Xu Wu

Assistant Professor • Department of Nuclear Engineering • North Carolina State University
2110 Burlington Engineering Laboratories • 2500 Stinson Drive • Raleigh, NC, USA 27695
☎ (919)-515-6570 • ✉ xwu27@ncsu.edu
https://www.ne.ncsu.edu/people/xwu27/
Research group: https://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 Simulators under the Bayesian Framework

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 Consistent Thermal-Hydraulics-Reactor Physics Feedback

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 December 2023, 1 visiting scholar, 5 PhD and 4 undergraduate students.

Postdoctoral Research Associate **Massachusetts Institute of Technology**
Department of Nuclear Science and Engineering *10/2017 - 06/2019*

Research Aide — **Argonne National Laboratory**
Nuclear Engineering Division — *05/2015 - 07/2015*

Research Intern — **Idaho National Laboratory**
Fuel Modeling and Simulation Department — *05/2014 - 07/2014*

Graduate Research Assistant — **University of Illinois at Urbana - Champaign**
Department of Nuclear, Plasma and Radiological Engineering — *01/2012 - 10/2017*

Teaching Experience

NE 795: Advanced Scientific Machine Learning — Fall 2023
Department of Nuclear Engineering, NCSU, newly developed course since Fall 2023

NE 795: Scientific Machine Learning — Fall semesters biennially
Department of Nuclear Engineering, NCSU, newly developed course since Fall 2020

NE 470/570: Monte Carlo Methods for Radiation Transport — Fall semesters biennially
Department of Nuclear Engineering, NCSU, newly developed course since Fall 2021

NE 405/505: Reactor Systems — Spring semesters since 2022
Department of Nuclear Engineering, NCSU

NE 408: Nuclear Engineering Design Project — Spring 2020 and 2023
Department of Nuclear Engineering, NCSU

NE 406: Nuclear Engineering Senior Design Preparation — Fall 2019 and 2022
Department of Nuclear Engineering, NCSU

Grants and Projects

	Wu budget
DOE National Nuclear Security Administration (NNSA) consortium, co-PI *Consortium for Nuclear Forensics (total budget $25 million)*	**$730,289** *09/2023 - 08/2028*
Consortium for Nuclear Power (CNP) with Duke Energy, PI *Using Machine Learning to Predict Locations with Crud Buildup*	**$70,000** *07/2022 - 06/2023*
Westinghouse Electric Company subcontract, PI *Uncertainty Quantification and Validation of CTF Two-phase Flow Modeling Capabilities*	**$50,000** *03/2022 - 03/2023*
NCSU Center for Nuclear Energy Facilities and Structures (CNEFS) project, co-PI *Probabilistic and AI/ML Approaches in Structural Engineering*	**$190,181** *01/2022 - 12/2023*
NCSU CNEFS project, co-PI *Statistical Approaches to Reduce Uncertainty in Probabilistic Seismic Hazard Analysis*	**$44,952** *01/2023 - 12/2023*
INL Laboratory Directed Research and Development (LDRD), university PI *Artificial Intelligence Based Process Control and Optimization for Advanced Manufacturing*	**$156,636** *10/2021 - 09/2023*
NCSU Data Science Initiative (DSI) Seed Fund, PI *ML-based Mathematical Representation of Model Uncertainty for Bayesian Inverse UQ*	**$31,057** *08/2021 - 05/2022*
INL LDRD project subcontract, university PI *Multi-scale Modeling and Optimization of Additive Manufacturing Process for Nuclear Fuels*	**$39,859** *01/2020 - 09/2020*

Peer-reviewed Journal Publications

1. 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. (*invited paper for the "Nuclear Fission Technology (NFT)" series of Virtual Special Issues (VSI) of the journal Nuclear Engineering and Design, in preparation*)

2. Furlong, A., Alsafadi, F., Palmtag, S., Godfrey, A., Hayes, S., and **Wu, X.** (2024). Data-driven Prediction and Uncertainty Quantification of PWR Crud-Induced Power Shift with Convolutional Neural Networks.

(*in preparation*)

3. Xie, Z. and **Wu, X.** (2024). Nonlinear Autoregressive Neural Network-based Model Discrepancy for Bayesian Inverse UQ of Transient Nuclear Thermal-Hydraulics Problems. (*in preparation*)

4. Moloko, L., Bokov, P., **Wu, X.**, and Ivanov, K. (2023). Clustering and Uncertainty Analysis to Improve the Machine Learning-based Predictions of SAFARI-1 Control Follower Assembly Axial Neutron Flux Profiles. (*under review, arXiv preprint arXiv:2312.14193*)

5. Brady, C., Murray, W., Moss, L., Zino, J., Saito, E., and **Wu, X.** (2023). Monte Carlo Criticality Safety Analysis of a Spiral Plate Heat Exchanger for Molten Salt Reactors. (*under review*)

6. Wang, C., **Wu, X.**, and Kozlowski, T. (2023). Inverse Uncertainty Quantification by Hierarchical Bayesian Modeling and Application in Nuclear System Thermal-Hydraulics Codes. (*under review, arXiv preprint arXiv:2305.16622*)

7. Baccou, J., Glantz, T., Ghione, A., Sargentini, L., Damblin, G., Fillion, P., Sueur, R., Iooss, B., Fang, J., Liu, J., Yang, C., Zheng, Y., Ui, A., Saito, M., Mendizábal, R., Bersano, A., 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., Di Maio, F., Ahmed, I., Zio, E., Pedroni, N., Zhang, J., Freixa, J., Ciurluini, C., Giannetti, F., and Adorni, M. (2023). A systematic approach for the adequacy analysis of a set of experimental databases: application in the framework of the ATRIUM project. (*in revision at Nuclear Engineering and Design*)

8. Xie, Z., Yaseen, M., and **Wu, X.** (2023). Functional PCA and Deep Neural Networks-based Bayesian Inverse Uncertainty Quantification with Transient Experimental Data. (*accepted, in press at Computer Methods in Applied Mechanics and Engineering*)

9. 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

10. 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

11. 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

12. 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

13. 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

14. Xie, Z., Jiang, W., Wang, C., and **Wu, X.** (2022). Bayesian inverse uncertainty quantification of a MOOSE-based melt pool model for additive manufacturing using experimental data. *Annals of Nuclear Energy*, 165:108782.
https://doi.org/10.1016/j.anucene.2021.108782

15. **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

16. 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

17. 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

18. 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

19. 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

20. **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

21. **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

22. 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

23. **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.nucengdes.2018.06.003

24. **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

25. **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

26. **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

27. **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

28. **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

29. **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

1. Alsafadi, F. and **Wu, X.** (2024). Data Augmentation of Nuclear Critical Heat Flux Experimental Data with Conditional Variational Autoencoders. In *Proceedings of the 14th International Topical Meeting on Nuclear Reactor Thermal Hydraulics, Operation and Safety* (*NUTHOS-14*). Vancouver, British Columbia, Canada, August 25-28, 2024

2. Xie, Z. and **Wu, X.** (2024). Improving Bayesian Inverse Uncertainty Quantification by Incorporating Calibrated Model Discrepancy. In *Proceedings of the 14th International Topical Meeting on Nuclear Reactor Thermal Hydraulics, Operation and Safety* (*NUTHOS-14*). Vancouver, British Columbia, Canada, August 25-28, 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. 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

5. 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

6. 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

7. **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

8. **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

9. 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

10. 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

11. 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

12. 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

13. 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

14. 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

15. 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

16. 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

17. 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

18. 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

19. 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

20. 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

21. 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

22. 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

23. Xie, Z., Jiang, W., Wang, C., and **Wu, X.** (2021). Inverse Uncertainty Quantification of a MOOSE-based 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

24. 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

25. 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

26. 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

27. **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

28. 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

29. 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

30. **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

31. **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

32. **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

33. 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* (*M&C+SNA+MC-2015*). Nashville, TN, USA, April 19-23, 2015

34. **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

35. **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

36. **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

37. 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. 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

2. **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

1. 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

2. 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

3. 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

4. **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

5. **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

6. 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

7. 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

8. 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

9. **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

10. 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

11. 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

12. 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

13. **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

14. 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

15. **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

16. **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

17. 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

18. **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

19. **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

20. **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

21. **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

22. **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

1. "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.
2. "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.
3. "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 thermal-

hydraulics (ATRIUM)" Project, Paris, France, November 21st, 2023.

4. "Inverse Uncertainty Quantification with Machine Learning for Nuclear Reactor Simulations", Nuclear Engineering Seminar Series, Virginia Tech, October 27th, 2023.
5. "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.
6. "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.
7. "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.
8. "Inverse Uncertainty Quantification with Machine Learning for Nuclear Reactor Simulations", Nuclear Science & Technology (NS&T) Distinguished Seminar Series, Idaho National Laboratory, August 2nd, 2023.
9. "Artificial Intelligence and Machine Learning Applications to Nuclear Engineering Problems", the inaugural Lise Meitner Program (LMP), International Atomic Energy Agency, June 9th, 2023.
10. "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.
11. "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.
12. "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.
13. "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.
14. "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.
15. "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.
16. "Scientific Machine Learning for Nuclear Engineering Applications", Workshop at PHYSOR 2022, Pittsburgh, PA, USA, May 15th, 2022.
17. "Inverse Uncertainty Quantification with Machine Learning for Nuclear Reactor Simulations", Department of Nuclear Engineering, The University of New Mexico, April 19th, 2022.
18. "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.
19. "Inverse Uncertainty Quantification with Machine Learning for Nuclear Reactor Simulations", Department of Mechanical and Aerospace Engineering, Ohio State University, March 2nd, 2022.
20. "Inverse Uncertainty Quantification with Machine Learning for Nuclear Reactor Simulations", School of

Nuclear Science & Engineering, Oregon State University, Feburary 23rd, 2022.

21. "Inverse Uncertainty Quantification with Machine Learning for Nuclear Reactor Simulations", Department of Mechanical, Aerospace, and Nuclear Engineering, Rensselaer Polytechnic Institute, November 17th, 2021.
22. "Scientific Machine Learning for Nuclear Engineering Applications", Workshop at M&C 2021, October 3rd, 2021.
23. "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.
24. "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.
25. "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.
26. "Forward and Inverse Uncertainty Quantification", Department of Nuclear Irradiation Experiment Neutronic Analysis, Idaho National Laboratory, April 8th, 2021.
27. "Uncertainty Quantification and Sensitivity Analysis for Nuclear Applications", Online Workshop in 2020 ANS Student Conference, April 5th, 2021.
28. "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.
29. "Uncertainty Quantification with Scientific Machine Learning" Machine Learning & Artificial Intelligence Symposium 3.0 (online), Idaho National Laboratory, October 16th, 2020.
30. "Uncertainty Quantification Methods", Graduate Research Seminar, Department of Nuclear Engineering, North Carolina State University, Raleigh, NC, USA, August 27th, 2020.
31. "Uncertainty Quantification Methods", the 2020 Modeling, Experimentation and Validation (MeV) Summer School, Idaho National Laboratory, Idaho Falls, ID, USA, August 3rd, 2020.
32. "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.
33. "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.
34. "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.
35. "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.
36. "Inverse Uncertainty Quantification using the Modular Bayesian Approach in the Presence of Model Discrepancy", Idaho National Laboratory, Idaho Falls, ID, USA, August 10th, 2018.
37. "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

Selected as the Russell L. Heath Distinguished Postdoc
Idaho National Laboratory *2018*

Best Paper of the ANS "Young Professional Thermal Hydraulics Research Competition"
American Nuclear Society Winter Meeting 2017 *2017*

Graduate College Conference Travel Award
University of Illinois at Urbana-Champaign, College of Engineering *2016*

Tau Beta Pi Engineering Honor Society
The Tau Beta Pi Engineering Honor Society *2015*

Conference Travel Scholarship
2014 International Congress on Advances in Nuclear Power Plants (ICAPP-2014) *2014*

Alpha Nu Sigma Honors Society
The Alpha Nu Sigma National Honor Society *2013, 2014, 2015*

Outstanding Graduate
Shanghai Jiao Tong University *2011*

National Endeavor Scholarship
China Ministry of Education *2009, 2010*

The 18th Guanghua Educational Scholarship
Guanghua Educational Fund *2009*

"Nuclear Power of China" Scholarship, first class
Nuclear Power Institute of China *2008, 2009, 2010*
Awarded to the undergraduate student with the highest overall GPA from nuclear engineering

Academic Excellence Scholarship, first class
Shanghai Jiao Tong University *2008, 2009, 2010*
Awarded to top 5% undergraduate students in academic performance from all areas

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

- IEEE Transactions on Emerging Topics in Computational Intelligence
- Reliability Engineering and System Safety
- Computer Physics Communications
- Computers & Security
- SoftwareX
- Mathematical Methods in the Applied Sciences
- Applied Mathematical Modeling
- Renewable Energy
- Science of the Total Environment

- Journal of Applied Statistics
- Systems Engineering
- Mathematical Problems in Engineering
- Scientific Reports
- IEEE Access
- Artificial Intelligence In Medicine
- Ecological Informatics
- Journal of Computational Mathematics and Data Science
- SN Applied Sciences by Springer Nature
- Artificial Intelligence In Medicine

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
  - 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.

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, Program Committee (2023 - present)
- ASME VVUQ 70 sub-committee on "Verification and Validation of Machine Learning" (2022 - present)

Conference organization

- M&C-2025 (Assistant Technical Program Chair, Workshop Chair)
- BEPU-2024 (TPC member)
- NUTHOS-2024 (TPC member, track co-chair of "Thermal Hydraulics and Safety of Advanced Reactors and Special Topics")
- M&C-2023 (TPC member)
- M&C-2021 (TPC member)

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 and Committees Served

PhD Committees

1. **Alexandra Akins** **chair**
   PhD student since 08/2023
   PhD thesis title: TBD, topic: AI/ML for anomaly detection in advanced reactors
2. **Christopher Brady** **chair**
   PhD student since 08/2023
   PhD thesis title: TBD, topic: ML and inverse UQ for radiation transport simulations in nuclear forensics
3. **Aidan Furlong** **chair**
   PhD student since 01/2023
   PhD thesis title: TBD, topic: transfer learning to improve neural network performance for nuclear applications
4. **Farah Alsafadi** **chair**
   PhD student since 01/2021
   PhD thesis title: TBD, topic: deep generative modeling for data augmentation of nuclear datasets
5. **Ziyu Xie** **chair**
   Prelim: 2023/12
   PhD thesis title: Machine Learning-based Model Discrepancy in Bayesian Inverse Uncertainty Quantification

6. **Lesego Moloko** **co-chair**
Prelim: 12/2023 (*co-advised with Professor Kostadin Ivanov*)
PhD thesis title: Machine Learning-Based Framework for Prediction and Uncertainty Quantification in Nuclear Reactor System Operation and Monitoring

7. **Chaitee Godbole** **co-chair**
Prelim: 10/2022, 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

8. **Parth Patel** (Department of Civil, Construction, and Environmental Engineering) **co-chair**
Prelim: 05/2022, defense: 12/2022 (*co-advised with Professor Abhinav Gupta*)
PhD thesis title: Simulating Damage and Degradation in Concrete Structures

9. **Jonathan Crozier** member
Prelim: 11/2023 (*advisor: Professor Ayman Hawari*)
PhD thesis title: Development and Implementation of Neural Thermal Scattering Modules for Monte Carlo and Multiphysics Analysis of Advanced Nuclear Reactors

10. **Andy Rivas** member
Prelim: 02/2023, defense: 11/2023 (*advisor: Professor Jason Hou*)
PhD thesis title: Development of the Dynamic Operation and Maintenance Optimization Framework

11. **Khaldoon Al-Dawood** member
Prelim: 12/2022 (*advisor: Professor Scott Palmtag*)
PhD thesis title: Advanced Liquid Metal Fast Reactors Fuel Cycle Methodology

12. **Nick Crowder** (Department of Civil, Construction, and Environmental Engineering) member
Prelim: 08/2022, defense: 11/2023 (*advisors: Professors Abhinav Gupta and Kevin Han*)
PhD thesis title: Improving Digital Engineering Workflows by Enabling BIM Interoperability for Structural Analysis and Facilitating Accurate Modeling of Building, Equipment, and Piping Systems

13. **Arsen Iskhakov** member
Prelim: 05/2022, defense: 06/2023 (*advisor: Professor Nam Dinh*)
PhD thesis title: Development of Data-driven Methods for Engineering and System Scale Thermal-hydraulic Modeling

14. **Edward Chen** member
Prelim: 05/2022, defense: 05/2023 (*advisor: Professor Nam Dinh*)
PhD thesis title: Development of Hazard and Reliability Methodologies for Intelligent Digital Instrumentation and Control System

15. **Chengyu Zhou** (Department of Industrial and Systems Engineering) member
Prelim: 08/2022, defense: 04/2023 (*advisor: Professor Xiaolei Fang*)
PhD thesis title: High-Dimensional Data Analytics for System Condition Monitoring

16. **Cheng-Kai Tai** member
Prelim: 04/2022, defense: 07/2023 (*advisor: Professor Igor Bolotnov*)
PhD thesis title: Knowledge Gap-driven Simulation Strategy development based on Direct Numerical Simulation of Mixed Convection Flows

17. **John Darges** (Department of Mathematics) member
Prelim: 04/2022 (*advisors: Professors Pierre Gremaud and Alen Alexanderian*)
PhD thesis title: Variance-based global sensitivity analysis of model output: surrogate-based approaches and application to inverse problems

18. **Lance Bullerwell** member
Prelim: 12/2021, defense: 10/2022 (*advisor: Professor Jason Hou*)
PhD thesis title: Implementation of a Numerically Improved Three-Dimensional Solver in the Residual Formulation of CTF

19. **Longcong Wang** member
Prelim: 05/2021, defense: 08/2022 (*advisor: Professor Nam Dinh*)
PhD thesis title: Development of Data Coverage Assessment Framework on Neural Network Based Digital Twins for Reactor Transients

20. **Cole Manring** member
Prelim: 05/2020, defense: 10/2021 (*advisor: Professor Ayman Hawari*)
PhD thesis title: Development of Neural Thermal Scattering (NeTS) Modules for Reactor Multi-Physics Applications

21. **Anil Gurgen** member
Prelim: 05/2020, defense: 04/2021 (*advisor: Professor Nam Dinh*)
PhD thesis title: Development and Assessment of Physics-guided Machine Learning Framework for Prognosis System

22. **Sean Kerrigan** member
Prelim: 02/2020, defense: 03/2023 (*advisor: Professor Mohamed Bourham*)
PhD thesis title: Development, Fabrication, and Testing of Piezoelectric Non-Intrusive Wireless Sensors for Nuclear Power Plant Applications

MS Committees

1. **Christopher Brady** **chair**
Defense: 05/2023
MS thesis title: Criticality Safety Analysis of a Spiral Plate Heat Exchanger for Molten Salt Reactors

2. **Richard Pfrogner** **chair**
Defense: 03/2023
MS thesis title: CTF PWR Core Modeling and Validation Applicable to High Burnup High Enrichment (HBHE) Fuel

3. **Halil Ibrahim San** **chair**
Defense: 08/2022
MS thesis title: Sensitivity Analysis of Core Reflood Phenomena with Deep Learning

4. **Mostafa Hamza** member
Defense: 09/2022 (*advisor: Professor Mihai Diaconeasa*)
MS thesis title: OpenPHI - A Human Reliability Analysis Methodology to Risk-Inform the Importance of Operator Actions for Advanced Reactors during Early Design Stages

5. **Damla Polat** member
Defense: 06/2022 (*advisor: Professor Mihai Diaconeasa*)
MS thesis title: A Probabilistic Risk Assessment Framework for Wildfire-Induced Releases from Radiologically Contaminated Forests for Risk-Informed Emergency Planning Purposes

6. **Johnny Klemes** member
Defense: 03/2022 (*advisor: Professor Scott Palmtag*)
MS thesis title: Methodology for the Quantification and Sensitivity Analysis of Isotopic Distributions

7. **Dominic Senteno** member
Defense: 04/2021 (*advisor: Professor John Mattingly*)
MS thesis title: Application of Unsupervised Machine Learning Algorithms to Neutron/Gamma Particle Identification using Organic Scintillators

Qualification Exam Committees

1. **Christopher Brady** **chair**
Exam date: 12/06/2023
QE topic: Review of Inverse Problems and Their Applications to Nuclear Forensics

2. **Mahmoud Yaseen** **chair**
Exam date: 11/10/2022
QE topic: Uncertainty quantification in scientific machine learning: Methods, metrics, and comparisons

3. **Farah Alsafadi** **chair**
Exam date: 11/09/2022
QE topic: BubGAN: Bubble generative adversarial networks for synthesizing realistic bubbly flow images

4. **Ziyu Xie** **chair**
Exam date: 07/28/2021
QE topic: Physics-Informed Neural Networks for Heat Transfer Problems

5. **Tim Kiefer** member
Exam date: 11/10/2023 (*advisor: Professor Scott Palmtag*)
QE topic: A Multilevel Quasi-Static Kinetics Method for Pin-Resolved Transport Transient Reactor Analysis

6. **Sultan Abdul Wasay** member
Exam date: 11/06/2023 (*advisor: Professor Igor Bolotnov*)
QE topic: Counter Current Flow Limitation (CCFL) - Review of Mechanisms involved in CCFL, Application of Non-Dimensional Groups to Model CCFL, Modeling Challenges and Simulation Approaches

7. **Khang Nguyen** member
Exam date: 09/29/2023 (*advisor: Professor Jason Hou*)
QE topic: The Use of Digital Twin on Nuclear Reactor Control

8. **Logan Williams** member
Exam date: 04/06/2023 (*advisor: Professor Dr. Mike Doster*)
QE topic: Advanced Reactor Deployment Strategies for Integrated Energy Systems

9. **Fadel Nasr** member
Exam date: 02/13/2023 (*advisor: Professor Yousry Azmy*)
QE topic: Parametric Study of Natural Circulation Flow in Molten Salt Fuel in Molten Salt Reactor

10. **Asmaa Farag** member
Exam date: 01/27/2023 (*advisor: Professor Mihai Diaconeasa*)
QE topic: Event Trees and Fault Trees Solution Approaches and their applicability in Nuclear PRA Models

11. **ATM Jahid Hasan** member
Exam date: 11/22/2022 (*advisor: Professor Benjamin Beeler*)
QE topic: Atomistic study of grain-boundary segregation and grain-boundary diffusion in Al-Mg alloys

12. **Jonathan Crozier** member
Exam date: 08/17/2022 (*advisor: Professor Ayman Hawari*)
QE topic: A 3-D Neutron Distribution Reconstruction Method Based on the Off-Situ Measurement for Reactor

13. **Egemen Aras** member
Exam date: 07/01/2022 (*advisor: Professor Mihai Diaconeasa*)
QE topic: Application of Different Approaches to Perform PRA

14. **Ana Antunes** member
Exam date: 03/30/2022 (*advisor: Professor Kostadin Ivanov*)
QE topic: Monte Carlo time-dependent neutronic simulations and coupling with thermal-hydraulics codes

15. **Mostafa Hamza** member
Exam date: 03/14/2022 (*advisor: Professor Mihai Diaconeasa*)
QE topic: A Plant-specific HRA Sensitivity Analysis Considering Dynamic Operator Actions and Accident Management Actions

16. **Nick Crowder** (Department of Civil, Construction, and Environmental Engineering) member
Exam date: 10/14/2021 (*advisors: Professors Abhinav Gupta and Kevin Han*)
QE topic: A Review on the Application of Bayesian Network Model for Seismic Risk Analysis

17. **Parth Patel** (Department of Civil, Construction, and Environmental Engineering) member
Exam date: 09/26/2021 (*advisor: Professor Abhinav Gupta*)
QE topic: A Review on Ensemble Learning with Bagging and Boosting

18. **Andy Rivas** member
Exam date: 04/19/2021 (*advisor: Professor Jason Hou*)
QE topic: Algorithm for Autonomous Power-Increase Operation Using Deep Reinforcement Learning and a Rule-Based System

19. **Cheng-Kai Tai** member
Exam date: 02/02/2021 (*advisor: Professor Igor Bolotnov*)
QE topic: Progress in Direct Numerical Simulation and model development of turbulent heat transfer in low Prandtl fluids

20. **Arsen Iskhakov** member
Exam date: 01/25/2021 (advisor: Professor Nam Dinh)
QE topic: Review of Physics-based and Data-driven Multiscale Simulation Methods for CFD and Nuclear Thermal Hydraulics

21. **Cole Takasugi** member
Exam date: 01/11/2021 (advisor: Professor Kostadin Ivanov)
QE topic: Evaluation of hot channel factor for sodium-cooled fast reactors with multi-physics toolkit

22. **Khaldoon Al-Dawood** member
Exam date: 10/20/2020 (advisor: Professor Scott Palmtag)
QE topic: Fission Matrix Decomposition for Criticality Calculations: Theory and Proof of Concept

23. **Edward Chen** member
Exam date: 07/15/2020 (advisor: Professor Nam Dinh)
QE topic: PMAC: probabilistic multimodality adaptive control

24. **Longcong Wang** member
Exam date: 04/15/2020 (advisor: Professor Nam Dinh)
QE topic: Scaling in nuclear reactor system thermal-hydraulics

Undergraduate Researchers Mentored

1. **Sofiia Asadchykh** 10/2023 - present
Project: ML and Inverse Uncertainty Quantification for Nuclear Forensics

2. **Julianna White** 10/2023 - present
Project: Scientific Machine Learning for Nuclear Reactor Simulations

3. **Jason Clifford** 10/2022 - present
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 University Nuclear Leadership Program (UNLP) Scholarship
   - 01/2024 - present: SULI internship with Argonne National Laboratory (ANL)

4. **Lauren Kohler** 10/2021 - present
Project: Using Machine Learning to Predict Locations with Crud Buildup
Selected honors:
   - 2022: DOE UNLP Scholarship
   - 01/2023 - present: SULI internship with ANL
   - 2023: DOE UNLP Scholarship
   - 2023: Roy G. Post Foundation Scholarship

5. **Alexandra Akins** (continued as a PhD student with Dr. Wu) 10/2020 - 05/2023
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
   - 2023: NSF Graduate Research Fellowship
   - 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: OECD/NEA Global Forum Rising Stars in Nuclear Education, Science, Technology and Policy