificial Intelligence for Simulation of Advanced Nuclear Systems) research group.

• Major focus areas: Uncertainty Quantification (UQ), Bayesian inverse problems, Reduced Order Modeling (ROM), Scientific Machine Learning (SciML), Deep Generative Modeling (DGM).

• As of Fall 2024, 6 PhD, 2 co-advised PhD and 6 undergraduate students.

Postdoctoral Research Associate

Massachusetts Institute of Technology

Department of Nuclear Science and Engineering

10/2017 - 06/2019

Research Aide Nuclear Engineering Division

Research Intern Fuel Modeling and Simulation Department

Graduate Research Assistant Department of Nuclear, Plasma and Radiological Engineering

Teaching Experience

NE 795: Advanced Scientific Machine Learning <i>Department of Nuclear Engineering, NCSU, newly developed course since Fall 2023</i>	Fall 2023
NE 795: Scientific Machine Learning Department of Nuclear Engineering, NCSU, newly developed course since Fall 2020	Fall semesters biennially
NE 470/570: Monte Carlo Methods for Radiation Transport <i>Department of Nuclear Engineering, NCSU, newly developed course since Fall 2021</i>	Fall semesters biennially
NE 405/505: Reactor Systems <i>Department of Nuclear Engineering, NCSU</i>	Spring semesters since 2022
NE 408: Nuclear Engineering Design Project	Spring 2020 and 2023

NE 408: Nuclear Engineering Design Project Department of Nuclear Engineering, NCSU

NE 406: Nuclear Engineering Senior Design Preparation Department of Nuclear Engineering, NCSU

Grants and Projects

	Wu budget
DOE NNSA Defense Nuclear Nonproliferation consortium, co-PI	\$625,000
Enabling Capabilities in Technology Consortium (total budget \$25 million)	03/2025 - 03/2030
DOE Office of Nuclear Energy Distinguished Early Career Program, PI	\$625,000
Establishing the Predictive Credibility of Data Driven SciML in Nuclear Applications	08/2024 - 09/2029
DOE National Nuclear Security Administration (NNSA) consortium, co-PI	\$730,289
Consortium for Nuclear Forensics (total budget \$25 million)	09/2023 - 08/2028
Consortium for Nuclear Power (CNP) with Duke Energy, PI	\$63,000
Design of 24-month fuel cycle for a Westinghouse 4-Loop plant - Phase 2	07/2024 - 06/2025
NCSU Center for Nuclear Energy Facilities and Structures (CNEFS) project, co-PI	\$250,181
Probabilistic and AI/ML Approaches in Structural Engineering	01/2022 - 12/2023
Electricite de France (EDF/DER), CNEFS Enhancement Project, co-PI	\$44,952
Statistical Approaches to Reduce Uncertainty in Probabilistic Seismic Hazard Analysis	01/2023 - 12/2023
Consortium for Nuclear Power (CNP) with Duke Energy, PI	\$63,000
Using Machine Learning to Predict Locations with Crud Buildup	07/2022 - 06/2023
Westinghouse Electric Company, PI	\$50,000
Uncertainty Quantification and Validation of CTF Two-phase Flow Modeling Capabilities	03/2022 - 03/2023
INL Laboratory Directed Research and Development (LDRD), co-PI	\$156,636
Artificial Intelligence Based Process Control and Optimization for Advanced Manufacturing	10/2021 - 09/2023
NCSU Data Science Initiative (DSI) Seed Fund, PI	\$50,000
ML-based Mathematical Representation of Model Uncertainty for Bayesian Inverse UQ	08/2021 - 05/2022
INL LDRD project subcontract, co-PI	\$39,859
Multi-scale Modeling and Optimization of Additive Manufacturing Process for Nuclear Fuels	01/2020 - 09/2020
	Total: \$2,697,917

Argonne National Laboratory 05/2015 - 07/2015

Idaho National Laboratory 05/2014 - 07/2014

University of Illinois at Urbana - Champaign

01/2012 - 10/2017

Fall 2019 and 2022

Peer-reviewed Journal Publications

- 1. **Wu, X.**, Moloko, L., Bokov, P., Delipei, G., Kaiser, J., and Ivanov, K. (2025). Uncertainty Quantification for Data-Driven Machine Learning Models in Nuclear Engineering Applications: Where We Are and What We Need? (*under review at Nuclear Engineering and Design*)
- 2. Akins, A., Kultgen, D., **Wu**, X., and Heifetz, A. (2025). Uncertainty Quantification through Monte Carlo Dropout for Multi-Modal Anomaly Detection in a Liquid Sodium Purification System. (*under review at Nuclear Technology*)
- 3. Alsafadi, F., Yaseen, M., and **Wu, X.** (2025). An Investigation on Machine Learning Predictive Accuracy Improvement and Uncertainty Reduction using VAE-based Data Augmentation. (*arXiv preprint arXiv:2410.19063, under review at Nuclear Engineering and Design*)
- 4. Alsafadi, F., Furlong, A., and **Wu**, X. (2025). Predicting Critical Heat Flux with Uncertainty Quantification and Domain Generalization Using Conditional VAEs and DNNs. (*arXiv preprint arXiv:2409.05790, under review at Annals of Nuclear Energy*)
- 5. Furlong, A., Alsafadi, F., Palmtag, S., Godfrey, A., Hayes, S., and **Wu**, X. (2025). Data-Driven Prediction and Uncertainty Quantification of PWR Crud-Induced Power Shift Using Convolutional Neural Networks. (*arXiv preprint arXiv:2407.04726, in revision at Energy*)
- Xie, Z., Wang, C., and Wu, X. (2025). Hierarchical Bayesian Modeling for Inverse Uncertainty Quantification of System Thermal-Hydraulics Code using Critical Flow Experimental Data. *International Journal of Heat and Mass Transfer*, 239:126489. https://doi.org/10.1016/j.ijheatmasstransfer.2024.126s
- Moloko, L., Bokov, P., Wu, X., and Ivanov, K. (2024). Clustering and uncertainty analysis to improve the machine learning-based predictions of SAFARI-1 control follower assembly axial neutron flux profiles. *Annals of Nuclear Energy*, 206:110630. https://doi.org/10.1016/j.anucene.2024.110630
- Brady, C., Murray, W., Moss, L., Zino, J., Saito, E., and Wu, X. (2024). Design considerations and Monte Carlo criticality analysis of spiral plate heat exchangers for Molten Salt Reactors. *Progress in Nuclear Energy*, 173:105266. https://doi.org/10.1016/j.pnucene.2024.105266
- 9. 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*, 423:113170. https://doi.org/10.1016/j.nucengdes.2024.113170
- Baccou, J., Glantz, T., Ghione, A., Sargentini, L., Fillion, P., Damblin, G., Sueur, R., Iooss, B., Fang, J., Liu, J., Yang, C., Zheng, Y., Ui, A., Saito, M., Mendizábal Sanz, R., Bersano, A., Mascari, F., Skorek, T., Tiborcz, L., Hirose, Y., Takeda, T., Nakamura, H., Choi, C., Heo, J., Petruzzi, A., Zeng, K., Xie, Z., Wu, X., Eguchi, H., Pangukir, F., Breijder, P., Franssen, S., Perret, G., Clifford, I., Coscai, T. M., Di Maio, F., Zio, E., Pedroni, N., Zhang, J., Freixa, J., Ciurluini, C., Giannetti, F., and Adorni, M. (2024). A systematic approach for the adequacy analysis of a set of experimental databases: Application in the framework of the ATRIUM activity. *Nuclear Engineering and Design*, 421:113035. https://doi.org/10.1016/j.nucengdes.2024.113035
- Xie, Z., Yaseen, M., and Wu, X. (2024). Functional PCA and Deep Neural Networks-based Bayesian Inverse Uncertainty Quantification with Transient Experimental Data. *Computer Methods in Applied Mechanics and Engineering*, 420:116721. https://doi.org/10.1016/j.cma.2023.116721
- 12. Yaseen, M., Yushu, D., German, P., and **Wu, X.** (2023). Fast and Accurate Reduced-Order Modeling of a MOOSE-based Additive Manufacturing Model with Operator Learning. *The International Journal of*

Advanced Manufacturing Technology, 129:3123–3139. https://doi.org/10.1007/s00170-023-12471-1

- 13. Wang, C., **Wu**, X., Xie, Z., and Kozlowski, T. (2023). Scalable Inverse Uncertainty Quantification by Hierarchical Bayesian Modeling and Variational Inference. *Energies*, 16(22):7664. https://doi.org/10.3390/en16227664
- 14. 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*, 415:112712. https://doi.org/10.1016/j.nucengdes.2023.112712
- Moloko, L., Bokov, P., Wu, X., and Ivanov, K. (2023). Prediction and Uncertainty Quantification of SAFARI-1 Axial Neutron Flux Profiles with Neural Networks. *Annals of Nuclear Energy*, 188:109813. https://doi.org/10.1016/j.anucene.2023.109813
- Yaseen, M. and Wu, X. (2023). Quantification of Deep Neural Network Prediction Uncertainties for VVUQ of Machine Learning Models. *Nuclear Science and Engineering*, 197(5):947–966. https://doi.org/10.1080/00295639.2022.2123203
- Xie, Z., Jiang, W., Wang, C., and Wu, X. (2022). Bayesian inverse uncertainty quantification of a MOOSEbased melt pool model for additive manufacturing using experimental data. *Annals of Nuclear Energy*, 165:108782. https://doi.org/10.1016/j.anucene.2021.108782
- 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*, 384:111460. https://doi.org/10.1016/j.nucengdes.2021.111460
- 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*, 383:111423. https://doi.org/10.1016/j.nucengdes.2021.111423
- Che, Y., Wu, X., Pastore, G., Li, W., and Shirvan, K. (2021). Application of Kriging and Variational Bayesian Monte Carlo method for improved prediction of doped UO2 fission gas release. *Annals of Nuclear Energy*, 153:108046. https://doi.org/10.1016/j.anucene.2020.108046
- 21. Lu, C., Wu, Z., and **Wu, X.** (2021). Enhancing the one-dimensional sfr thermal stratification model via advanced inverse uncertainty quantification methods. *Nuclear Technology*, 207(5):692–710. https://doi.org/10.1080/00295450.2020.1805259
- 22. Jin, Y., **Wu**, X., and Shirvan, K. (2020). System code evaluation of near-term accident tolerant claddings during pressurized water reactor station blackout accidents. *Nuclear Engineering and Design*, 368:110814. https://doi.org/10.1016/j.nucengdes.2020.110814
- Wu, X. and Shirvan, K. (2020). System code evaluation of near-term accident tolerant claddings during boiling water reactor short-term and long-term station blackout accidents. *Nuclear Engineering and Design*, 356:110362. https://doi.org/10.1016/j.nucengdes.2019.110362
- 24. **Wu, X.**, Shirvan, K., and Kozlowski, T. (2019). Demonstration of the Relationship Between Sensitivity and Identifiability for Inverse Uncertainty Quantification. *Journal of Computational Physics*, 396:12–30. https://doi.org/10.1016/j.jcp.2019.06.032
- 25. Wang, C., **Wu**, X., and Kozlowski, T. (2019). Gaussian process–based inverse uncertainty quantification for trace physical model parameters using steady-state psbt benchmark. *Nuclear Science and Engineering*,

193(1-2):100–114. https://doi.org/10.1080/00295639.2018.1499279

26. Wu, X., Kozlowski, T., Meidani, H., and Shirvan, K. (2018). Inverse uncertainty quantification using the modular Bayesian approach based on Gaussian Process, Part 2: Application to TRACE. *Nuclear Engineering and Design*, 335:417–431.
https://doi.org/10.1016/j.jparce.pdes.2018.06.002

https://doi.org/10.1016/j.nucengdes.2018.06.003

27. **Wu, X.**, Kozlowski, T., Meidani, H., and Shirvan, K. (2018). Inverse uncertainty quantification using the modular Bayesian approach based on Gaussian process, part 1: theory. *Nuclear Engineering and Design*, 335:339–355.

https://doi.org/10.1016/j.nucengdes.2018.06.004

- Wu, X., Kozlowski, T., and Meidani, H. (2018). Kriging-based Inverse Uncertainty Quantification of Nuclear Fuel Performance Code BISON Fission Gas Release Model using Time Series Measurement Data. *Reliability Engineering & System Safety*, 169:422–436. https://doi.org/10.1016/j.ress.2017.09.029
- 29. Wu, X., Mui, T., Hu, G., Meidani, H., and Kozlowski, T. (2017). Inverse uncertainty quantification of TRACE physical model parameters using sparse gird stochastic collocation surrogate model. *Nuclear Engineering and Design*, 319:185–200. https://doi.org/10.1016/j.nucengdes.2017.05.011
- Wu, X. and Kozlowski, T. (2017). Inverse uncertainty quantification of reactor simulations under the Bayesian framework using surrogate models constructed by polynomial chaos expansion. *Nuclear Engineering and Design*, 313:29–52. https://doi.org/10.1016/j.nucengdes.2016.11.032
- Wu, X., Kozlowski, T., and Hales, J. D. (2015). Neutronics and fuel performance evaluation of accident tolerant FeCrAl cladding under normal operation conditions. *Annals of Nuclear Energy*, 85:763–775. https://doi.org/10.1016/j.anucene.2015.06.032
- Wu, X. and Kozlowski, T. (2015). Coupling of system thermal–hydraulics and Monte-Carlo code: Convergence criteria and quantification of correlation between statistical uncertainty and coupled error. *Annals of Nuclear Energy*, 75:377–387. https://doi.org/10.1016/j.anucene.2014.08.016

Peer-reviewed Full-length Conference Papers

- Le-Corre, J.-M., Delipei, G., Zhao, X., Wu, X., and Buss, O. (2025). OECD/NEA Benchmark on Artificial Intelligence and Machine Learning for Critical Heat Flux Predictions – Summary of Phase 1 Results. In *Proceedings of the 21th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-21)*. Busan, Republic of Korea, August 31-September 5, 2025
- Akins, A. G., Wu, X., and Heifetz, A. (2025). Synchronization of Heterogeneous Thermal Hydraulic Sensor Responses for Machine Learning-based Anomaly Detection. In *Proceedings of the* 21th *International Topical Meeting on Nuclear Reactor Thermal Hydraulics* (NURETH-21). Busan, Republic of Korea, August 31-September 5, 2025
- Furlong, A., Wu, X., Zhao, X., and Salko, R. (2025). The Prediction of Critical Heat Flux with Hybrid Machine Learning: Uncertainty Quantification and CTF Deployment. In *Proceedings of the* 21th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-21). Busan, Republic of Korea, August 31-September 5, 2025
- Alsafadi, F. and Wu, X. (2025). Evaluating the Performance of Diffusion Models for Scientific Data Augmentation - a Case Study with Critical Heat Flux. In *Proceedings of the* 21th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-21). Busan, Republic of Korea, August 31-September 5,

2025

- Clifford, J., Wu, X., Hawari, A., and Heifetz, A. (2025). Enhancing Learning for Nuclear Reactor Operator Trainees with Large Language Models. In *Proceedings of the 2025 Nuclear Plant Instrumentation and Control* & Human-Machine Interface Technology (NPIC&HMIT). Chicago, IL, USA, June 15-18, 2025
- Brady, C., Asadchykh, S., Xie, Z., and Wu, X. (2025). Preliminary Results on using Bayesian Inverse Uncertainty Quantification for OECD/NEA WPNCS Subgroup 14 Benchmark Exercise for Error Recovery and Experimental Coverage. In *Proceedings of the 2025 International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2025)*. Denver, Colorado, USA, April 27-30, 2025
- 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
- 8. Furlong, A. and **Wu, X.** (2024). Improving Machine Learning-based Critical Heat Flux Predictions in Data Scarce Rectangular Channels with Transfer Learning. In *Proceedings of the 2024 Advances in Thermal Hydraulics (ATH 2024)*. Orlando, FL, USA, November 17-21, 2024
- 9. Akins, A., Kultgen, D., **Wu, X.**, and Heifetz, A. (2024). Uncertainty Quantification of Long Short-Term Memory Autoencoder for Monitoring of Liquid Sodium Cold Trap. In *Proceedings of the 2024 Best Estimate Plus Uncertainty International Conference (BEPU 2024)*. Lucca, Italy, May 19-24, 2024
- 10. Kohler, L., Lisowski, D., **Wu, X.**, and Heifetz, A. (2024). Bayesian Calibration of Fiber Optic Distributed Temperature Sensing in a Thermal Mixing Tee. In *Proceedings of the 2024 Best Estimate Plus Uncertainty International Conference (BEPU 2024)*. Lucca, Italy, May 19-24, 2024
- 11. 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
- 12. Xie, Z., Wang, C., and **Wu, X.** (2024). Hierarchical Bayesian Inverse Uncertainty Quantification with Application to the ATRIUM project. In *Proceedings of the 2024 Best Estimate Plus Uncertainty International Conference (BEPU 2024)*. Lucca, Italy, May 19-24, 2024
- 13. **Wu, X.**, Moloko, L., Bokov, P., Delipei, G., Kaiser, J., and Ivanov, K. (2024). Elucidating the Uncertainties Introduced by Data-Driven Machine Learning Models. In *Proceedings of the 2024 Best Estimate Plus Uncertainty International Conference* (*BEPU 2024*). Lucca, Italy, May 19-24, 2024
- 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
- 15. Wu, X., Delipei, G., Avramova, M., Ivanov, K., and Buss, O. (2023). Introducing the OECD/NEA WPRS Benchmark on Artificial Intelligence and Machine Learning for Scientific Computing in Nuclear Engineering. In *Proceedings of the 20th International Topical Meeting on Nuclear Reactor Thermal Hydraulics* (*NURETH-20*). Washington, D.C., USA, August 20-25, 2023
- 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
- Yaseen, M., Xie, Z., and Wu, X. (2023). Uncertainty Quantification of Deep Neural Network Predictions for Time-dependent Responses with Functional PCA. In *Proceedings of the 20th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-20)*. Washington, D.C., USA, August 20-25, 2023

- Xie, Z. and Wu, X. (2023). Neural Networks and Functional Alignment-based Bayesian Inverse UQ using FEBA Reflood Experiment Data. In *Proceedings of the 20th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-20)*. Washington, D.C., USA, August 20-25, 2023
- Godbole, C., Delipei, G., Wu, X., Avramova, M., and Rohatgi, U. (2023). Prediction of Departure from Nucleate Boiling Power using ANN and PIML Algorithms. In *Proceedings of the 20th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-20)*. Washington, D.C., USA, August 20-25, 2023
- 20. Ghione, A., Sargentini, L., Damblin, G., Fillion, P., Baccou, J., Sueur, R., Iooss, B., Petruzzi, A., Zeng, K., Zhang, J., Havet, M., Mendizábal, R., Skorek, T., Wu, X., Freixa Terradas, J., and Adorni, M. (2023). Applying the SAPIUM guideline for Input Uncertainty Quantification: the ATRIUM project. In *Proceedings of the 20th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-20)*. Washington, D.C., USA, August 20-25, 2023
- Moloko, L., Bokov, P., Wu, X., and Ivanov, K. (2023). Improving SAFARI-1 Control Follower Assembly Axial Flux Prediction by Combining Supervised and Unsupervised Machine Learning. In *Proceedings of the 2023 International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2023)*. Niagara Falls, Ontario, Canada, August 13-17, 2023
- 22. Yaseen, M., Yushu, D., German, P., and **Wu, X.** (2023). Reduced Order Modeling of a Moose-based Advanced Manufacturing Model with Operator Learning. In *Proceedings of the 2023 International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2023)*. Niagara Falls, Ontario, Canada, August 13-17, 2023
- 23. Xie, Z. and **Wu, X.** (2023). Bayesian Estimation of a Machine Learning-based Representation of Model Discrepancy. In *Proceedings of the 2023 International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2023)*. Niagara Falls, Ontario, Canada, August 13-17, 2023
- Brady, C., Murray, W., Moss, L., Zino, J., Saito, E., and Wu, X. (2023). Criticality Safety Analysis of a Spiral Heat Exchanger for Molten Salt Reactors. In *Proceedings of the 2023 International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2023)*. Niagara Falls, Ontario, Canada, August 13-17, 2023
- 25. Godbole, C., Delipei, G., **Wu**, X., Avramova, M., and Rohatgi, U. (2022). Machine Learning-based Prediction of Departure from Nucleate Boiling Power for PSBT Benchmark. In *Proceedings of the Advances in Thermal Hydraulics (ATH 2022)*. Anaheim, CA, USA, June 12-16, 2022
- Moloko, L., Bokov, P., Wu, X., and Ivanov, K. (2022). Quantification of Neural Networks Uncertainties with Applications to SAFARI-1 Axial Neutron Flux Profiles. In *Proceedings of the International Conference* on *Physics of Reactors (PHYSOR)* 2022, pages 1398–1407. Pittsburgh, PA, USA, May 15-20, 2022
- 27. Xie, Z. and **Wu, X.** (2022). Bayesian Inverse Uncertainty Quantification of TRACE Physical Model Parameters using FEBA Reflood Experiments. In *Proceedings of the International Conference on Physics of Reactors (PHYSOR)* 2022. Pittsburgh, PA, USA, May 15-20, 2022
- 28. Akins, A. and **Wu, X.** (2022). Using Physics-Informed Neural Networks to solve a System of Coupled ODEs for a Reactivity Insertion Accident. In *Proceedings of the International Conference on Physics of Reactors* (*PHYSOR*) 2022. Pittsburgh, PA, USA, May 15-20, 2022
- 29. Xie, Z. and **Wu, X.** (2021). A Comprehensive Framework to Improve Computer Model Simulations by Integrating Inverse Uncertainty Quantification and Validation. In *Proceedings of the 2021 International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C-2021)*. Raleigh, NC, USA, October 3-7, 2021
- 30. Xie, Z., Jiang, W., Wang, C., and **Wu, X.** (2021). Inverse Uncertainty Quantification of a MOOSEbased Melt Pool Model for Additive Manufacturing. In *Proceedings of the 2021 International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C-2021)*. Raleigh,

NC, USA, October 3-7, 2021

- 31. Wang, C., Wu, X., and Kozlowski, T. (2019). Inverse Uncertainty Quantification by Hierarchical Bayesian Inference for TRACE Physical Model Parameters based on BFBT benchmark. In *Proceedings of the 18th International Topical Meeting on Nuclear Reactor Thermal Hydraulics* (NURETH-18). Portland, Oregon, USA, Aug. 18-22, 2019
- 32. Che, Y., **Wu**, X., Li, W., Shirvan, K., Pastore, G., and Hales, J. (2018). Sensitivity and Uncertainty Analysis of Fuel Performance Assessment of Chromia-Doped Fuel during Large-Break LOCA. In *Proceedings of the 2018 Light Water Reactor Fuel Performance Conference (TopFuel-2018)*. Prague, Czech Republic, Sep. 30 Oct. 04, 2018
- 33. Wang, C., **Wu**, X., and Kozlowski, T. (2018). Surrogate-based Bayesian Calibration of Thermal-Hydraulics Models based on PSBT Time-dependent Benchmark Data. In *Proceedings of the ANS Best Estimate Plus Uncertainty International Conference* (*BEPU-2018*). Real Collegio, Lucca, Italy, May 13-19, 2018
- 34. **Wu, X.**, Kozlowski, T., and Shirvan, K. (2018). Inverse Uncertainty Quantification using the Modular Bayesian Approach in the Presence of Model Discrepancy. In *Proceedings of the ANS Best Estimate Plus Uncertainty International Conference* (*BEPU-2018*). Real Collegio, Lucca, Italy, May 13-19, 2018
- 35. Wang, C., Wu, X., and Kozlowski, T. (2017). Surrogate-based Inverse Uncertainty Quantification of TRACE Physical Model Parameters using Steady-State PSBT Void Fraction Data. In *Proceedings of the 17th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-17)*. Xi'an, Shaanxi, China, Sept. 3-8, 2017
- 36. Wang, C., Wu, X., and Kozlowski, T. (2017). Sensitivity and Uncertainty Analysis of TRACE Physical Model Parameters based on PSBT benchmark using Gaussian Process Emulator. In *Proceedings of the* 17th *International Topical Meeting on Nuclear Reactor Thermal Hydraulics* (NURETH-17). Xi'an, Shaanxi, China, Sept. 3-8, 2017
- Wu, X. and Kozlowski, T. (2017). Investigation of Adaptive Markov Chain Monte Carlo Algorithms for Inverse Uncertainty Quantification. In *Proceedings of the 2017 International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C-2017)*. Jeju, Korea, April 16-20, 2017
- Wu, X., Wang, C., and Kozlowski, T. (2017). Kriging-based Surrogate Model for Uncertainty Quantification and Sensitivity Analysis. In *Proceedings of the 2017 International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C-2017)*. Jeju, Korea, April 16-20, 2017
- 39. **Wu, X.**, Wang, C., and Kozlowski, T. (2017). Global Sensitivity Analysis of TRACE Physical Model Parameters based on BFBT benchmark. In *Proceedings of the 2017 International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C-2017).* Jeju, Korea, April 16-20, 2017
- 40. Rose, M., Downar, T., **Wu, X.**, and Kozlowski, T. (2015). Evaluation of Accident Tolerant FeCrAl Coating for PWR Cladding under Normal Operating Conditions with Coupled Neutron Transport and Fuel Performance. In *Proceedings of the 2015 Mathematics and Computations, Supercomputing in Nuclear Applications and Monte Carlo International Conference (<i>M&C+SNA+MC-2015*). Nashville, TN, USA, April 19-23, 2015
- 41. **Wu, X.** and Kozlowski, T. (2014). Development of a New Convergence Criterion for Monte Carlo Simulation with Thermal-Hydraulics Feedback. In *Proceedings of the 2014 Physics of Reactors conferences* (*PHYSOR-2014*). Kyoto, Japan, September 28 October 3, 2014
- 42. **Wu, X.**, Kozlowski, T., and Heuser, B. (2014). Neutronics Analysis of Improved Accident Tolerance of LWR Fuel by Modifying Zircaloy Cladding of Fuel Pins. In *Proceedings of the 2014 International Congress on*

Advances in Nuclear Power Plants (ICAPP-2014). Charlotte, NC, USA, April 6-9, 2014

- 43. **Wu, X.** and Kozlowski, T. (2014). Coupling of System Thermal-Hydraulics and Monte-Carlo Method for a Consistent Thermal-Hydraulics-Reactor Physics Feedback. In *Proceedings of the 2014 International Congress on Advances in Nuclear Power Plants (ICAPP-2014)*. Charlotte, NC, USA, April 6-9, 2014
- 44. Heuser, B., Kozlowski, T., and **Wu, X.** (2013). Engineered Zircaloy Cladding Modifications for Improved Accident Tolerance of LWR Fuel: A Summary. In *Proceedings of the 2013 LWR Fuel Performance Meeting* (*TopFuel-2013*), pages 15–19. Charlotte, NC, USA, September 15-19, 2013

Book Chapters and Books

- 1. **Wu, X.** and Haghighat, A., "Scientific Machine Learning with Nuclear Engineering Applications", Taylor & Francis Group (in preparation)
- 2. Wu, X. and Kozlowski, T., (2024) "Inverse uncertainty quantification based on the modular Bayesian approach", Chapter 16 in "Risk-informed Methods and Applications in Nuclear and Energy Engineering", Academic Press, Elsevier, ISBN: 978-0-323-91152-8

Technical Reports

- 1. Le Corre, J.-M., Delipei, G., **Wu**, X., and Zhao, X. (2024). Benchmark on Artificial Intelligence and Machine Learning for Scientific Computing in Nuclear Engineering. Phase 1: Critical Heat Flux Exercise Specifications. Technical report, NEA Working Papers, NEA/WKP(2023)1, OECD Publishing, Paris
- Yan, E., Sabharwall, P., Sandhu, H. K., Bodda, S. S., Gupta, A., and Wu, X. (2021). Structural Health Monitoring of Microreactor Safety Systems Using Convolutional Neural Networks. Technical report, INL/EXT-21-63619, Idaho National Laboratory, Idaho Falls, ID, USA
- 3. **Wu, X.**, Sabharwall, P., Hales, J., and Kozlowski, T. (2014). Neutronics and Fuel Performance Evaluation of Accident Tolerant Fuel under Normal Operation Conditions. Technical report, INL/EXT-14-32591, Idaho National Laboratory, Idaho Falls, ID, USA

Peer-reviewed Conference Transactions and Summaries

- Sadek, A., Yaseen, M., Ercanbrack, S., Ramzy Altahhan, M., Wu, X., and Ivanov, K. (2024). Evaluating the Uncertainty Effects of Carbon Nuclear Data on Pebble Bed Reactor Physics: A Comparative Study of ENDF/B-VII.1 and ENDF/B-VIII.0. In *Transactions of American Nuclear Society*. Orlando, FL, USA, November 17-21, 2024
- Richards, W., Dahm, Z., Buss, O., Anghel, C., Moravej, K., Zhao, X., Foad, B. F., Rohatgi, U., Delipei, G., Wu, X., and Chatzidakis, S. (2024). Developing a Machine Learning Benchmark Using Real-Time Data from the PUR-1 Reactor for Nuclear Applications. In *Transactions of American Nuclear Society*. Las Vegas, NV, USA, June 16-19, 2024
- Kohler, L., Clifford, J., Karim, N., Harilal, S. S., Kautz, E., and Wu, X. (2024). ML-LIBS: Machine Learning-Based Spectra Predictions of Time-Dependent Lithium Emission Spectroscopy Imaging. In *Transactions of the 2024 ANS Student Conference*. University Park, Pennsylvania, USA, April 4-6, 2024
- 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
- Bolgova, D., Abarca, A., Wu, X., and Avramova, M. (2023). CANDU Fuel Channel Modeling in CTF Within the OECD-NEA Blind Benchmark on CANDU Thermal-Hydraulics. In *Transactions of American Nuclear Society*. Washington, D.C., USA, November 12-15, 2023
- 6. Yushu, D., McMurtrey, M., **Wu, X.**, Monson, A., and German, P. (2023). Directed Energy Deposition Process Modeling, Validation, and Process-Informed Optimization. In *Proceedings of the 17th U. S. National Congress on Computational Mechanics (USNCCM)*. Albuquerque, New Mexico, USA, July 23-27, 2023

- 7. **Wu, X.**, Delipei, G., Avramova, M., and Ivanov, K. (2022). Introducing the OECD/NEA WPRS Task Force on Artificial Intelligence and Machine Learning. In *Transactions of American Nuclear Society*. Phoenix, AZ, USA, November 13-17, 2022
- 8. Wu, X., Delipei, G., Avramova, M., and Ivanov, K. (2022). Why is Uncertainty Quantification Important for Machine Learning Models? In *Transactions of American Nuclear Society*. Phoenix, AZ, USA, November 13-17, 2022
- 9. Zino, J. and **Wu, X.** (2022). A New Monte Carlo Course for Undergraduate Nuclear Engineering Students. In *Transactions of American Nuclear Society*. Anaheim, CA, USA, June 12-16, 2022
- 10. Yaseen, M. and **Wu, X.** (2022). How to Quantify Approximation Uncertainties of Deep Neural Networks? In *Transactions of American Nuclear Society*. Anaheim, CA, USA, June 12-16, 2022
- 11. 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
- 12. **Wu, X.** (2022). Development of a New Course on Scientific Machine Learning in a Nuclear Engineering Department. In *Transactions of American Nuclear Society*. Anaheim, CA, USA, June 12-16, 2022
- 13. 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
- 14. Akins, A., Xie, Z., and **Wu, X.** (2021). Solving a System of Ordinary Differential Equations for Reactivity Insertion Accident with Artificial Neural Networks. In *Transactions of American Nuclear Society*. Washington, DC, USA, Nov. 30 - Dec. 4, 2021
- 15. Jin, Y., **Wu, X.**, and Shirvan, K. (2019). TRACE Simulation of a BWR Large Break LOCA with Zircaloy and Cr-Coated Cladding. In *Transactions of American Nuclear Society*. Washington, DC, USA, Nov. 17-21, 2019
- 16. **Wu, X.** and Shirvan, K. (2018). System Code Evaluation of Accident Tolerant Claddings during BWR Station Blackout Accident. In *Transactions of American Nuclear Society*. Orlando, FL, USA, Nov. 11-15, 2018
- Che, Y., Wu, X., Pastore, G., Hales, J., and Shirvan, K. (2018). Sensitivity and Uncertainty Analysis for Fuel Performance Evaluation of Cr2O3-doped UO2 Fuel under LB-LOCA. In *Transactions of American Nuclear Society*. Orlando, FL, USA, Nov. 11-15, 2018
- Wu, X., Shirvan, K., and Kozlowski, T. (2018). Validating TRACE Void Fraction Predictive Capability using the Quantitative Area Validation Metric. In *Transactions of American Nuclear Society*. Philadelphia, PA, USA, June 17-21, 2018
- 19. **Wu, X.**, Shirvan, K., and Kozlowski, T. (2018). On the Connection between Sensitivity and Identifiability for Inverse Uncertainty Quantification. In *Transactions of American Nuclear Society*. Philadelphia, PA, USA, June 17-21, 2018
- Wang, C., Wu, X., Borowiec, K., and Kozlowski, T. (2018). Bayesian Calibration and Uncertainty Quantification for TRACE Based on PSBT Benchmark. In *Transactions of American Nuclear Society*. Philadelphia, PA, USA, June 17-21, 2018
- Wu, X. and Kozlowski, T. (2017). Inverse Uncertainty Quantification of TRACE Physical Model Parameters with Model Discrepancy. In *Transactions of American Nuclear Society*. Washington, DC, USA, Oct. 29 - Nov. 2, 2017
- 22. **Wu, X.** and Kozlowski, T. (2017). Metamodel-based Inverse Uncertainty Quantification of TRACE Physical Model Parameters. In *ASME Verification and Validation Symposium* (*VVS-2017*). Las Vegas, NV, USA, May 3-5, 2017
- 23. Wu, X. and Kozlowski, T. (2017). Kriging-based Inverse Uncertainty Quantification of BISON Fission

Gas Release Model. In Transactions of American Nuclear Society. San Francisco, CA, USA, June 11-15, 2017

- 24. **Wu, X.** and Kozlowski, T. (2016). Inverse Uncertainty Quantification of Reactor Simulation with Polynomial Chaos Surrogate Model. In *Transactions of American Nuclear Society*. New Orleans, LA, USA, June 12-16, 2016
- 25. **Wu, X.** and Kozlowski, T. (2014). Uncertainty Quantification for Coupled Monte Carlo and Thermal-Hydraulics Codes. In *Transactions of American Nuclear Society*. Reno, NV, USA, June 15-19, 2014

Invited Talks

- "A Comparative Review of Quantitative Validation Metrics", OECD/NEA Working Group on Analysis and Management of Accidents (WGAMA), Workshop on the "Application Tests for Realization of Inverse Uncertainty quantification and validation Methodologies in thermal-hydraulics (ATRIUM)" Project, Paris, France, November 14th, 2024.
- "SciML-based Inverse UQ for Improving the Quality of Nuclear Data for Radiation Transport Simulations in Nuclear Forensics Applications", DOE NNSA Consortium for Nuclear Forensics Annual Workshop, Gainesville, FL, USA, October 15th, 2024.
- "Artificial Intelligence and Machine Learning for Scientific Computing in Nuclear Engineering: Status, Benchmarks, and Outlook", American Nuclear Society Thermal Hydraulics Division Webinar on "Year in Review: Nuclear Thermal Hydraulics Achievements of 2023", March 15th, 2024.
- 4. "Inverse Uncertainty Quantification Methods of Nuclear System Thermal-Hydraulics Codes", SIAM Conference on Uncertainty Quantification (UQ24), Mini-symposium on "Uncertainty Quantification of Thermal-Hydraulics Models in Nuclear Engineering", Trieste, Italy, March 1st, 2024.
- "Uncertainty Quantification of Deep Neural Networks for Nuclear Reactor Applications", SIAM Conference on Uncertainty Quantification (UQ24), Mini-symposium on "Recent Advances in Uncertainty Quantification for Scientific Machine Learning", Trieste, Italy, February 27th, 2024.
- 6. "ARTISANS Artificial Intelligence for Simulation of Advanced Nuclear Systems", Nuclear Science and Engineering Division, Argonne National Laboratory, Lemont, IL, USA, February 22nd, 2024.
- 7. "Treatment of Different Sources of Uncertainties in Inverse Uncertainty Quantification", OECD/NEA Working Group on Analysis and Management of Accidents (WGAMA), Workshop on the "Application Tests for Realization of Inverse Uncertainty quantification and validation Methodologies in thermalhydraulics (ATRIUM)" Project, Paris, France, November 21st, 2023.
- "Inverse Uncertainty Quantification with Machine Learning for Nuclear Reactor Simulations", Nuclear Engineering Seminar Series, Virginia Tech, October 27th, 2023.
- "Uncertainty Quantification of Machine Learning to Establish AI Trustworthiness in Nuclear Engineering Applications", U.S. Nuclear Regulatory Commission (NRC) Data Science and Artificial Intelligence Regulatory Applications Workshops #4: AI Characteristics for Regulatory Consideration, Panel Session on "AI Safety, Security and Explainability", Rockville, MD, USA, September 19th, 2023.
- "Everything You Need To Know About Deep Neural Networks", in Workshop of "Scientific Machine Learning for Nuclear Engineering Applications", M&C-2023, Niagara Falls, Ontario, Canada, August 13th, 2023.
- 11. "Uncertainty Quantification for Physics-based Models and Data-driven Machine Learning Models", the 2023 Modeling, Experimentation and Validation (MeV) Summer School, Idaho National Laboratory, August 3rd, 2023.
- "Inverse Uncertainty Quantification with Machine Learning for Nuclear Reactor Simulations", Nuclear Science & Technology (NS&T) Distinguished Seminar Series, Idaho National Laboratory, August 2nd, 2023.
- 13. "Artificial Intelligence and Machine Learning Applications to Nuclear Engineering Problems", the inaugural Lise Meitner Program (LMP), International Atomic Energy Agency, June 9th, 2023.

- 14. "Status Update on the Benchmark Exercises on AI/ML for Scientific Computing in Nuclear Engineering", Annual Benchmark Workshops of the OECD/NEA Working Party of Scientific Issues and Uncertainty Analysis of Reactor Systems (WPRS), Bologna, Italy, May 24th, 2023.
- 15. "Status Update on the OECD/NEA WPRS EGMUP Task Force on AI/ML for Scientific Computing in Nuclear Engineering", OECD/NEA Working Party on Scientific Issues and Uncertainty Analysis of Reactor Systems (WPRS), Expert Group on Reactor System Multiphysics (EGMUP) 3rd Meeting, February 22nd, 2023.
- 16. "Introducing the WPRS EGMUP Task Force on Artificial Intelligence and Machine Learning for Scientific Computing in Nuclear Engineering", OECD/NEA Working Party on Materials Science Issues in Nuclear Fuels and Structural Materials (WPFM), Expert Group on Fuel Materials (EGFM) Online Meeting, January 26th, 2023.
- 17. "Overview of Artificial Intelligence and Machine Learning with Potential Applications to Nuclear Industry Problems", Duke Energy Meeting with NCSU, McGuire Nuclear Station, Huntersville, NC, USA, June 23rd, 2022.
- "Gaps and Challenges in Machine Learning Applications for Scientific Computing in Nuclear Engineering", ATH-2022 panel session on "Machine Learning for Reactor Thermal Hydraulics: Progresses, Challenges, and Opportunities", Anaheim, CA, USA, June 15th, 2022.
- 19. "EGMUP Task Force on Artificial Intelligence and Machine Learning for Scientific Computing in Nuclear Engineering", Annual Benchmark Workshops of the OECD/NEA Working Party of Scientific Issues and Uncertainty Analysis of Reactor Systems (WPRS), Aix-en-Provence, France, June 1st, 2022.
- 20. "Scientific Machine Learning for Nuclear Engineering Applications", Workshop at PHYSOR 2022, Pittsburgh, PA, USA, May 15th, 2022.
- 21. "Inverse Uncertainty Quantification with Machine Learning for Nuclear Reactor Simulations", Department of Nuclear Engineering, The University of New Mexico, April 19th, 2022.
- 22. "Bayesian Inverse Uncertainty Quantification and Validation of Nuclear Reactor Simulators", SIAM Conference on Uncertainty Quantification (UQ22), Mini-symposium on "*Data-Centric Machine Learning for Uncertainty Quantification in Complex Systems*", Atlanta, GA, USA, April 12th, 2022.
- 23. "Inverse Uncertainty Quantification with Machine Learning for Nuclear Reactor Simulations", Department of Mechanical and Aerospace Engineering, Ohio State University, March 2nd, 2022.
- 24. "Inverse Uncertainty Quantification with Machine Learning for Nuclear Reactor Simulations", School of Nuclear Science & Engineering, Oregon State University, Feburary 23rd, 2022.
- 25. "Inverse Uncertainty Quantification with Machine Learning for Nuclear Reactor Simulations", Department of Mechanical, Aerospace, and Nuclear Engineering, Rensselaer Polytechnic Institute, November 17th, 2021.
- 26. "Scientific Machine Learning for Nuclear Engineering Applications", Workshop at M&C 2021, October 3rd, 2021.
- 27. "Improving Model Prediction by Integrating Inverse UQ and Quantitative Validation", Workshop on Uncertainty Analysis in Modelling of Light Water Reactors (UAM-LWR), OECD/NEA Working Party of Scientific Issues and Uncertainty Analysis of Reactor Systems (WPRS), July 1st, 2021.
- "Modular Bayesian Approach for Inverse Uncertainty Quantification", Workshop on Uncertainty Analysis in Modelling of Light Water Reactors (UAM-LWR), OECD/NEA Working Party of Scientific Issues and Uncertainty Analysis of Reactor Systems (WPRS), July 1st, 2021.
- 29. "Improving Modeling & Simulation of Advanced Nuclear Reactors by Uncertainty Quantification and Scientific Machine Learning", Engineering Foundation Board, North Carolina State University, Raleigh, NC, USA, April 16th, 2021.
- 30. "Forward and Inverse Uncertainty Quantification", Department of Nuclear Irradiation Experiment Neutronic Analysis, Idaho National Laboratory, April 8th, 2021.
- 31. "Uncertainty Quantification and Sensitivity Analysis for Nuclear Applications", Online Workshop in 2020

ANS Student Conference, April 5th, 2021.

- 32. "Uncertainty Quantification and Machine Learning in Thermal-Hydraulics Applications", the Second Meeting of the Expert Group on Reactor Core Thermal-Hydraulics and Mechanics (EGTHM), OECD/NEA, February 16th, 2021.
- 33. "Uncertainty Quantification with Scientific Machine Learning" Machine Learning & Artificial Intelligence Symposium 3.0 (online), Idaho National Laboratory, October 16th, 2020.
- 34. "Uncertainty Quantification Methods", Graduate Research Seminar, Department of Nuclear Engineering, North Carolina State University, Raleigh, NC, USA, August 27th, 2020.
- 35. "Uncertainty Quantification Methods", the 2020 Modeling, Experimentation and Validation (MeV) Summer School, Idaho National Laboratory, Idaho Falls, ID, USA, August 3rd, 2020.
- 36. "Bridging the Gap between Models and Data Addressing the ANS Nuclear Grand Challenge on Simulation and Experimentation", the 2019 "Big Data for Nuclear Power Plants" Workshop, the Ohio State University, Columbus, OH, USA, December 11th, 2019.
- 37. "Physics and Technology of Advanced Water Cooled Reactors Passive Safety Systems", presented at the IAEA Group Scientific Visit on the "State of Art Knowledge of Advanced Nuclear Power Reactor Designs with Educational Tools Supporting Regional Human Capacity Development", Department of Nuclear Engineering, North Carolina State University, Raleigh, NC, USA, September 9th, 2019.
- 38. "Bridging the Gap between Models and Data Addressing the ANS Nuclear Grand Challenge on Simulation and Experimentation", Department of Materials Science and Engineering, University of Florida, Gainesville, FL, USA, March 7th, 2019.
- 39. "Bridging the Gap between Models and Data Addressing the ANS Nuclear Grand Challenge on Simulation and Experimentation", Department of Nuclear Engineering, North Carolina State University, Raleigh, NC, USA, February 7th, 2019.
- 40. "Inverse Uncertainty Quantification using the Modular Bayesian Approach in the Presence of Model Discrepancy", Idaho National Laboratory, Idaho Falls, ID, USA, August 10th, 2018.
- 41. "Inverse Uncertainty Quantification using the Modular Bayesian Approach based on Gaussian Process", Department of Nuclear Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA, USA, July 10th, 2017.

Selected Honors and Awards

Distinguished Early Career Award Department of Energy Office of Nuclear Energy	2024
Best Overall Paper Award 2024 American Nuclear Society (ANS) Student Conference	2024
Selected as the Russell L. Heath Distinguished Postdoc Idaho National Laboratory (declined due to faculty offer at NCSU)	2018
Best Paper of the ANS "Young Professional Thermal Hydraulics Research Competition" 2017 American Nuclear Society (ANS) Winter Meeting	2017

Professional Service

Reviewer for journals in Nuclear Engineering

- Nuclear Engineering and Design
- Annals of Nuclear Energy
- Progress in Nuclear Energy
- Journal of Nuclear Materials
- Nuclear Science and Engineering
- Nuclear Technology

- Nuclear Engineering and Technology
- Science and Technology of Nuclear Installations
- Nuclear Science and Techniques

Reviewer for journals in Computational Science and others

- Acta Materialia
- Applied Mathematical Modeling
- Artificial Intelligence In Medicine
- Computer Physics Communications
- Computers & Security
- Ecological Informatics
- IEEE Access
- IEEE Transactions on Emerging Topics in Computational Intelligence
- International Journal of Heat and Mass Transfer
- Journal of Applied Statistics
- Journal of Computational Mathematics and Data Science
- Mathematical Methods in the Applied Sciences
- Mathematical Problems in Engineering
- Reliability Engineering and System Safety
- Renewable Energy
- Science of the Total Environment
- Scientific Reports
- SN Applied Sciences by Springer Nature
- SoftwareX
- Systems Engineering

Reviewer for professional conferences

- Transactions of American Nuclear Society
- ATH: Advances in Thermal Hydraulics
- ICAPP: Int. Congress on Advances in Nuclear Power Plants
- NURETH: Int. Topical Meeting on Nuclear Reactor Thermal Hydraulics
- NUTHOS: Int. Topical Meeting on Nuclear Reactor Thermal-Hydraulics, Operation, and Safety
- BEPU: Int. Conf. on Best Estimate Modelling Plus Uncertainties in Safety Analyses
- PHYSOR: Int. Conf. on Physics of Reactors
- *M&C*: Int. Conf. on Mathematics and Computational Methods in Nuclear Science and Engineering

Reviewer for grants

- U.S. DOE Office of Nuclear Energy Consolidated Innovative Nuclear Research (CINR) proposals
- U.S. DOE Office of Science Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Programs Phase I & II proposals
- U.S. National Science Foundation (NSF), Computational and Data-Enabled Science and Engineering (CDS&E) meta-program, Condensed Matter and Materials Theory (CMMT) program

Workshops, symposiums and special sessions organized/chaired

• Workshop series on "Scientific Machine Learning for Nuclear Engineering Applications", in

- M&C-2025, April 27th, 2025
- PHYSOR-2024, April 21st, 2024
- M&C-2023, August 13th, 2023
- PHYSOR-2022, May 15th, 2022
- M&C-2021, October 3rd, 2021

- Special panel session on "AI/ML in Nuclear Engineering", in NUTHOS-14, 2024
- Symposium on "ML-Aided Uncertainty Quantification for Complex Systems Analysis", in the 17th US National Congress on Computational Mechanics (USNCCM), July 25th, 2023.
- Workshop on "Uncertainty Quantification", Idaho National Laboratory, July 26th, 2022.
- Workshop on "Uncertainty Quantification and Sensitivity Analysis", in 2021 ANS Student Conference, April 10th, 2021

International collaboration and service

- Chair, Task Force on Artificial Intelligence and Machine Learning for Scientific Computing in Nuclear Engineering, Working Party on Scientific Issues and Uncertainty Analysis of Reactor Systems (WPRS), Organisation for Economic Co-operation and Development (OECD) Nuclear Energy Agency (NEA).
 - In this role, I am coordinating a Task Force of 61 professionals from 25 institutions in 8 countries to develop benchmark exercises to evaluate the performance of AI/ML in multi-physics modeling and simulation of reactor systems.

Editorship

- Editorial Advisory Board member (June 2023 present), ANS journal of *Nuclear Science and Engineering*, Taylor & Francis Online.
- Guest Advisor for Article Collection on "Scientific Machine Learning for Nuclear Engineering Problems" at *Nuclear Science and Engineering*

Lecturer

- Lise Meitner Program (LMP) for Early Professional Women Nuclear Engineers, International Atomic Energy Agency (IAEA)
- Modeling, Experimentation and Validation (MeV) Summer School
- Nuclear Engineering Young Investigators' Summer Program, NCSU

Professional society committees

- ANS Thermal-Hydraulics Division, Executive Committee (2024 present)
- ANS Thermal-Hydraulics Division, Program Committee (2023 present)
- ASME VVUQ 70 sub-committee on "Verification and Validation of Machine Learning" (2022 present)

Conference organization - Technical Program Committee (TPC) member for

- PHYSOR-2026
- NURETH-2025 (Track chair of "Digital Technologies for Thermal Hydraulics")
- M&C-2025 (Assistant TPC Chair, Workshop Chair)
- BEPU-2024
- NUTHOS-2024 (Track co-chair of "Thermal Hydraulics and Safety of Advanced Reactors")
- M&C-2023
- M&C-2021

Organizer, ANS Young Professional Thermal Hydraulics Research Competition (YPTHRC) in

- 2024 Advances in Thermal Hydraulics
- 2023 ANS Winter Meeting
- 2022 Advances in Thermal Hydraulics
- 2021 ANS Winter Meeting

Conference session chairs

- PHYSOR
- NURETH
- M&C
- ANS Annual and Winter Meetings

Professional societies

• American Nuclear Society (ANS)

- Society for Industrial and Applied Mathematics (SIAM)
- American Society of Mechanical Engineers (ASME)

Students Mentored

PhD Students

Lauren Kohler (UNLP graduate fellow)

08/2024 - *present* PhD thesis title: TBD, topic: AI/ML for digital twins for advanced reactors

2. Alexandra Akins (NSF graduate fellow)

08/2023 - *present* PhD thesis title: TBD, topic: AI/ML for anomaly detection in advanced reactors

3. Christopher Brady

08/2023 - present PhD thesis title: TBD, topic: ML and inverse UQ for radiation transport simulations in nuclear forensics

4. Aidan Furlong

[•] 01/2023 - *present* PhD thesis title: TBD, topic: AI/ML with a focus on transfer learning and domain generalization

5. Farah Alsafadi

01/2021 - present

PhD thesis title: Deep Generative Modeling-based Data Augmentation to Address the Data Scarcity Issue in Nuclear Engineering

6. Ziyu Xie

Final defense: 09/2024

PhD thesis title: Machine Learning-based Model Discrepancy in Bayesian Inverse Uncertainty Quantification First job after defense: TBD

7. Lesego Moloko

· Final defense: 09/2024

PhD thesis title: Integrated Neutronics Simulation and Machine Learning with Uncertainty Quantification for Reactor Core Monitoring and Safety

First job after defense: senior scientist at South African Nuclear Energy Corporation (Necsa)

8. Chaitee Godbole

Final defense: 03/2023 (*co-advised with Professor Maria Avramova*) PhD thesis title: Machine Learning-based Prediction of Power at which Departure from Nucleate Boiling Occurs First job after defense: postdoc at Idaho National Laboratory

9 Parth Patel (Department of Civil, Construction, and Environmental Engineering)

Final defense: 12/2022 (*co-advised with Professor Abhinav Gupta*) PhD thesis title: Simulating Damage and Degradation in Concrete Structures First job after defense: postdoc at NCSU

MS Students

Aidan Furlong

Defense: 03/2024 MS thesis title: Prediction of CIPS Susceptibility in PWR Assemblies Using 3D Convolutional Neural Networks

2. Mahmoud Yaseen

Defense: 03/2024 MS thesis title: Uncertainty Quantification in Deep Neural Network Models for Nuclear Reactor Benchmarks

3. Christopher Brady

". Defense: 05/2023

MS thesis title: Criticality Safety Analysis of a Spiral Plate Heat Exchanger for Molten Salt Reactors

Richard Pfrogner 4. Defense: 03/2023 MS thesis title: CTF PWR Core Modeling and Validation Applicable to High Burnup High Enrichment (HBHE) Fuel Halil Ibrahim San 5. Defense: 08/2022 MS thesis title: Sensitivity Analysis of Core Reflood Phenomena with Deep Learning **Undergraduate Researchers and Achievements Oliver Maynard** 09/2024 - present 1. Project: Evolutionary Optimization using Machine Learning **Evan Hong** 09/2024 - present 2. Project: Scientific Machine Learning for Nuclear Reactor Simulations Addyson Hunsicker 01/2024 - present 3. Project: Scientific Machine Learning for Nuclear Reactor Simulations **Julianna White** 10/2023 - present 4. Project: ML-Based Spectra Predictions of Lithium Emission Spectroscopy Imaging Sofiia Asadchykh 10/2023 - present 5. Project: ML and Inverse Uncertainty Quantification for Nuclear Forensics Selected honors: • 2024: DOE University Nuclear Leadership Program (UNLP) Scholarship • 2024: ANS Scholarship Jason Clifford 10/2022 - present 6. Project: ML-Based Spectra Predictions of Lithium Emission Spectroscopy Imaging Selected honors: • 2023: National Academy of Engineering's Grand Challenge Scholars Program • 05/2023 - 11/2023: Science Undergraduate Laboratory Internships (SULI) with Idaho National Laboratory (INL) • 2023: DOE UNLP Scholarship • 2023: ANS Scholarship • 01/2024 - present: SULI internship with Argonne National Laboratory (ANL) • 2024: ANS Joseph Naser Undergraduate Scholarship • 2024: DOE UNLP Scholarship Lauren Kohler (continued as a PhD student with Dr. Wu) 10/2021 - 05/2024 7. Project: ML-Based Spectra Predictions of Lithium Emission Spectroscopy Imaging Selected honors: • 2022: DOE UNLP Scholarship • 2022: ANS Scholarship • 01/2023 - present: SULI internship with ANL • 2023: DOE UNLP Scholarship • 2023: Roy G. Post Foundation Scholarship • 2024: ANS Robert A. Dannels Memorial Scholarship • 2024: Best Overall Paper Award at 2024 ANS Student Conference • 2024: Best Presentation Award in Power Reactor Reliability Operations & Safety at 2024 ANS Student Conference • 2024: ANS John and Muriel Landis Scholarship • 2024: DOE UNLP Graduate Fellowship • 2024: OECD/NEA Global Forum Rising Stars in Nuclear Education, Science, Technology and Policy Alexandra Akins (continued as a PhD student with Dr. Wu) 10/2020 - 05/2023

^{3.} Project: Solving a System of ODEs for Reactivity Insertion Accident with ANNs

Selected honors:

- 2021: DOE UNLP Scholarship
- 2021: NCSU Women and Minority Engineering Programs Scholarship
- 2022: DOE UNLP Scholarship
- 05/2022 05/2023: SULI internship with ANL
- 2023: nominated for the "impact Argonne award" by ANL
- 2023: CoE Senior Award of Humanities
- 2023: NC State Sustainability Award
- o 2023: ANS Student Conference Best Undergraduate Paper
- 2023: NCSU Nuclear Engineering Senior Design best presentation
- 2023: Featured Paper selected by the Editor of the journal "Energies", with the title "Anomaly Detection in Liquid Sodium Cold Trap Operation with Multisensory Data Fusion Using Long Short-Term Memory Autoencoder"
- 2023: NSF Graduate Research Fellowship
- o 2023: OECD/NEA Global Forum Rising Stars in Nuclear Education, Science, Technology and Policy