Jinsu Kim

Mechanical and Aerospace Engineering, Princeton University, New Jersey, USA
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RESEARCH INTERESTS

Plasma Kinetic Theory	Model Reduction
Fluid Mechanics	Operator Learning for Dynamic Systems
Physics-Informed Machine 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 **(Double major)** Mar 2015 - Feb 2019
 GPA: 3.98 / 4.3 (**Summa Cum Laude**, **1 out of 30** at Dept. of Nuclear Engineering), Major GPA: 4.1 / 4.3
 Best Undergraduate Thesis Award
 (Thesis: Effect of RMP on electron heat transport using Time-to-peak method in KSTAR)

PUBLICATIONS

Jinsu Kim et al., "Disruption Prediction and Analysis through Multimodal Deep Learning in KSTAR", Fusion Engineering and Design, 2024

Jinsu Kim et al., "Enhancing Disruption Prediction through Bayesian Neural Network in KSTAR", Plasma Physics and Controlled Fusion, 2024

Jinsu Kim & Jaemin Seo., "Design Optimization of Nuclear Fusion Reactor through Deep Reinforcement Learning", arXiv, 2024

Jeongwon Lee, Jayhyun Kim, Jinsu Kim, et al., "Machine Learning based Disruption Prediction using Long Short-Term Memory in KSTAR Lower Carbon Divertor Database", Nuclear Fusion, 2024 (submitted)

RESEARCH EXPERIENCES

Seoul National University Seoul, Korea
Dept. of Energy System Engineering - Nuclear Engineering Mar 2022 - Feb 2024
Research:

 Disruption prediction and analysis through multimodal deep learning in KSTAR
  - Develop neural network-based disruption predictors with IVIS, EFIT, and diagnostics through multimodal deep learning
  - Employ explainable AI techniques to analyze model capabilities and critical features to detect disruptions

 Bayesian neural network for predicting disruptions using EFIT and diagnostic data in KSTAR
  - Optimize disruption prediction with enhancing precision through stochastic Bayesian neural network in KSTAR
  - Integrate model for disruption prediction and cause estimation from multi-time scale input signals

 Tokamak plasma operation control based on multi-objective reinforcement learning in KSTAR
  - Design a data-driven tokamak simulator with sequence learning and a physics-informed neural network (PINN-EFIT)
  - Apply multi-objective reinforcement learning (GPI-LS) for multi-target control to cover the Pareto-optimal situation

 Fusion reactor design optimization using reinforcement learning
  - Computation to estimate design parameters of tokamaks and optimization based on single-step reinforcement learning

Seoul National University Seoul, Korea
Dept. of Nuclear Engineering Mar 2018 - Feb 2019
Research:

 Effect of RMP on electron heat transport using Time-to-peak method in KSTAR
  - Computed electron heat transport coefficient with 1D Vlasov equation from ECE data using Time-to-peak method
  - Analyzed the effect of RMP with estimated heat transport coefficient of electron with different modes in KSTAR

Seoul National University Seoul, Korea

Dept. of Physics and Astronomy Jun 2018 - Feb 2019

Research:

Measurement of Pockel coefficient in LiNbO3 using Teng-Man method and analysis
- Calculated the electric impermeability of LiNbO3 by analyzing phase difference changes of reflected EM waves

PROJECTS

Autonomous tokamak plasma operation control based on reinforcement learning for V-DEMO, Seoul National University and Gangwon Technopark (Research and Development, Jul 2022 - Dec 2023).

Development of data-driven tokamak simulators for high beta and ELMs control via reinforcement learning, Seoul National University and Korea Institute of Fusion Energy (Research and Development, Oct 2023 - Mar 2024).

Design Optimization of Tokamak Fusion Reactor through Deep Reinforcement Learning, Chung-ang University and Korea Institute of Fusion Energy (Research and Development, Mar 2024 - Present).

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)

PROFESSIONAL MEMBERSHIPS

Deepest: Machine learning and deep learning community of SNU   May 2022 – Present
Academic organization for machine learning and deep learning researchers

DIYA: Community for AI research and development   Mar 2021 - Present
Academic club for students and developers for AI research and application
Project: K-MolOCR (a deep-learning-based web service for detecting molecular structure information from PDF)

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

EXPERIENCES

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

Development of Mobile Application: Customized welfare notification service for the underprivileged   Apr 2021 - Feb 2022
Project Leader and Frontend Developer for the Mobile Application "Welfare For Everyone"
Award: **Winner of the Minister of Science and ICT Award** for the 2021 ProBono Competition in Korea, 2021
Project link: Github, Google Playstore

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

LANGUAGES & SKILLS

Language
   Native in **Korean**
   Fluent in **English**
Programming
   Computation: C, C++, CUDA, MPI, MATLAB
   Machine Learning & Deep Learning: Python, PyTorch, TensorFlow
   Web Development: Javascript, Typescript, HTML, CSS
   App Development: Java, Andriod studio