

# Dong-Kyum Kim

POSTDOCTORAL RESEARCHER

Data Science Group, Institute for Basic Science (IBS), Daejeon 34126, Korea

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## Summary

I am a physicist passionate about AI and did my PhD in physics at KAIST, Korea. Under professor Hawoong Jeong's supervision, I worked on applications of ML in complex systems and statistical physics. My current research focus is understanding highly complex nonequilibrium systems, such as biological systems, active matter, and others in nature, through stochastic thermodynamics with ML-based approaches.

## Education

### Korea Advanced Institute of Science and Technology (KAIST)

Daejeon, Korea

DOCTOR OF PHILOSOPHY (PHD) IN PHYSICS, ADVISOR: PROF. [HAWOONG JEONG](#)

Mar. 2016 - Feb. 2022

- Dissertation: Nonequilibrium Statistical Physics Study using Deep Learning

### Seoul National University (SNU)

Seoul, Korea

BACHELOR OF SCIENCE (BS) IN PHYSICS WITH A MINOR IN COMPUTER SCIENCE & ENGINEERING

2011 - 2015

## Experience

### Institute for Basic Science (IBS)

Daejeon, Korea

SENIOR RESEARCHER

Mar. 2022 - present

- Hosted by prof. [Meeyoung Cha](#) (Chief Investigator).
- Data Science Group, Center for Mathematical and Computational Sciences.

### Samsung Electronics

Hwaseong, Korea

MACHINE LEARNING INTERN

Sep. 2017 - Dec. 2017

- Collaborated with [Daniel Kim](#), PhD (Senior Data Scientist).
- Improved anomaly image classification tasks via distributed multi-GPU training methods of Keras & Spark.
- Implemented a distributed image searching framework to detect similar patterns in images through Elasticsearch.

## Publication

### Transformer as a hippocampal memory consolidation model based on NMDAR-inspired nonlinearity

D.-K. KIM, J. KWON, M. CHA, & C. J. LEE, *Conference on Neural Information Processing Systems (NeurIPS)*

2023

### SUBTLE: An unsupervised platform with temporal link embedding that maps animal behavior

J. KWON, S. KIM, D.-K. KIM, J. JOO, S. H. KIM, M. CHA, & C. J. LEE, *bioRxiv* 2023.04.12.536531 (UNDER REVIEW)

2023

### Multidimensional entropic bound: Estimator of entropy production for Langevin dynamics with an arbitrary time-dependent protocol

S. LEE, D.-K. KIM, J. M. PARK, W. K. KIM, H. PARK & J. S. LEE, *Phys. Rev. Research* **5**, 013194

2023

### Neural Classification of Terrestrial Biomes

V. SHEN, D.-K. KIM, E. ZELLER, M. CHA, *IEEE International Conference on Big Data and Smart Computing (BigComp)*

2023

### Transformer needs NMDA receptor nonlinearity for long-term memory

D.-K. KIM, J. KWON, M. CHA, C. J. LEE, *NeurIPS-W 2022 (Memory in Artificial and Real Intelligence)*

2022

### Inferring dissipation maps from videos using convolutional neural networks

Y. BAE, D.-K. KIM & H. JEONG, *Phys. Rev. Research* **4**, 033094, [qodudrud/CNEEP](#)

2022

### Estimating entropy production with odd-parity state variables via machine learning

D.-K. KIM, S. LEE & H. JEONG, *Phys. Rev. Research* **4**, 023051, [kdkyum/odd\\_neep](#)

2022

### Spontaneous emergence of music detectors in a deep neural network

G. KIM, D.-K. KIM & H. JEONG, *bioRxiv* 2021.10.27.466049, [kgspiano/Music](#) (UNDER REVIEW)

2021

- Deep reinforcement learning for feedback control in a collective flashing ratchet**  
D.-K. KIM & H. JEONG, *Phys. Rev. Research* **3**, L022002, [kdkyum/RatchetDRL](#) 2021
- Learning Entropy Production via Neural Networks**  
D.-K. KIM, Y. BAE, S. LEE & H. JEONG, *Phys. Rev. Lett.* **125**, 140604, [kdkyum/neep](#) 2020
- Multi-Label Classification of Historical Documents by Using Hierarchical Attention Networks**  
D.-K. KIM, B. LEE, D. KIM & H. JEONG, *J. Korean Phys. Soc.* **76**, 368 2020

## Skills

**Programming Languages** Python\*, R, JAVA, Scheme, C, C++ (\* skills daily used)  
**ML Frameworks** JAX\*, PyTorch\*, Keras, TensorFlow  
**Distributed Computing** Slurm\*, Spark, Elasticsearch

## Award

2021.8.30 Pre-doctoral Fellow of Physics at KAIST Daejeon, Korea

## Presentation

- Working and reference memory in transformers on a navigation task**  
2022 KIAS CAINS SUMMER WORKSHOP (INVITED TALK) Sono Belle, Jeju, Korea  
Sep. 2, 2022
- Deep reinforcement learning for optimal mechanism in active Brownian particles**  
2022 NONEQUILIBRIUM STATISTICAL PHYSICS OF COMPLEX SYSTEMS (CONFERENCE, POSTER) KIAS, Seoul, Korea  
Jul. 25, 2022
- Exploring optimal mechanisms in active Brownian particles via deep reinforcement learning**  
APCTP WORKSHOP FOR PHYSICS AND MACHINE LEARNING (INVITED TALK) Jeju, Korea  
Nov. 26, 2021
- Methods of estimating entropy production**  
SEOUL NATIONAL UNIVERSITY STATISTICAL PHYSICS SEMINAR (INVITED TALK) (Online) Korea  
Feb. 1, 2021
- Deep reinforcement learning for feedback-controlled flashing ratchets**  
KOREAN PHYSICAL SOCIETY FALL MEETING (CONFERENCE, ORAL) (Online) Korea  
Nov. 6, 2020
- Discovering wiring patterns of neural networks via backboning**  
NETSCI2020 (CONFERENCE, ORAL) (Online) Rome, Italy  
Sep. 22, 2020
- Neural estimator for entropy production**  
KOREAN PHYSICAL SOCIETY SPRING MEETING (CONFERENCE, ORAL) (Online) Korea  
Jul. 13, 2020
- Quantifying Individual Reputation in Large-scale Historical Documents**  
QUANTIFYING SUCCESS SATELLITE AT NETSCI2019 (CONFERENCE, ORAL) Burlington, Vermont, USA  
May. 27, 2019

## Teaching Experience

- Computational Physics**  
INVITED TALK KAIST, Korea  
Apr. 24 & May. 1, 2023
- Physics and AI Winter School**  
INVITED TALK (Online) Korea  
Feb. 24, 2022
- General Physics II**  
TEACHING ASSISTANT KAIST, Korea  
2016 (Fall), 2017 (Spring)

## References

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### Hawoong Jeong

Professor

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### Meeyoung Cha

Associate Professor

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### Yongjoo Baek

Assistant Professor

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### Junghyo Jo

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