Jinsu Kim

Mechanical and Aerospace Engineering, Princeton University, NJ, USA

E-mail: jk9075@princeton.edu
Homepage: https://zinzinbin.github.io/
Github: https://github.com/ZINZINBIN
Linkedin: https://www.linkedin.com/in/zinzinbin/
Google Scholar: https://scholar.google.com/citations?user=bdGTQSkAAAAJ&hl=ko

Research Interest

Plasma Kinetic Theory
Fluid Mechanics
Physics-Informed Machine Learning
Model Reduction
Operator Learning
Data Assimilation and Control

Education

Princeton University — New Jersey, USA
Ph.D. Mechanical and Aerospace Engineering — July 2024 - Present
Supervisor: Prof. Clarence Rowley

Seoul National University — Seoul, Korea
M.S. Nuclear Engineering — Mar 2022 - Feb 2024
GPA: 4.09 / 4.3, Major GPA: 4.09 / 4.3
Thesis: Optimizing disruption prediction based on Bayesian Deep Learning in KSTAR

Seoul National University — Seoul, Korea
B.S. Nuclear Engineering; Physics and Astronomy — Mar 2015 - Feb 2019
GPA: 3.98 / 4.3, Major GPA: 4.1 / 4.3
Thesis: Effect of RMP on electron heat transport using Time-to-peak method in KSTAR
- Summa Cum Laude, 1 out of 30 at Dept. of Nuclear Engineering
- Best Undergraduate Thesis Award

Publications

1. J. Lee,..., J. Kim, et al., “Machine Learning based Disruption Prediction using Long Short-Term Memory in KSTAR Lower Carbon Divertor Database”, Nuclear Fusion, 2025 (reviewed)
2. J. Kim & J. Seo., “Design Optimization of Nuclear Fusion Reactor through Deep Reinforcement Learning”, arXiv, 2024
3. J. Kim et al., “Enhancing Disruption Prediction through Bayesian Neural Network in KSTAR”, Plasma Physics and Controlled Fusion, 2024
4. J. Kim et al., “Disruption Prediction and Analysis through Multimodal Deep Learning in KSTAR”, Fusion Engineering and Design, 2024
5. J. Kim, “Optimizing Disruption Prediction based on Bayesian Deep Learning in KSTAR”, Seoul National University, 2024

Research Experiences

Princeton University — New Jersey, USA
Dept. of Mechanical and Aerospace Engineering — July 2024 - Present
Research topics:

Model reduction on nonlinear dynamic systems

Structure-preserving model reduction for Vlasov-Poisson plasma system

- Symplectic model order reduction with Balanced Proper Symplectic Decomposition for reduced modeling in the Vlasov-Poisson structure
- Development of the Particle-In-Cell simulation code in electrostatic plasma systems

Computational plasma physics

Symplectic integration of the Particle-In-Cell method for plasma kinetic simulations

- Development of the Particle-In-Cell method with symplectic integration in an electromagnetic plasma system
- Spectral solver for electromagnetic PIC and application of parallel computation for acceleration

Seoul National University Seoul, Korea
Dept. of Nuclear Engineering Mar 2015 - Feb 2024
Research topics:

Data-driven modeling for fusion plasma and optimized control

Disruption prediction for KSTAR tokamak plasma based on data-driven approaches

- Development of multi-modal deep neural network with EFIT, diagnostics, and IVIS for predicting thermal quench
- Uncertainty modeling for high precision with Bayesian neural network and cause estimation with multi-time scale input signals in disruption prediction

Data-driven plasma equilibrium modeling and control for tokamak plasma operation

- Development of a physics-informed neural network (PINN-EFIT) to simulate the plasma equilibrium by solving Grad-Shafranov equation and estimating the plasma profile
- Implementation of multi-parameter control in plasma operation with multi-objective reinforcement learning (GPI-LS)

Reactor design optimization

Design optimization of a tokamak reactor with data-driven approaches

- Development of a tokamak reactor design computation code
- Reactor design optimization for high-performance and sustainable operation based on Bayesian optimization and reinforcement learning

Plasma transport

Study on the effect of Resonant Magnetic Perturbation (RMP) on electron heat transport

- Computation of electron heat transport coefficient with 1D Vlasov equation from ECE data using Time-to-peak analysis
- Analysis of the effect of RMP with different plasma operation modes in KSTAR

Work Experiences

GaussLabs Seoul, Korea
Machine Learning and Data Science Dec 2022 - Mar 2023
Title: Applied Machine Learning Scientist Intern

Fault detection and diagnostic of wafer samples in plasma etching process

- Development of physics-guided feature extraction code for ML pipeline in plasma etching process
- Utilized online-machine learning algorithms for real-time manufacturing processes
- Developed hyperparameter optimization tools for multiple manufacturing equipment diagnostic data

Teaching Assistant Mar 2022 - Dec 2022
Department of Nuclear Engineering, Seoul National University
Subject: Introduction to Plasma Physics, Fusion Reactor Engineering 2

Reserve Officers' Training Corps (ROTC, class: 1st Lieutenant) Mar 2017 - Jun 2021
Platoon Leader of Chemical, Biological, Radiological, and Nuclear (CBRN) of the 5th Infantry Division, Korean Army
Troop management of CBRN protection unit, Supervision of COVID-19 quarantine for Korean Army and Incheon Airport

Presentations

Oral presentations:

Jinsu Kim et al., "ML application in KSTAR: Disruption prediction and autonomous tokamak plasma control", NSTX meeting, Princeton Plasma Physics Laboratory, USA (2023).

Poster presentations:

Jinsu Kim et al., "Bayesian neural network application for disruption prediction using EFIT and diagnostic data in KSTAR", 2023 Fall meeting of the Korean Physics Society, Changwon, Korea (Oct 2023).

Jinsu Kim et al., “Tokamak plasma operation control using multi-objective reinforcement learning in KSTAR”, 2nd International Fusion and Plasma Conference, Busan, Korea (Aug 2023).

Jinsu Kim et al., “Disruption prediction and its analysis using multimodal data in KSTAR via deep learning”, 2022 Fall meeting of the Korean Physics Society, Busan, Korea (Oct 2022).

Jinsu Kim et al., “Disruption prediction based on video data in KSTAR via deep learning”, 1st International Fusion and Plasma Conference, Jeju, Korea (Aug 2022).

Jinsu Kim et al., “Effect of RMP on electron heat transport using Time-to-peak method in KSTAR”, 2018 Fall meeting of the Korean Physics Society, Changwon, Korea (Oct 2018).

Honors and Awards

Award for Best Poster Presentation: Tokamak plasma operation control using multi-objective reinforcement learning in KSTAR
International Fusion Plasma Conference (iFPC 2023), Korea (Aug 2023)

Award for Best Group-Project Presentation: Mass inference of dark matter halo using machine learning
The 14th KIAS CAC Summer School on Parallel Computing and AI, Korean Institute For Advanced Study, Korea (Jun 2023)

Award for Best Poster Presentation: Disruption prediction and its analysis using multimodal data in KSTAR via deep learning
2022 KPS Fall Meeting, The Korean Physics Society, Korea (Oct 2022)

Award for Outstanding Teaching Assistant: Recognized for exceptional instructional skills and contribution to SNU
College of Engineering, Seoul National University, Korea (Sep 2022)

Award for Best Group-Project Presentation: Protein function & structure classification using ML and DL
The 13th KIAS CAC Summer School on Parallel Computing and AI, Korean Institute For Advanced Study, Korea (Jun 2022)

Chairman’s Award at the Big Data Forum: Investigation of an optimal price prediction model for seafood import price
Data Competition: 2021 Big Contest, National Information Society Agency and Ministry of Science and ICT, Korea (Dec 2021)

Summa Cum Laude: Graduated with highest honors as the **top-ranked student** in the Department of Nuclear Engineering
Seoul National University, Korea (Feb 2019)

Award for Best Undergraduate Thesis: Effect of RMP on electron heat transport using Time-to-peak method in KSTAR
Department of Nuclear Engineering, Seoul National University, Korea (Feb 2019)

Award for Best Group-Project Presentation: The correlation energy of 2D electron cloud using Linear Response Theory
KIAS-SNU Physics Winter Camp 2018, Korean Institute For Advanced Study, Korea (Dec 2018)

Award for Best Poster Presentation: Effect of RMP on electron heat transport using Time-to-peak method in KSTAR
2018 KPS Fall Meeting, The Korean Physics Society, Korea (Oct 2018)

Scholarships

Youlchon AI Research Fellowship: Research for X+AI (Fusion plasma)
Artificial Intelligence Institute of Seoul National University, Youlchon, Korea (Oct 2022)

Basic Science Research Program through the National Research Foundation
The ministry of education, Korea (Mar 2022 - Dec 2022)

Chungsoo Scholarship
Scholarship from Chungo Association, Korea (Mar 2017 - Feb 2019)

Scholarship for academic excellence
Seoul National University, Korea (Sep 2015 - Dec 2016)

Memberships

Expertise: License of Engineer Nuclear Power Oct 2019
Korea Institute of Nuclear Safety (KINS)

STEM: SNU Tomorrow’s Engineers Membership Mar 2017 – Feb 2019
Honor society for **academic excellence** of the College of Engineering at Seoul National University

NAEK: The National Academy of Engineering of Korea Aug 2015 – Feb 2019
Young Engineer Honor Society of the College of Engineering at Seoul National University