
Research Interests

Artificial intelligence for inverse design · Artificial intelligence for manufacturing · Data-driven optimization · Large Language Models

Education & Experience

Postdoctoral Fellow

Feb. 2026 – Present

PRISM-AI Center (InnoCORE) & AiM⁴ Lab, Korea Advanced Institute of Science and Technology (KAIST), S. Korea

Advisor: Prof. Seunghwa Ryu

Ph.D. in Mechanical Engineering

Sep. 2022 – Feb. 2026

KAIST, S. Korea

Advisor: Prof. Seunghwa Ryu

Research Assistant

Mar. 2022 – Aug. 2022

KAIST, S. Korea

Advisor: Prof. Seunghwa Ryu

M.S. in Mechanical Engineering

Mar. 2020 – Feb. 2022

KAIST, S. Korea

Advisor: Prof. Seunghwa Ryu

B.Eng. in Convergence Engineering, *Summa Cum Laude*

Mar. 2015 – Feb. 2019

Daegu Gyeongbuk Institute of Science and Technology (DGIST), S. Korea

Publications

⁺Equal contribution ^{*}Corresponding author

16. Demeke, W.⁺, **Lee, J.**⁺, Lee, I.⁺, Ryu, B.^{*}, & Ryu, S.^{*} (2027). “A Comprehensive Review of Thermoelectric Power Generators: Advances in Material Discovery, Structural Optimization for Performance Enhancement, and Service Life Stability.” **Renewable and Sustainable Energy Reviews**, 244, 117459 (2027). [IF: 18.0, JCR Top 3.1%] [10.1016/j.rser.2026.117459](https://doi.org/10.1016/j.rser.2026.117459)
15. Yu, J.⁺, Byun, J.⁺, Moon, H., **Lee, J.**, & Ryu, S.^{*} (2026). “Dual-Constrained Diffusion Model for Nonlinear Microstructure Inverse Design with Direct Evaluation.” **Computer Methods in Applied Mechanics and Engineering**, 461, 119267 (2026). [IF: 7.6, JCR Top 2.2%] [\[Paper\]](#) [\[engrXiv\]](#)
14. Cho, H., Yu, J., Moon, H., Yoon, J., **Lee, J.**, Park, J., & Ryu, S.^{*} (2026). “Real-Time Structural Health Monitoring with Bayesian Neural Networks: Distinguishing Aleatoric and Epistemic Uncertainty for Digital Twin Frameworks.” **International Journal of Precision Engineering and Manufacturing – Green Technology**, 13, 2555–2569 (2026). [IF: 6.6, JCR Top 9.2%] [10.1007/s40684-026-00913-6](https://doi.org/10.1007/s40684-026-00913-6) [\[SSRN\]](#)
13. Lee, S., **Lee, J.**, Park, D., Lee, S., Cho, J., Lee, K.^{*}, Kim, H.^{*}, & Ryu, S.^{*} (2026). “Reassessing Negative 24 h pH Impedance Tests for Hidden Gastroesophageal Reflux Disease Using Multi Feature Anomaly Detection.” **npj Digital Medicine**, 9(1), 643 (2026). [IF: 18.0, JCR Top 0.3%] [10.1038/s41746-026-02796-y](https://doi.org/10.1038/s41746-026-02796-y)
12. Kim, J.-Y.⁺, Lee, S.⁺, Yu, J., **Lee, J.**, & Ryu, S.^{*} (2026). “Federated Learning for Privacy-Preserving Quality Prediction in the Globalized Plastic Injection Molding Industry.” **Internationa-**

tional Journal of Precision Engineering and Manufacturing, In press. [IF: 3.9, JCR Top 23.9%] [10.1007/s12541-026-01546-0](https://doi.org/10.1007/s12541-026-01546-0)

11. **Lee, J.⁺**, Kim, J.-Y.⁺, Kim, H.⁺, Lee, I., & Ryu, S.* (2025). “IM-Chat: A Multi-agent LLM Framework Integrating Tool-Calling and Diffusion Modeling for Knowledge Transfer in Injection Molding Industry.” **Journal of Manufacturing Systems**, 83, 839–855 (2025). (IF: 14.2, JCR Top 0.7%) [10.1016/j.jmsy.2025.11.007](https://doi.org/10.1016/j.jmsy.2025.11.007)
10. Lee, H.⁺, Moon, H.⁺, **Lee, J.⁺**, & Ryu, S.* (2025). “Toward Knowledge-Guided AI for Inverse Design in Manufacturing: A Perspective on Domain, Physics, and Human-AI Synergy.” **Advanced Intelligent Discovery**, e202500107. [10.1002/aidi.202500107](https://doi.org/10.1002/aidi.202500107)
9. Kang, H.⁺, **Lee, J.⁺**, Lee, S., Jeon, J., Mun, C., Yang, J.-Y., Seo, D., Kwon, H.-J., Lee, I.-C., Kim, S., Lim, E.-K., Jung, J., Jung, Y.*, Park, S.*, Ryu, S.*, & Kang, T.* (2025). “Interpretability-Driven Deep Learning for SERS-based Classification of Respiratory Viruses.” **Biosensors and Bioelectronics**, 289, 117891 (IF: 10.5, JCR Top 3.2%). [10.1016/j.bios.2025.117891](https://doi.org/10.1016/j.bios.2025.117891)
8. Yoon, J.⁺, **Lee, J.⁺**, Ryu, S.*, & Park, J.* (2025). “Enhanced Energy Harvesting in Rotational Triboelectric Nanogenerator via Gaussian Process Regression-Based Bayesian Optimization.” **Nano Energy**, 135, 110653 (IF: 17.1, JCR Top 7.8%). [10.1016/j.nanoen.2025.110653](https://doi.org/10.1016/j.nanoen.2025.110653)
7. Moon, H., **Lee, J.**, Yu, J., & Ryu, S.* (2025). “Physics-Informed Machine Learning for Material Characterization: A Perspective on Data-Efficient Discovery through Physics-Informed Neural Networks.” **International Journal of AI for Materials and Design**, 2(4). [10.36922/IJAMD025440043](https://doi.org/10.36922/IJAMD025440043)
6. **Lee, J.**, Park, K., Park, K., Kim, Y., Kim, J.*, & Ryu, S.* (2024). “Electrode Placement Optimization for Electrical Impedance Tomography using Active Learning.” **Advanced Engineering Materials**, 26(11), 2301865. [10.1002/adem.202301865](https://doi.org/10.1002/adem.202301865)
5. Kang, H.⁺, **Lee, J.⁺**, Moon, J.⁺, Lee, T.⁺, Lim, E., Jung, J., Jung, Y., Lee, S., Lee, K.*, Ryu, S.*, & Kang, T.* (2024). “Multiplex Detection of Foodborne Pathogens using 3D Nanostructure Swab and Deep Learning-Based Classification of Raman Spectra.” **Small**, 20(35), 2308317 (IF: 13.0, JCR Top 10.6%). (front cover) [10.1002/smll.202308317](https://doi.org/10.1002/smll.202308317)
4. **Lee, J.**, Park, D., Lee, M., Lee, H., Park, K., Lee, I., & Ryu, S.* (2023). “Machine learning-based inverse design methods considering data characteristics and design space size in materials design and manufacturing: a review.” **Materials Horizons**, 10, 5436–5456 (IF: 13.3, JCR Top 9.8%). [10.1039/D3MH00039G](https://doi.org/10.1039/D3MH00039G)
3. Yoon, J.⁺, **Lee, J.⁺**, Kim, G., Ryu, S.*, & Park, J.* (2022). “Deep neural network-based structural health monitoring technique for real-time crack detection and localization using strain gauge sensors.” **Scientific Reports**, 12(1), 20204. [10.1038/s41598-022-24269-4](https://doi.org/10.1038/s41598-022-24269-4)
2. Park, K., **Lee, J.**, & Ryu, S.* (2021). “Damage detection of composite materials via IR thermography and electrical resistance measurement: A review.” **Structural Engineering and Mechanics**, 80(5), 563–583. [10.12989/sem.2021.80.5.563](https://doi.org/10.12989/sem.2021.80.5.563)
1. Lim, S. H.⁺, Sohn, S. W.⁺, Lee, H., Choi, D., Jang, E., Kim, M., **Lee, J.**, & Park, S.* (2020). “Analysis and evaluation of path planning algorithms for autonomous driving of electromagnetically actuated microrobot.” **International Journal of Control, Automation and Systems**, 18(11), 2943–2954. [10.1007/s12555-019-0637-9](https://doi.org/10.1007/s12555-019-0637-9)

Submitted

6. Kim, H.⁺, **Lee, J.⁺**, Lee, J., Jang, H., Kim, S., Lim, E.-K., Jung, J., Ryu, S.*, & Kang, T.* “Automated and Transferable Colorimetric CRISPR Diagnostics via Deep Learning.” Submitted.
5. Choi, J.⁺, **Lee, J.⁺**, & Ryu, S.* “A Multi-Agent Framework for Automated Coarse-Grained Molecular Dynamics of Polymers.” Submitted. [[arXiv](#)]
4. Park, J.⁺, Lee, I.⁺, **Lee, J.**, & Ryu, S.* “Predicting Space Groups of Double Perovskites by LLM with Dynamic Few-Shot Learning.” Submitted. [[arXiv](#)]

3. Lee, J., Kim, J.-Y., & Ryu, S.* “Before You Build a Multi-Agent System: An Escalation Framework for LLM Adaptation.” Submitted. [engrXiv]
2. Choi, Y., Ok, S., Lee, J., Ryu, S.*, & Choo, J.* “An agentic-AI calibrate–diagnose–suggest workflow for soil constitutive model calibration.” Submitted.
1. Lee, I.⁺, Lee, J.⁺, Park, J., Lim, K.* & Ryu, S.* “Enhancing LLM-based Conditional Material Generation for Double Perovskite through Multi-Agent Feedback and Domain Knowledge.” Submitted. [arXiv:2511.22307]

Patents

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2. Kim, J., Lee, J., Kim, H., Lee, I., Ryu, S., Nam, K., & Yoon, S. (2025). “Knowledge Transfer Device and Method using an Agent Based on a Large Language Model.” Filed (KR 10-2025-0145843).
 1. Ryu, S., Lee, J., & Park, K. (2023). “Method and Apparatus for Optimization of Cathode Material Design Multi-objective Bayesian Optimization.” Filed (KR 10-2023-0172701).

Conferences

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13. Lee, J.⁺, Kim, J.-Y., Kim, H., Lee, I., & Ryu, S. (2026). “A Multi Agentic LLM-Based Expert System for Injection Molding Process.” **WCCM-ECCOMAS 2026**, Munich, Germany (Oral).
 12. Lee, J., Kim, J., Kim, H., Lee, I., Choi, H., & Ryu, S.* (2026). “LLM-based Knowledge Transfer System for Injection Molding: Implementation and Performance Enhancement.” **KSME CAE & Applied Mechanics Conference** (Oral).
 11. Lee, J.⁺, Kim, J.⁺, Kim, H.⁺, Lee, I., Park, J., & Ryu, S.* (2025). “Enhancing Knowledge Transfer in Injection Molding Through a Multi-Agent LLM Framework.” **KSME CAE & Applied Mechanics Conference** (Oral).
 10. Lee, I., Lee, J., & Ryu, S.* (2025). “Multi-Agent Argumentative LLM Framework for Conditional Exploration of Double-Perovskite Materials.” **Spring Conference of the Korean Institute of Metals and Materials** (Oral).
 9. Kang, H.⁺, Lee, J.⁺, Moon, J.⁺, Lee, T.⁺, Lim, E., Jung, J., Jung, Y., Lee, S., Lee, K.*, Ryu, S.*, & Kang, T.* (2024). “3D Nanostructure Swab and Deep Learning Analysis of Raman Spectra for Detection of Multiple Foodborne Pathogens.” **KSME Conference** (Oral).
 8. Kang, H.⁺, Lee, J.⁺, Moon, J.⁺, Lee, T.⁺, Lim, E., Jung, J., Jung, Y., Lee, S., Lee, K.*, Ryu, S.*, & Kang, T.* (2024). “Detection of Multiple Foodborne Pathogens Utilizing a Three-dimensional Nanostructure Swab and Deep Learning-based Analysis of Raman Spectra.” **Nano Korea** (Oral).
 7. Lee, J.⁺, Park, D., Lee, M., Park, K., Lee, H., Lee, I., Lee, I., & Ryu, S.* (2024). “Review of Machine Learning-based Inverse Design Methods in Materials Design and Manufacturing.” **KSME CAE & Applied Mechanics Conference** (Poster).
 6. Lee, J.⁺, Yoon, J.⁺, Kim, G., Park, J.*, & Ryu, S.* (2023). “Real-time Crack Localization using Strain Gauge Sensors with Deep Learning.” **KSME CAE & Applied Mechanics Conference** (Oral).
 5. Lee, J.⁺, Yoon, J.⁺, Kim, G., Park, J.*, & Ryu, S.* (2023). “A Deep Learning Approach for Crack Sensing in Structural Health Monitoring using Strain Gauge Sensors.” **COSEIK** (Oral).
 4. Lee, J., & Ryu, S.* (2022). “Deep Learning-based Electrode Placement Optimization for Crack Sensing of Carbon-based Composites using Electrode Resistance Tomography.” **GRC Additive Manufacturing of Soft Materials** (Poster).

3. **Lee, J.**, Lee, H., & Ryu, S.* (2022). “Electrode Placement Optimization for Electrical Resistance Tomography using Transfer Learning.” **KSME CAE & Applied Mechanics Conference** (Oral).
2. **Lee, J.**, & Ryu, S.* (2021). “Data-Driven Electrode Placement Optimization for Crack Sensing of Carbon-based Composites using Electrical Resistance Tomography.” **KSME CAE & Applied Mechanics Conference** (Oral).
1. Choi, D., Jang, E., Kim, M., **Lee, J.**, Lim, S., Sohn, S., Lee, H., & Park, S.* (2018). “Analysis of Path Planning Algorithm for Autonomous Control of Electromagnetically Actuated Microrobot.” **SMIT2018-IBEC2018 Joint Conference** (Poster).

Honors & Awards

Excellent Dissertation Award, KSME Headquarters	2026
Outstanding Paper Award, KSME CAE & Applied Mechanics Division	2026
Woo-Deok Future Scholar, Woo-Deok Foundation	2025
Outstanding Paper Award, KSME CAE & Applied Mechanics Division	2025
DGIST Presidential Fellowship	2016–2019
• Placed on the Dean’s list. • \$10K expenses for Undergraduate Group Research Program • \$20K financial support for overseas lab experience	
Dean’s List, DGIST	2015
• Included in the top 5 excellent students ranking in each semester • \$2.5K financial support for undergraduate study	

Projects

InnoCORE Project, MSIT Korea	2025–Present
• National flagship program (~\$25M USD over 4.5 years) to advance AI-driven manufacturing across KAIST, GIST, DGIST, and UNIST. • Led proposal development and conceptual design of an LLM-based autonomous manufacturing framework. • Developing LLM-driven methods for materials design, structural optimization, and process parameter tuning.	
Advanced GPU Utilization Support Program, NIPA	2026
• Competitively selected for NIPA’s Advanced GPU program under AiM⁴ Lab, KAIST. • Research on Continual Pre-training for building design & manufacturing domain-specialized foundation models. • Allocated NVIDIA B200 × 7 servers (56 GPUs) for 2 months. • Led proposal writing for the project.	
Large Action Model-Based Digital Twin Autonomous Operation, KETI	2026–Present
• Commissioned research (~₩120M/year) sub-contracted to AiM⁴ Lab, KAIST. • Developing LAM-based digital twin technology for autonomous operation and active problem solving in intelligent manufacturing. • Led proposal writing for the commissioned research scope.	
National Agenda Basic Research Program, MSIT Korea	2025–Present
• Three-year project (~\$150K USD/year) developing domain-specialized LLMs for advanced manufacturing productivity.	

- Contributing to core LLM frameworks enabling intelligent, domain-aware automation in smart manufacturing.

Teaching & Leadership

AiM⁴ Lab Student Representative, KAIST 2024

- Coordinated research activities, organized internal seminars, managed lab resources

Teaching Assistant, KAIST 2022–2025

- ME567: Introduction to Statistical Thermodynamics (2022)
- ME231: Solid Mechanics (2023, 2025)
- ME639: Elasticity & Micromechanics (2023)
- ME211: Thermodynamics (2024)
- ME491B: Statistical Data Analysis (2024)
- ME221: Fluid Mechanics (2024, 2025)

Teaching Assistant, DGIST 2019

- SE201b: Linear Algebra (2019)

Skills

Simulation / Coding: COMSOL Multiphysics, ABAQUS, Fe-safe, HyperMesh, ADINA, EIDORS, MATLAB, Python

Data-Driven Design: Generative modeling, surrogate modeling & optimization, Bayesian optimization

Large Language Model: Multi-agent orchestration, RAG (retrieval-augmented generation), tool-calling

Languages: Korean (native), English (advanced)

References

Prof. Seunghwa Ryu Department of Mechanical Engineering, KAIST ryush@kaist.ac.kr

Prof. Ikjin Lee Department of Mechanical Engineering, KAIST ikjin.lee@kaist.ac.kr

Prof. Jinhyoung Park School of Mechatronics Engineering, Korea University of Technology and Education jhpark98@koreatech.ac.kr