Minseok Kim

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Department of Mechanical and Aerospace Engineering, Princeton University, Princeton, NJ, USA

EDUCATION

Princeton University (PU) *2023.07-present*
Doctor of Philosophy in Mechanical and Aerospace Engineering *Princeton, NJ, USA*

- Cumulative GPA: 3.68/4.00
- Supervisor: Prof. Egemen Kolemen

Korea Advanced Institute of Science and Technology (KAIST) *2023.03-2023.06*
Doctor of Philosophy in Nuclear and Quantum Engineering (drop out) *Daejeon, Korea*

- Supervisor: Prof. Young-chul Ghim

Korea Advanced Institute of Science and Technology (KAIST) *2021.03-2023.02*
Master of Science in Nuclear and Quantum Engineering *Daejeon, Korea*

- Cumulative GPA: 4.02/4.30
- Thesis: Predicting plasma kinetic profiles with the Gaussian process and a neural network in KSTAR based on magnetic and heating information
- Supervisor: Prof. Young-chul Ghim

Korea University (KU) *2015.03-2021.02*
Bachelor of Science in Physics and Bachelor of Engineering in Interdisciplinary Major in Artificial Intelligence (Double Major) *Seoul, Korea*

- Cumulative GPA: 3.93/4.50, **Major GPA: 4.13/4.50**

※ I had mandatorily served in the Republic of Korea Army from 2016.09 to 2018.06.

RESEARCH EXPERIENCE

Graduate (Ph.D.): *2023.07-*
- **Supervisor:** Prof. Egemen Kolemen, Department of Mechanical and Aerospace Engineering *Princeton University*
- **Reconstructing and controlling plasma density at KSTAR in real-time**
  - Reconstructing plasma density profile by using five channels of interferometer (TCI)
  - The reconstruction algorithm has been implemented and tested at the KSTAR plasma control system (PCS).
  - The plasma density near the pedestal and core would be controlled for higher performance.
- **Making a database of kinetic equilibrium at DIII-D**
  - Making a database of kinetic equilibrium by using rtCAKENN developed by Ricardo Shousha

Graduate (Masters): *2021.03-2023.02*
- **Supervisor:** Prof. Young-chul Ghim, Department of Nuclear and Quantum Engineering *KAIST*
- **Inferred kinetic profiles in KSTAR using Gaussian process regression (GPR)**
  - Inferred kinetic profiles from diagnostic data in KSTAR using Gaussian process regression, a non-parametric profile fitting method
  - Detected outliers using support vector machine regression (SVMR)
  - Marginalized hyperparameters of the GPR's kernel function by using the No-U-turn sampler, one of the MCMC algorithms
  - Conducted the research as a person in charge of the task commissioned by the Korea Institute of Fusion Energy (KFE)
- **Corrected magnetic drifts in KSTAR**
  - Corrected undesirable drifts in magnetic signals to be consistent with plasma currents measured by the Rogowski coils
  - Inferred missing values utilizing symmetry of magnetic signals with respect to the Z = 0 plane and adopted GPR for the magnetic profile regression
  - Investigated various approaches to correct magnetic drifts, including integrator cell method on the EAST device and iterative correction algorithm with NMR on the LHC device
  - Conducted the research as a person in charge of the task commissioned by ITER

- **Predicted kinetic profiles utilizing magnetic and heating information with an artificial neural network**
  - Inferred kinetic profiles in real-time utilizing magnetic and heating information to prepare for the nuclear fusion power plant, which may have only a few diagnostics, including magnetic probes
  - Utilized SVMR and GPR for inference of the kinetic profiles and its gradients
  - Corrected magnetic signal drifts with a linear model
- **Estimated blob structures in VEST using Gaussian process regression**
  - Provided support for utilizing Gaussian process regression to Euichan Joung at the Seoul National University (now the Princeton Plasma Physics Laboratory Ph.D. student)
  - Inferred blob size from visible fast camera images in VEST with synthetic images
  - The research is supported by K-CLOUD nuclear fusion manpower training project funded by Korea Hydro and Nuclear Power Co., Ltd.

Undergraduate: *2019.01-2019.06*

- Supervisor: Prof. Jun-Gil Lee, Department of Physics *KU*
- Edited typos in mathematical formulas and made figures for the classical mechanics textbook distributed to the department of Physics major course
- Participated renewal of general physics experiments for freshmen

PUBLICATION & PRESENTATION

Publication:

- **Minseok Kim**, Won-Ha Ko, Sehyun Kwak, Semin Joung, Wonjun Lee, Boseong Kim, Donguk Kim, Jongha Lee, Choongki Sung, Yong-Su Na, and Young-chul Ghim※, "Kinetic profile inference with outlier detection using Support vector machine regression and Gaussian process regression", 2024 *Nucl. Fusion* **64** 106052

Poster presentation:

1. **Minseok Kim**, SangKyeun Kim, Azarakhsh Jalalvand, Ricardo Shousha, Alvin Garcia, Max Curie, Jalal Butt and Egemen Kolemen※, "Autonomous detection and control of Sawtooth instability triggering ELM", The 5th International Conference on Data-Driven Plasma Science (ICDDPS-5), August 12 – August 16, 2024.
2. **Minseok Kim**, Ricardo Shousha, Azarakhsh Jalalvand, SangKyeun Kim, Max Curie, Egemen Kolemen※, "Detecting ELM originated by Sawtooth at DIII-D", 2023 American Physical Society Division of Plasma Physics (APS DPP), October 30 – November 03, 2023.
3. **Minseok Kim**, Seongmin Choi, Semin Joung, Hoiyun Jeong, Sunghyun Park, Y.-c Ghim※, "Correction algorithm for signal drifts in KSTAR magnetic probes using Bayesian statistics", 2023 Korea Physics Society (KPS) Spring Meeting, Daejeon Convention Center, Daejeon, Korea, April 19-21, 2023.
4. **Minseok Kim**, Semin Joung, Sunghyun Park, Y.-c Ghim※, "Feasibility studies on software-based approaches to correct magnetic drifts in KSTAR", 20th International Congress on Plasma Physics (ICPP), HICO, Gyeongju, Korea, November 27-December 2, 2022.
5. **Minseok Kim**, Semin Joung, Sunghyun Park, Y.-c Ghim※, "Software-based approaches including the Bayesian statistics to correct magnetic drifts in tokamaks", Korea Physics Society (KPS) 70th Anniversary and 2022 Fall Meeting, BEXCO, Busan, Korea, October 19-21, 2022.
6. **Minseok Kim**, Semin Joung, W.J. Lee, B. Kim, Yong-Su Na, W.H.Ko, J.H. Lee, and Y.-c Ghim※, "Inference of kinetic profiles for KSTAR plasmas using Gaussian process regression", 1st International Fusion and Plasma Conference (iFPC), Haevichi, Jeju, Korea, August 22-26, 2022.
7. **Minseok Kim**, Semin Joung, W.J. Lee, B. Kim, Yong-Su Na, W.H.Ko, J.H. Lee, and Y.-c Ghim※, "Kinetic profile reconstruction for KSTAR plasmas using support vector machine regression and Gaussian process regression", High-Temperature Plasma Diagnostics (HTPD) Conference 2022, Hyatt Regency Rochester, Rochester, NY, USA, May 15-19, 2022.
8. **Minseok Kim**, Semin Joung, W.H. Ko, J.H. Lee, and Y.-c. Ghim※, "Predicting plasma pressure profiles with Gaussian process and a neural network in KSTAR based on magnetic signals", 2021 American Physical Society Division of Plasma Physics (APS DPP), Virtual, November 08-12, 2021.
9. **Minseok Kim**, Semin Joung, W.H. Ko, J.H. Lee, and Y.-c. Ghim※, "Inference of spatially continuous kinetic profiles with Gaussian processes and neural networks in KSTAR", 2021 Korea Physics Society (KPS) Spring Meeting, Virtual, April 21-23, 2021.

※ Indicates corresponding author

AWARD & HONORS

Best Poster Award of iFPC, *2022 1st International Fusion and Plasma Conference* *2022.08*
Exemplary Warrior Award for 4th prize in cook training college, *Republic of Korea Army* *2017.04*

SCHOLARSHIP

Jin Tae Young scholarship for excellent academic achievements *2019.03-2020.12*
Department of Physics, Korea University
(Covers full tuition fee for 4 semesters)

WORK EXPERIENCE

Army cook at the Northern Forefront *2016.09-2018.06*
Headquarters company, 81st regiment, 28th division, Republic of Korea Army

OTHER EXPERIENCES

International Mini-Workshop on Open Magnetic Systems for Plasma Confinement, *Virtual* *2021.08.24-25*
2021 APCTP Workshop on Frontiers in Plasma and Beam Physics, *POSTECH, Pohang, Korea* *2021.08.08-09*
6th Korean Nuclear Fusion Winter School, *Virtual* *2021.01.25-29*
Particle Physics Winter Camp, *Bloomvista, Yang-pyeong, Korea* *2019.12.26-29*
2019 English•Science•Vision Summer Camp, *Sangjin Elementary School, Danyang, Chungbuk, Korea* *2019.07.22-26*

- Being a weekly teacher of computer programming for suburban students

TECHNICAL & LANGUAGES SKILLS

Computer programs:

- Proficient in **Python**
- Intermediate in **MATLAB, C**

Language:

- Fluent in **English**
  - Best TOEFL scores: RC **30**, LC **26**, SPK **22**, WRT **26**, Total **104**
- Native in **Korean**