Junhyeong Lee

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Korea Advanced Institute of Science and Technology (KAIST)
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Research Interest

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

Education

Korea Advanced Institute of Science and Technology (KAIST), S. Korea
Ph.D. Candidate in Mechanical Engineering, (Sep. '22 – Present)
Advisor: Prof. Seunghwa Ryu

Korea Advanced Institute of Science and Technology (KAIST), S. Korea
Research Assistance in Mechanical Engineering, (Mar. '22 – Aug. '22)
Advisor: Prof. Seunghwa Ryu

Korea Advanced Institute of Science and Technology (KAIST), S. Korea
M.S. Candidate in Mechanical Engineering, (Mar. '20 – Feb. '22)
Advisor: Prof. Seunghwa Ryu

Daegu Gyeongbuk Institute of Science and Technology (DGIST), S. Korea
B. Eng. Convergence Engineering, *Summa Cum Laude* (Mar.'15 –Feb.'19)

Publications

Peer-reviewed Journals ($^{+}$ Equal contribution, * Corresponding author)

10 **Lee, J.**$^{+}$, Kim, J.$^{+}$, Kim, H.$^{+}$, Lee, I., & Ryu, S.* (2025). "*IM-Chat: A Multi-agent LLM-based Framework for Knowledge Transfer in Injection Molding Industry*." **Journal of Manufacturing Systems**, 83, 839 (IF: 14.2, JCR: Top 0.7% based on JIF 2024).

9 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 (New journal, IF pending).

8 Kang, H.$^{+}$, **Lee, J.**$^{+}$, Lee, S., Jeon, J., Mun, C., Yang, J., Kwon, H., Lee, I., Kim, S., Lim, E., 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**, 117891 (IF: 10.5, JCR: Top 3.2% based on JIF 2024).

7 Yoon, J. $^{+}$, **Lee, J.**$^{+}$, Ryu, S.*, & Park, J.* (2025). "*Enhanced Energy Harvesting in Rotary Triboelectric Nanogenerators via Gaussian Process Regression-Based Bayesian Optimization*", **Nano Energy**, 135, 110653 (IF: 17.1, JCR: Top 7.8% based on JIF 2024).

6 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 Raman spectra*", **Small**, 20(35), 2308317 (IF: 13.0, JCR: Top 10.6% based on JIF 2023). (front cover)

5 **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 (IF: 3.4, JCR: Top 42.7% based on JIF 2023).

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% based on JIF 2022).

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 (IF: 4.997, JCR: Top 25% based on JIF 2021).

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 (IF: 3.524, JCR: Top 25.91% based on JIF 2020).

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, 2943-2954 (IF: 2.733, JCR: Top 48.41% based on JIF 2019).

Under Review / In Preparation

6 Moon, H., **Lee, J.**, Yu, J., & Ryu, S.* "*Physics-Informed AI for Material Characterization: A Perspective on Data-Efficient Discovery through Physics-Informed Neural Network*", International Journal of AI for Materials and Design, Submitted.

5 Cho, H., Yu, J., Moon, H., Yoon, J., **Lee, J**., Kim, G., Park, J., & Ryu, S.* "*Real-Time Structural Health Monitoring with Bayesian Neural Networks: Distinguishing Aleatoric and Epistemic Uncertainty for Digital Twin Frameworks*", Submitted.

4 Lee, S., **Lee, J.**, Park, D., Lee, S., Lee, K.*, Kim, H.*, & Ryu, S.* "*Reducing False Negatives in Gastroesophageal Reflux Disease Diagnosis Through Multi-Feature Anomaly Detection of pH-Impedance Signals*", Submitted.

3 Kim, J.+, Kee, S.+, Yu, J., **Lee, J.**, & Ryu, S.* "*Federated Learning Framework for Data-Sovereign Quality Prediction in Injection Molding*", Submitted.

2 Demeke, W.+, **Lee, J.**+, Lee, I.+, Ryu, B.*, & Ryu, S.* "*A Comprehensive Review of Thermoelectric Power Generators: Advances in Material Discovery, Structural Optimization for Performance Enhancement, and Service Life Stability*"**,** Submitted.

1 Lee, I.+, **Lee, J**.+, Park, J., Lim, K.*, & Ryu, S* "*Enhanced Conditional Generation of Double Perovskite by Knowledge-Guided Language Model Feedback*", In preparation (Arxiv:2511.22307).

Patents

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

11 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 Presentation).

10 **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 Presentation).

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 Presentation).

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 Presentation).

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 Presentation).

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 Presentation).

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**, 2022 (Oral Presentation).

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 Presentation).

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

Outstanding Paper Award, CAE and Applied Mechanics Division, Korean Society of Mechanical Engineering (KSME) / 2025

DGIST Presidential Fellowship, DGIST / 2016 – 2019

Dean's List, DGIST / 2015

Working Projects

InnoCORE Project, Ministry of Science and ICT (MSIT), Korea / 2025 – Present

- National flagship program (~$25 M USD over 4.5 years) to advance AI-driven manufacturing and foster postdoctoral researchers across Korea's four Institutes of Science and Technology (KAIST, GIST, DGIST, UNIST).
- Led the proposal development and conceptual design of an LLM-based autonomous manufacturing framework integrating materials, structure, and processing, under the leadership of my advisor's lab, which serves as the lead institution of the project.
- Developing LLM-driven methods for materials design, structural optimization, and process parameter tuning.

National Agenda Basic Research Program, MSIT, Korea / 2025 – Present

- Three-year national research project (~$150 K USD per year) focused on developing domain-specialized LLMs to enhance productivity in advanced manufacturing.
- Contributing to the development of core LLM frameworks and application technologies enabling intelligent, domain-aware automation in smart manufacturing workflows.

Teaching Experience & Leadership

AiM^4 Lab Student Representative, KAIST / 2024

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

Teaching Assistant, KAIST / 2022 – 2025

- ME567: Introduction to statistical thermodynamics (2022)
- ME231: Solid Mechanics (2023)
- ME639: Introduction to Elasticity and Micromechanics (2023)
- ME211: Thermodynamics (2024)
- ME491B: Introduction to statistical data analysis (2024)
- ME221: Fluid Mechanics (2024)
- ME231: Solid Mechanics (2025)
- ME221: Fluid Mechanics (2025)

Teaching Assistant, DGIST / 2019

- SE201b: Linear Algebra (2019)

Skills

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

Data-Driven Design: Generative modeling, Surrogate modeling & optimization algorithm, Bayesian optimization, etc.

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

Languages: Korean (native), English (advanced)

References

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Prof. Jinhyoung Park
School of Mechatronics Engineering, Korea University of Technology and Education
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