Ziyu Xie

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Research Interests

- Sensitivity Analysis, Mathematics representation of Model Discrepancy, and Inverse Uncertainty Quantification
- Scientific Machine Learning and its application to Nuclear Engineering and Inverse Uncertainty Quantification

Education

North Carolina State University   **Raleigh, NC, USA**
Ph.D. Student, Department of Nuclear Engineering   *Jan 2020 – Present*

- Cumulative GPA – **3.564/4.0**

Shandong University   **Jinan, China**
B.S., Physics Major in Taishan College   *Sep. 2015 – Jun. 2019*

- Cumulative GPA – **89.21/100**

Duke University   **Durham, NC, USA**
Visiting undergraduate student, Physcis Department   *Aug. 2017 – May. 2018*

- Cumulative GPA – **3.96/4.0**

Research and Work Experience

Graduate Research & Teaching Assistant   **North Carolina State University**
Department of Nuclear Engineering   *Jan. 2020 – Present*

- Perform inverse Uncertainty Quantification (UQ) using adaptive Markov Chain Monte Carlo sampling method on thermal hydraulic simulation models.
- Apply functional Principal Components Analysis for the Bayesian calibration of TRACE time dependent model.
- Develop mathematical representation of model discrepancy based on machine learning methods for inverse UQ.
- Participate in the ATRIUM project
- TA: NE765 (Verification and Validation), Fall 2022; NE795 (Scientific Machine Learning), Fall 2023.

Research Aide   **Argonne National Laboratory**
Nuclear Engineering Division   *May. 2022 – Jul. 2022*

- Apply a forward UQ based on different source of input uncertainties using DAKOTA for the SAM model of Fast Flux Test Facility.
- Improve the SAM model using a multi channel rod bundle component for Fast Flux Test Facility.

Undergraduate Research Assistant   **Shandong University**
Department of Physics   *Dec. 2018 – Nov. 2019*

- Develop the simulation code of Wigner flow using entangled trajectory dynamics for a two body system.

- Compare the results with classic mechanics, figure out the impact of quantum effects.

Undergraduate Research Assistant   **Duke University**
Department of Physics   *Aug. 2017 – May. 2018*
- Develop a dynamic model for an impact experiment of granular material.
- Validate the dynamic model based on the oblique impact experiment of granular material.

Skills

- Programming – **Python**, **MATLAB**, **DAKOTA**
- Language – **English** [Fluent], **Chinese** [Native]

Refereed Journal Publications

- **Xie, Z.**, Wang, C. and Wu, X. (2024). Hierarchical Bayesian Modeling for Inverse Uncertainty Quantification of System Thermal-Hydraulics Code using Critical Flow Experimental Data. (in revision at International Journal of Heat and Mass Transfer)
- 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. (2024). A systematic approach for the adequacy analysis of a set of experimental databases: application in the framework of the ATRIUM project. *Nuclear Engineering and Design*, 421:113035
- **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
- Wang, C. Wu, X. **Xie, Z.**, Kozlowski, T. (2023). Scalable Inverse Uncertainty Quantification by Hierarchical Bayesian Modeling and Variational Inference. *Energies*, 16(22):7664
- Liu, Y., Mui, T., **Xie, Z.**, and Hu, R. (2023). Benchmarking FFTF LOFWOS Test# 13 using SAM code: Baseline model development and uncertainty quantification. *Annals of Nuclear Energy*, 192:110010
- **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
- 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
- **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

Refereed Conference Papers and Summaries

- **Xie, Z.**, Wang, C. and Wu, X. (2024). Hierarchical Bayesian Inverse Uncertainty Quantification with Application to the ATRIUM project. In *Proceedings of BEPU-2024*. Lucca, Tuscany, Italy, May 19-23, 2024
- **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
- Yaseen, M., **Xie, Z.**, and Wu, X. (2023). Uncertainty Quantification of Deep Neural Network Predic-

tions 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). 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

- **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

- 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

- 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

- **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, North Carolina, October 3–7, 2021

- **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, North Carolina, October 3–7, 2021

Awards

Summer Graduate Merit Award (GMA)   *2021*
- College of Engineering, North Carolina State University

Outstanding Graduate Student   *2019*
- Shandong University

Outstanding Undergraduate Student Scholarship, Shandong University   *2016, 2017*
- Shandong University