Sangwoong Yoon, Ph.D.

AI Research Fellow
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RESEARCH INTERESTS

- Discovering and understanding new learning principles in the interface between generative modeling and reinforcement learning.
- Building AI agents that can interact with humans and the world safely and reliably.
- Applying AI to real-world problems, including robotics and natural sciences.

EDUCATION

Seoul National University   Mar 2020 - Aug 2023
Ph.D. in Mechanical Engineering
Advisor: Frank Chongwoo Park
Thesis: Energy-Based Probabilistic Models for Epistemic Uncertainty Quantification

Seoul National University   Mar 2014 - Feb 2016
M.S. in Interdisciplinary Program in Neuroscience
Advisor: Byoung-Tak Zhang (Department of Computer Science and Engineering)
Thesis: Adaptive Bayesian Optimization for Organic Material Screening

Hong Kong University of Science and Technology   Aug 2010 - Dec 2010
Exchange Program

Seoul National University   Mar 2008 - Feb 2013
B.S. in Chemical and Biological Engineering
GPA: 3.85 / 4.3 (*cum laude*)

Gyeonggi Science High School   Mar 2006 - Feb 2008
Valedictorian, Top of Graduating Class

EMPLOYMENT

Korea Institute for Advanced Study (KIAS), Seoul, Korea   Sep 2023 - Present
AI Research Fellow, Center for AI and Natural Sciences
- Research on the fundamental connection between generative modeling and reinforcement learning.

Amazon.com, Seattle, WA, USA   Jun 2022 - Sep 2022
Applied scientist intern, Search Science and AI
- Research on incorporating uncertainty information into a large language model to improve click-through rate prediction in advertisement.
- Received "inclined to hire" evaluation.

Kakao Brain, Seoul, Korea   Oct 2019 - May 2020
Research scientist intern, Video Intelligence Team
- Research on scene-graph based image-to-image and text-to-image retrieval.

Saige Research, Seoul, Korea   Mar 2019 - Sep 2019
Researcher

- Develop deep learning-based optical defect inspection solutions for manufacturers.
- Research on deep learning algorithms for supervised and unsupervised anomaly detection.

Haezoom Inc., Seoul, Korea   Jan 2016 - July 2018
Lead of machine learning team
- Led a team of five to develop a solar power forecasting system.
- Develop a data processing pipeline that integrates data from weather stations, satellites, numerical weather forecasters, and solar power plants.
- Develop fault detection system for solar power plants.
- Develop future cloud movement prediction algorithms based on 3D convolutional neural networks.

Research Visits

University College London, London, UK   Jul 2024 - Sep 2024
Department of Electronic and Electrical Engineering
Host: Prof. Ilija Bogunovic
- Research collaboration on reinforcement learning from human feedback for large language models.

Heidelberg University, Heidelberg, Germany   Mar 2023
Institute for Theoretical Physics
Host: Prof. Tilman Plehn
- Application of deep learning-based anomaly detection algorithms to high-energy physics data.

Ohio State University, Columbus, OH, USA   Dec 2022
Department of Psychology
Host: Prof. Jay Myung
- Discussion on improving Bayesian optimization using Generative Gaussian Processes.

Awards

Outstanding Doctoral Dissertation Award   Aug 2023
Department of Mechanical Engineering, Seoul National University

Qualcomm Innovation Fellowship Korea 2021, Qualcomm Korea   Sep 2021
Awarded for our work "Autoencoding Under Normalization Constraints"

Youlchon AI Stars Scholarship 2021, SNU AI Institute   Aug 2021

Best Poster Award & Most Popular Poster Award   Aug 2021
Machine Learning Summer School (MLSS) 2021 Taipei

Best Poster Award, The AI KOREA 2019   Aug 2019
The first place among poster presentations

Cum laude, Seoul National University   Feb 2013

Four-year full tuition scholarship, Korea Student Aid Foundation   2008 - 2012

Gyeonggi Province Governer Award, Geyonggi Science High School   Feb 2008
Awarded as the valedictorian

Publications

Books

1. Frank C. Park, Yonghyeon Lee, Cheongjae Jang, Seongyeon Lee, and **Sangwoong Yoon**. Manifold, Geometry, and Machine Learning (in preparation, expected 2025).

2. Authors: Kevin M. Lynch, Frank C. Park, Translators: Byongho Lee, **Sangwoong Yoon**, Jaewoon Kwon, Younghun Kim, Jongmin Kim, Jungbin Lim, Minjun Sohn, Jin Jung, Sanghyeon Lee, and Woosung Yang. Modern Robotics. Acorn Publishing, 2023 (Translation from English to Korean).

3. Daeil Kwon, Mintaek Kwon, Jungwan Mok, Geunjueong Yu, and **Sangwoong Yoon**. 과학고 공부벌레들 (Bookworms of Science High School). Dasan Books. 2008.

Journals

1. Woobin Yi, Dae Yeon Kim, Howon Jin[†], Sangwoong Yoon[†], and Kyung Hyun Ahn. **Early Detection of Pore Clogging in Microfluidic Systems with 3D Convolutional Neural Network**. *Separation and Purification Technology*. 2024 (in press). link

2. Shalil Khanal, Yuanhang Liu, Adebowale O. Bamidele, Alexander Q. Wixom, Alexander M. Washington, Nidhi Jalan-Sakrikar, Shawna A. Cooper, Ivan Vuckovic, Song Zhang, Jun Zhong, Kenneth L. Johnson, M. Cristine Charlesworth, Iljung Kim, Yubin Yeon, **Sangwoong Yoon**, Yung-Kyun Noh, Chady Meroueh, Abdul Aziz Timbilla, Usman Yaqoob, Jinhang Gao, Yohan Kim, Fabrice Lucien, Robert C. Huebert, Nissim Hay, Michael Simons, Vijay H. Shah, and Enis Kostallari. **Glycolysis in hepatic stellate cells coordinates fibrogenic extracellular vesicle release spatially to amplify liver fibrosis**. *Science Advances*, 2024 (to appear on June 28). IF 13.6, JCR Top 2.342%

3. Howon Jin[*], **Sangwoong Yoon**[*], Frank C. Park, and Kyung Hyun Ahn. **Data-driven constitutive model of complex fluids using recurrent neural networks**. *Rheologica Acta*, 2023. link IF 2.3, JCR Top 42.0%

4. Minwoo Lee[*], **Sangwoong Yoon**[*], Juhan Kim, Yuangang Wang, Keeman Lee, Frank Chongwoo Park, Chae Hoon Sohn. **Classification of Impinging Jet Flames Using Convolutional Neural Network with Transfer Learning**. *Journal of Mechanical Science and Technology*, 2022. link IF 1.6, JCR Top 65.0%

5. Kyu Min Park, Younghyo Park, **Sangwoong Yoon**, and Frank C. Park. **Collision Detection for Robot Manipulators Using Unsupervised Anomaly Detection Algorithms**. *IEEE Transactions on Mechatronics*, 2021. link IF 6.4, JCR Top 6.618%

[†] Co-correspondence
[*] Equal contribution

Peer-Reviewed Conference Papers

1. **Sangwoong Yoon**, Himchan Hwang, Dohyun Kwon, Yung-Kyun Noh, and Frank C. Park. **Maximum Entropy Inverse Reinforcement Learning of Diffusion Models with Energy-Based Models**, *Advances in Neural Information Processing Systems (NeurIPS)*, 2024. Oral Presentation (Acceptance rate: 0.46%) link

2. **Sangwoong Yoon**, Young-Uk Jin, Yung-Kyun Noh, and Frank C. Park. **Energy-Based Models for Anomaly Detection: A Manifold Diffusion Recovery Approach**, *Advances in Neural Information Processing Systems (NeurIPS)*, 2023. link

3. **Sangwoong Yoon**, Frank C. Park, Gunsu S. Yun, Iljung Kim, and Yung-Kyun Noh. **Variational Weighting for Kernel Density Ratios**, *Advances in Neural Information Processing Systems (NeurIPS)*, 2023. link

4. Yonghyeon Lee, **Sangwoong Yoon**, Minjun Son, and Frank C. Park. **Regularized Autoencoders for Isometric Representation Learning**, *Proceedings of International Conference on Learning Representations (ICLR)*, 2022. link

5. **Sangwoong Yoon**, Yung-Kyun Noh, and Frank C. Park. **Autoencoding Under Normalization Constraints**, *Proceedings of the 38th International Conference on Machine Learning (ICML)*, 2021. link

6. **Sangwoong Yoon**, Woo Young Kang, Sungwook Jeon, SeongEun Lee, Changjin Han, Jonghun Park, and Eun-Sol Kim. **Image-to-Image Retrieval by Learning Similarity between Scene Graphs**, *Proceedings of the 35th AAAI Conference on Artificial Intelligence (AAAI)*, 2021. link

7. SooKyung Kim, Hyojin Kim, Joonseok Lee, **Sangwoong Yoon**, Samira E. Kahou, Karthik Kashinath, Mr Prabhat. **Deep Hurricane-Tracker: Tracking and Forecasting Extreme Climate Events**, *IEEE Winter Conference on Applications of Computer Vision (WACV)*, 2019.

Workshop Papers

1. **Sangwoong Yoon***, William Bankes*, Seongho Son*, Anja Petrovic*, Shyam Sundhar Ramesh, Xiaohang Tang, and Ilija Bogunovic. **Group Robust Best-of-K Decoding of Language Models for Pluralistic Alignment**. Neural Information Processing Systems 2024 Pluralistic Alignment Workshop. 2024.

2. **Sangwoong Yoon**, Frank C. Park, and Yung-Kyun Noh. **Kullback-Leibler Divergence Estimation using Variationally Weighted Kernel Density Estimators**, *Neural Information Processing Systems 2019 Information Theory and Machine Learning Workshop*, 2019.

3. **Sangwoong Yoon**, Yonho Song, Minsoo Kim, Frank C. Park and Yung-Kyun Noh. **Interpretable Feature Selection Using Local Information for Credit Assessment**. *Neural Information Processing Systems 2018 Workshop on Challenges and Opportunities for AI in Financial Services*, 2018 (Oral).

4. **Sangwoong Yoon**, Sang-Woo Lee, and Byoung-Tak Zhang, **Predictive Property of Hidden Representations in Recurrent Neural Network Language Models**, *Neural Information Processing Workshop Systems 2014 Workshop on Modern Machine Learning Methods and Natural Language Processing*, 2014.

PATENTS

1. Oh-Hyun Kwon, Jung-Seok Hyung and **Sangwoong Yoon**, **Method, Server, and System for Detecting Abnormality of a Power Plant using Solar Energy**, the Republic of Korea patent, KR101775065B1, applied in Aug 5, 2016, granted in Sep 6, 2017.

2. Oh-Hyun Kwon, Jung-Seok Hyung and **Sangwoong Yoon**, **Method and Server for Forecasting Generation of a Power Plant using Solar Energy**, the Republic of Korea patent, KR101808047B1, applied in Aug 5, 2016, granted in Dec 14, 2017.

INVITED TALKS

International
- **University of Michigan**, Ann Arbor, USA   Oct 2024
  Electrical Engineering and Computer Science (Host: Stella X. Yu)
  Title: Maximum Entropy Inverse Reinforcement Learning of Diffusion Models with Energy-Based Models

- **University College London**, London, UK   Jul 2024
  Department of Electronic and Electrical Engineering (Host: Ilija Bogunovic)
  Title: Maximum Entropy Inverse Reinforcement Learning of Diffusion Models with Energy-Based Models

- **Cambridge University**, Cambridge, UK (virtual)   Feb 2024
  Department of Applied Mathematics and Theoretical Physics (Host: Carola-Bibiane Schönlieb)
  Title: Why autoencoders fail at anomaly detection and what we can do about it

- **Heidelberg University**, Heidelberg, Germany   Mar 2023
  Institute for Theoretical Physics (Host: Tilman Plehn)
  Title: Rethinking autoencoder-based anomaly detection from probabilistic perspective

- **Ohio State University**, Columbus, USA   Dec 2022
  Department of Psychology (Host: Jay Myung)
  Title: Gaussian processes are density estimators

Domestic
- **Saige Research Inc.**   Oct 2024
  Title: Energy-Based Models for Classifying In-and-Out

- **The Korean Institute of Chemical Engineers Fall Meeting**   Oct 2024
  Title: AI in Manufacturing: Will Revolution Come?

- **Innovation Center for Industrial Mathematics, National Institute for Mathematical Sciences**   May 2024
  Title: Diffusion by Dynamic Programming

- **Korean Mathematical Society Spring Meeting 2024** Apr 2024
  Title: Maximum Entropy Inverse Reinforcement Learning of Diffusion Models with Energy-Based Models

- **Korea Research Institute of Chemical Technology** Feb 2024
  Title: Training Diffusion Models with (Inverse) Reinforcement Learning

- **KCMS-Theory Workshop** Dec 2023
  Title: Why autoencoders fail at anomaly detection and what we can do about it

- **College of Agriculture and Life Sciences** Dec 2023
  Seoul National University
  Title: Why autoencoders fail at anomaly detection and what we can do about it

- **High-Energy Physics and AI Workshop, Hanyang University** Dec 2023
  Title: Why autoencoders fail at anomaly detection and what we can do about it

- **Robot Intelligence Lab, Korea University** Nov 2023
  Title: Generative Modeling is Imitation Learning

- **AI and Quantum Information for Particle Physics, KAIST** Nov 2023
  Title: Why autoencoders fail at anomaly detection and what we can do about it

- **IITP Workshop on Video Understanding and Generation using Knowledge-based Deep Logic Neural Networks** Sep 2023
  Title: Energy-Based Models for Classifying In and Out

- **Data Science Career Day, Graduate School of Data Science,** Sep 2023
  Seoul National University
  Title: Lessons from Three Degrees from Three Departments

- **LG AI Research** Feb 2022
  Title: Autoencoding Under Normalization Constraints

GRANTS

- **Developing Reliable Foundation Models with Theoretical Framework and Scalable Personalization** Aug 2024 - Aug 2027
  Ministry of Science and ICT Global Basic Research Laboratory
  PI: Hye Won Chung (KAIST)
  Role: Participating researcher

- **Investigation on Theoretical Connection between Generative Modeling and Reinforcement Learning** Sep 2023 - Aug 2025
  KIAS Basic Research Grant
  PI: Sangwoong Yoon

- **Development of Training and Inference Methods for Goal-Oriented Artificial Intelligence Agents** Apr 2022 - Dec 2026
  IITP Human-Centric AI Core Technology Development
  PI: Frank Chongwoo Park (SNU)
  Role: Lead author of the proposal and main researcher

- **LIDAR-Based Lane Detection**, Seoul Robotics Jun 2022 - Dec 2022
  PI: Frank Chongwoo Park (SNU)
  Role: Lead author of the proposal and main researcher

- **Development of Method for Accelerating Organic Material Search using Machine Learning** Apr 2014 - Apr 2015
  Samsung Advanced Institute of Technology
  PI: Byong-Tak Zhang (SNU)
  Role: Lead author of the proposal and main researcher

TEACHING

- **KIAS-Hanyang AI Summer School**, Hanynag University Oct 2023
  Instructed two lectures: "Introduction to DDPM" and "Diffusion Model Hands-on Tutorial."

- **Introduction to Machine Learning**, Microrheology Laboratory Aug 2020
  Department of Chemical and Biological Engineering, Seoul National University
  Instructed a 20-hour course on machine learning and deep learning, including coding practice sessions.

- **Interpretable Machine Learning Course**, Fast Campus Apr 2019
  One-day lecture on interpretable machine learning

- **Variational Autoencoder Course**, Fast Campus Apr 2018
  Two-day lecture on variational autoencoders

PROFESSIONAL SERVICES

Services for Academic Communities
- Reviewer of NeurIPS, ICML, ICLR, AAAI, AISTATS, and ACML 2019 - Present
- Website admin for Korea-Japan Machine Learning Workshop 2019 Feb 2019
- Co-organizer of KIAS-Hanyang AI Summer School Oct 2023
- Organizer of IITP Joint Workshop between Frank Park's project and Byong-Tak Zhang's project Sep 2023

Services for Developer Communities
- Contributor of Pandas, an open-source Python library: Submitted 5 merged pull requests to Pandas: #17253, #19427, #22380, #26157, #26158
- Staff at PYCON KR 2015 and PYCON APAC 2017

SKILLS

- **Languages**: Korean (native), English (TOEFL: 107/120 (2019.8.4), TEPS 852/990 (2015.8.22))
- **Programming Languages**: Expert in Python, competent in MATLAB, SQL, Bash, JavaScript, and some knowledge of C, C++, Java

REFERENCES

- **Frank Chongwoo Park** (`fcp@snu.ac.kr`)
  Professor, Department of Mechanical Engineering,
  Seoul National University (Ph.D. Advisor)

- **Byoung-Tak Zhang** (`btzhang@snu.ac.kr`)
  Professor, Department of Computer Science and Engineering, Seoul National University (M.S. Advisor)
- **Yung-Kyun Noh** (`nohyung@hanyang.ac.kr`)
  Associate Professor, Department of Computer Science, Hanyang University
- **Eun-Sol Kim** (`eunsolkim@hanyang.ac.kr`)
  Assistant Professor, Department of Computer Science, Hanyang University
- **Hyokun Yun** (`yunhyoku@amazon.com`)
  Principal Applied Scientist, Amazon.com (Internship Manager)