

# Yihui (Ray) Ren

## Curriculum Vitae

<https://scholar.google.com/citations?user=XCByFMoAAAAJ>

### Current Position

- 2024–Present **Computational Scientist (AI/ML)**, *Brookhaven National Laboratory*, Upton, NY
- AI Codesign Group Lead
  - Lead research projects building scalable foundation models for nuclear and particle physics, software-hardware codesign, AI algorithms for event-based camera, etc.

### Education

- 2010–2015 **Ph.D. in Physics**, *University of Notre Dame*, Notre Dame, IN
- 2005–2009 **B.Sc. in Physics**, *Hunan University*, Changsha, China

### Professional Experience

- 2021–2024 **Associate Computational Scientist (AI/ML)**, *Brookhaven National Laboratory*, Upton, NY
- Led a project developing unpaired and unsupervised domain mapping techniques bridging simulation and experimental data
  - Co-led on several real-time neural network inference projects.
- 2019–2021 **Assistant Computational Scientist (AI/ML)**, *Brookhaven National Laboratory*, Upton, NY
- Developed graph neural network-based molecule fingerprinting for COVID-19 research
  - Developed efficient neural compression methods for sparse nuclear physics detector data
- 2018–2019 **Postdoctoral Research Associate (AI/ML)**, *Brookhaven National Laboratory*, Upton, NY
- Developed deep learning object detection for nuclear non-proliferation
  - Benchmarked AI workloads on cutting-edge hardware including NVIDIA DGX2
- 2015–2018 **Postdoctoral Research Associate**, *Virginia Tech, Biocomplexity Institute*, Blacksburg, VA
- Connected Moore-Shannon Network Reliability with Ising Model in condensed matter physics
  - Developed probabilistic agent-based modeling for human behavior and epidemics

### Research Grants

- 2025 PI, LDRD-D 25-045: “FM4NPP Foundation Models for Nuclear and Particle Physics”
- 2024 PI, LDRD-A 25-041: “AI-Circuit-Materials Co-Design for Mitigating Memristive Stochasticity”
- 2024 Co-PI, LDRD-B 25-026: “Real time learning on heterogeneous devices for detector calibration” (PI: Haider Abidi)
- 2022 Co-PI, LDRD-A 23-048: “Real-time Information Distillation on Novel AI Hardware” (PI: Jin Huang)
- 2021 Co-PI, LDRD-B 22-018: “Real-time Image Classification using Machine Learning” (PI: Elizabeth C. Brost)
- 2020 Co-PI, LDRD-A 21-023: “Towards Edge Computing: A Software and Hardware Co-Design Methodology for ASIC-based Scientific Neuromorphic Computing” (PI: Sandeep Miryala)

- 2020 PI, LDRD-A 21-029: "Bridging the Gap between Scientific Simulations and Experiments with Cycle-Consistent Generative Models"

## Selected Publications

### AI for Science

- 2025 David Park, Shuhang Li, Yi Huang, Xihaier Luo, et al., **Yihui Ren**, "FM4NPP: A Scaling Foundation Model for Nuclear and Particle Physics," *arXiv:2508.14087*
- 2024 Luo, X., Xu, W., **Ren, Y.**, Yoo, S., Nadiga, B., "Continuous Field Reconstruction from Sparse Observations with Implicit Neural Networks," *ICLR 2024*
- 2024 Huang, Y., Torbunov, D., Viren, B., Yu, H., et al., **Ren, Y.**, "Unpaired Image Translation to Mitigate Domain Shift in Liquid Argon Time Projection Chamber Detector Responses," *Machine Learning: Science and Technology*
- 2024 Huang, Y., Go, Y., Huang, J., et al., **Ren, Y.**, "Variable Rate Neural Compression for Sparse Detector Data," *SSRN 5262322*
- 2024 Luo, X., Lurvey, S., Huang, Y., **Ren, Y.**, Huang, J., Yoon, B.J., "Efficient Compression of Sparse Accelerator Data using Implicit Neural Representations and Importance Sampling," *arXiv:2412.01754*
- 2024 Torbunov, D., Huang, Y., Lin, M., **Ren, Y.**, et al., Huang, J., "Effectiveness of Denoising Diffusion Probabilistic Models for Fast and High-fidelity Whole-event Simulation in High-energy Heavy-ion Experiments," *Physical Review C*
- 2023 Huang, Y., **Ren, Y.**, Yoo, S., Huang, J., "Fast 2D Bicephalous Convolutional Autoencoder for Compressing 3D Time Projection Chamber Data," *SC'23 Workshops*
- 2022 Luo, X., Nadiga, B.T., Park, J.H., **Ren, Y.**, Xu, W., Yoo, S., "A Bayesian Deep Learning Approach to Near-term Climate Prediction," *Journal of Advances in Modeling Earth Systems*
- 2021 Yu, H.W., Bishai, M., et al., Qian, X., **Ren, Y.**, "Augmented Signal Processing in Liquid Argon Time Projection Chambers with a Deep Neural Network," *Journal of Instrumentation*

### Computer Vision

- 2025 Torbunov, D., **Ren, Y.**, Ghose, A., Dim, O., Cui, Y., "EvRT-DETR: The Surprising Effectiveness of DETR-based Detection for Event Cameras," *ICCV 2025*
- 2023 Torbunov, D., Huang, Y., Yu, H. et al., **Ren, Y.**, "UVCGAN: UNet Vision Transformer cycle-consistent GAN for Unpaired Image-to-Image Translation," *WACV 2023*

### AI-Hardware Co-design

- 2024 Kharel, S.R., Mukim, P., Maj, P., et al., **Ren, Y.**, Mandal, S., "Automated and Holistic Co-design of Neural Networks and ASICs for Enabling In-Pixel Intelligence," *arXiv:2407.14560*
- 2024 Das, S., Kundu, S., Menon, A., **Ren, Y.**, Kharel, S., Basu, K., "Analyzing and Mitigating Circuit Aging Effects in Deep Learning Accelerators," *IEEE VTS 2024*
- 2022 Miryala, S., Mittal, S., **Ren, Y.**, Carini, G., Deptuch, G., et al., "Waveform Processing Using Neural Network Algorithms on the Front-end Electronics," *Journal of Instrumentation*

### High-Performance Computing

- 2024 Park, D.K., **Ren, Y.**, Kilic, O.O., Korchuganova, T., Vatsavai, S.S., et al., "AI Surrogate Model for Distributed Computing Workloads," *SC24 Workshops*
- 2019 **Ren, Y.**, Yoo, S., Hoisie, A., "Performance Analysis of Deep Learning Workloads on Leading-edge Systems," *IEEE/ACM PMBS 2019*

### Network Science and Complex Systems

- 2020 Cedeno-Mieles, V., Hu, Z., **Ren, Y.**, Deng, X., Contractor, N., et al., "Data Analysis and Modeling Pipelines for Controlled Networked Social Science Experiments," *PLOS ONE*
- 2018 Nath, M., **Ren, Y.**, Khorramzadeh, Y., Eubank, S., "Determining Whether a Class of Random Graphs is Consistent with an Observed Contact Network," *Journal of Theoretical Biology*
- 2016 **Ren, Y.**, Eubank, S., Nath, M., "From Network Reliability to the Ising Model: A Parallel Scheme for Estimating the Joint Density of States," *Physical Review E*
- 2014 **Ren, Y.**, Ercsey-Ravasz, M., Wang, P., González, M.C., Toroczkai, Z., "Predicting Commuter Flows in Spatial Networks Using a Radiation Model Based on Temporal Ranges," *Nature Communications*