

DONG-KYUM KIM

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| CONTACT INFORMATION | Center for Mathematical and Computational Sciences (Data Science Group) Institute for Basic Science Website : kdkyum.github.io Email : kdkyum531@gmail.com |
| EDUCATION | Korea Advanced Institute of Science and Technology (KAIST) 2016 – 2022 Ph.D. in Physics <ul style="list-style-type: none">• Advisor : Prof. Hawoong Jeong• Dissertation : Nonequilibrium Statistical Physics Study using Deep Learning Seoul National University (SNU) 2011 – 2015 Bachelor of Science (BS) in Physics with a minor in Computer Science & Engineering |
| RESEARCH INTEREST | Artificial Intelligence (AI), Deep Learning, Machine Learning, Interpretable AI, Mechanistic Interpretability, Large Language Models (LLMs), Data Science, AI for Physics, Statistical Physics, Nonequilibrium Physics, Neuroscience, Brain-Inspired AI, Learning & Memory |
| EMPLOYMENT HISTORY | Institute for Basic Science (IBS) Mar. 2022 – Present Senior Researcher <ul style="list-style-type: none">• Hosted by prof. Meeyoung Cha (Chief Investigator).• Data Science Group, Center for Mathematical and Computational Science Samsung Electronics Sep. 2017 – Dec. 2017 Data Science Intern <ul style="list-style-type: none">• 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. |
| PUBLICATIONS | [†] : equal contribution. Jea Kwon, Sunpil Kim, Dong-Kyum Kim , Jinhyeong Joo, SoHyung Kim, Meeyoung Cha, C. Justin Lee. “SUBTLE : An unsupervised platform with temporal link embedding that maps animal behavior”. <i>Under review</i> . bioRxiv:10.1101/2023.04.12.536531 . Gwangsu Kim, Dong-Kyum Kim , and Hawoong Jeong. “Spontaneous emergence of rudimentary music detectors in deep neural networks”. In : Nature Communications 15 , 148 (2024). Dong-Kyum Kim [†] , Jea Kwon [†] , Meeyoung Cha, and C. Justin Lee. “Transformer as a hippocampal memory consolidation model based on NMDAR-inspired nonlinearity”. In : Advances in Neural Information Processing Systems (2023). Sangyun Lee, Dong-Kyum Kim , Jong-Min Park, Won Kyu Kim, Hyunggyu Park, and Jae Sung Lee. “Multidimensional entropic bound : Estimator of entropy production for Langevin dynamics with an arbitrary time-dependent protocol”. In : Physical Review Research 5 , 013194 (2023). Vyacheslav Shen, Dong-Kyum Kim , Elke Zeller, and Meeyoung Cha. “Neural Classification of Terrestrial Biomes”. In : 2023 IEEE International Conference on Big Data and Smart Computing (BigComp) , pp. 163-166, (2023). Youngkyoung Bae, Dong-Kyum Kim , and Hawoong Jeong. “Inferring dissipation maps from videos using convolutional neural networks”. In : Physical Review Research 4 , 033094 (2022). Dong-Kyum Kim [†] , Sangyun Lee [†] , and Hawoong Jeong. “Estimating entropy production with odd-parity state variables via machine learning”. In : Physical Review Research 4 , 023051 (2022). Dong-Kyum Kim and Hawoong Jeong. “Deep reinforcement learning for feedback control in a collective flashing ratchet”. In : Physical Review Research 3 , L022002 (2021). |

Dong-Kyum Kim[†], Youngkyoung Bae[†], Sangyun Lee, and Hawoong Jeong. “Learning Entropy Production via Neural Networks”. In : *Physical Review Letters* **125**, 140604 (2020). [arXiv : 2003.04166 \[cond-mat.stat-mech\]](#).

Dong-Kyum Kim[†], Byunghwee Lee[†], Daniel Kim, and Hawoong Jeong. “Multi-label classification of historical documents by using hierarchical attention networks”. In : *Journal of the Korean Physical Society* **76**, 368 (2020).

AWARDS

- **Pre-doctoral Fellow of Physics at KAIST**

Aug. 30, 2021

PRESENTATIONS

Invited talks and lectures

- Computational Physics Course in KAIST (Daejeon, Korea). May. 1, 2023
“Deep learning applications : Nonequilibrium statistical physics study using AI”
- Computational Physics Course in KAIST (Daejeon, Korea). Apr. 24, 2023
“Deep Learning Introduction”
- IBS Winter School on AI-Boosted Basic Science (Daejeon, Korea). Dec. 13, 2022
“Resemblances between Transformer’s Nonlinearity and NMDA Receptor Dynamics”
- KIAS CAINS Summer Workshop (Jeju, Korea). Sep. 2, 2022
“Working and reference memory in transformers on a navigation task”
- KIAS Nonequilibrium Statistical Physics of Complex Systems (Seoul, Korea). Jul. 25, 2022
“Deep reinforcement learning for optimal mechanism in active Brownian particles”
- SNU Physics and AI Winter School (Seoul, Korea). Feb. 24, 2022
“Exploring Irreversibility via Machine Learning”
- APCTP Workshop for Physics and Machine Learning (Jeju, Korea). Nov. 26, 2021
“Exploring optimal mechanisms in active Brownian particles via deep reinforcement learning”
- Seoul National University Statistical Physics Seminar ((Online) Korea). Feb. 1, 2021
“Methods of estimating entropy production”
- Korean Physical Society Fall Meeting ((Online) Korea). Nov. 6, 2020
“Deep reinforcement learning for feedback-controlled flashing ratchets”
- NetSci2020 ((Online) Rome, Italy). Sep. 22, 2020
“Discovering wiring patterns of neural networks via backboning”
- Korean Physical Society Spring Meeting ((Online) Korea). Jul. 13, 2020
“Neural estimator for entropy production”
- Quantifying Success satellite at NetSci2019 (Burlington, Vermont, USA). May. 27, 2019
“Quantifying Individual Reputation in Large-scale Historical Documents”

IN THE PRESS

Selected list of media coverages

- “Transformer as a hippocampal memory consolidation model based on NMDAR-inspired nonlinearity” (*NeurIPS* 2023)
 - [IBS Research News \(2023/11/28\)](#) ; [Korean version](#).
 - [Donga Science \(2023/11/30\)](#).
 - [YTN Science \(2023/11/30\)](#).
- “Learning Entropy Production via Neural Networks” (*Phys. Rev. Lett.* **125**, 140604, 2020)
 - [Physics and High Technology \(2020/12/17\)](#).

REFERENCES

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