GEUNHYEONG LEE

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ACADEMIC EXPERIENCE

Scientist (Staff)
Dec 2023 – Present
Michigan, US

Facility for Rare Isotope Beams (FRIB) | Michigan State University (MSU)
High Power Targetry Department

- Achieved 72% improvement in beam dump power handling through hybrid GA–Reinforcement Learning optimization framework.
- Developed CNN-MLP surrogate model for real-time thermal limit prediction of rotating beam dumps.
- Performed multi-physics thermal-fluid-electromagnetic simulation and validation for high-power targetry devices.

Postdoc
Aug 2021 – Dec 2023
Daejeon, Korea

Korea Atomic Energy Research Institute (KAERI)
Applied Artificial Intelligence Lab

- Achieved 14.8% heat exchanger performance improvement via deep RL topology optimization; validated through metal 3D printing and thermal-fluid loop experiments.
- Designed flow channels for Samsung OLED susceptors using RL-based optimization models.
- Designed a novel 3D-printable single-body DC electromagnetic pump with 52% reduction in required input current.
- Applied AI anomaly detection to the RAON accelerator for operational stability.

EDUCATION

Ph.D. & M.S.
Mar 2016 – Aug 2021
Ulsan, Korea

Ulsan National Institute of Science and Technology (UNIST)
Nuclear Engineering (Advisor: HeeReyoung Kim)
Thesis: Optimization of Lithium Charge Stripper through MHD Circulator Development

B.S.
Mar 2010 – Feb 2016
Ulsan, Korea

Ulsan National Institute of Science and Technology (UNIST)
Nuclear Engineering & Mechanical Engineering (Dual Major)

RESEARCH INTERESTS

AI-Driven Design Optimization, Deep Reinforcement Learning, Surrogate Modeling, Heat Exchangers, Thermal Management, Electromagnetic Pumps, Additive Manufacturing, Small Modular Reactors

SCIE JOURNAL PUBLICATIONS

Total 14, First Author†: 13, Corresponding Author: 5*

1. (Accepted) Lee, G†*., Song. J., Quispe-Adad, R., Patil, M., & Kanemura, T. Optimization of the FRIB Beam Dump: A Hybrid Genetic Algorithm and Reinforcement Learning Approach, Nuclear Science and Techniques. (IF: 3.8, JCR Top 3.7% in Nuclear Science & Technology)

2. (2026) Lee, G†*. Conceptual Design of a 3D-Printable DC Electromagnetic Pump for Additive Manufacturing, Nuclear Engineering and Technology, 58(1),103916. https://doi.org/10.1016/j.net.2025.103916

3. (2025) Kim, D[1]., Kim, H., Kwon, H., Yu, Y., & Lee, G*. Deep learning-based anomaly detection in drift tube quadrupole operation for the KOMAC linac, Journal of Nuclear Science and Technology, 62(8), 709-714. https://doi.org/10.1080/00223131.2025.2464742

4. (2024) Lee, G†*., Joo, Y., Lee, S.U., Kim, T., Yu, Y., & Kim, H.G. Design optimization of heat exchanger using deep reinforcement learning. International Communications in Heat and Mass Transfer, 159, 107991. https://doi.org/10.1016/j.icheatmasstransfer.2024.107991 (IF: 6.4, JCR Top 5.1% in Mechanics)

5. (2023) Lee, G†*., Joo, Y†., Yu, Y., & Kim, H.G. Dual-fluid Topology Optimization of Printed-circuit Heat Exchanger with Low-pumping-power Design. Case Studies in Thermal Engineering, 49, 103318. https://doi.org/10.1016/j.csite.2023.103318 (IF: 6.4, JCR Top 5.8% in Thermodynamics)

6. (2023) Kang, T†., Lee, G†., & Kim, H.R*. Experimental characterization of the flowline of a lithium film formed using an electromagnetic thruster for a RAON prototype charge stripper. Nuclear Engineering and Design, 412, 112481. https://doi.org/10.1016/j.nucengdes.2023.112481

7. (2021) Lee, G†., & Kim, H.R*. Numerical study of Faraday-type nitrogen plasma magnetohydrodynamic generator. Journal of the Korean Physical Society, 78(7), 600-606. https://doi.org/10.1007/s40042-021-00116-z

8. (2020) Lee, G†., & Kim, H.R*. The variable analysis of an MHD generator with electrical output of 10 kW for application to bi-plant method electricity generation. International Journal of Energy Research, 44(10), 8125-8132. https://doi.org/10.1002/er.5100 (IF: 5.2, JCR Top 1.5% in Nuclear Science & Technology)

9. (2019) Lee, G†., & Kim, H.R*. Mathematical approach for optimization of magnetohydrodynamic circulation system. Nuclear Engineering and Technology, 51(3), 654-664. https://doi.org/10.1016/j.net.2018.12.008

10. (2018) Lee, G†., & Kim, H.R*. Magnetohydrodynamics approach for active decay heat removal system in future generation IV reactor. International Journal of Energy Research, 42(10), 3266-3278. https://doi.org/10.1002/er.4080 (IF: 3.3, JCR Top 1.5% in Nuclear Science & Technology)

11. (2018) Lee, G†., & Kim, H.R*. Numerical analysis of the electromagnetic force for design optimization of a rectangular direct current electromagnetic pump. Nuclear Engineering and Technology, 50(6), 869-876. https://doi.org/10.1016/j.net.2018.04.010

12. (2018) Lee, G†., & Kim, H.R*. Magnetic-field analysis of an MHD channel in a liquid-metal circulation system of a prototype GenIV sodium fast reactor. Annals of Nuclear Energy, 115, 343-351. https://doi.org/10.1016/j.anucene.2018.01.049

13. (2017) Lee, G†., & Kim, H.R*. Design analysis of DC electromagnetic pump for liquid sodium–CO2 reaction experimental characterization. Annals of Nuclear Energy, 109, 490-497. https://doi.org/10.1016/j.anucene.2017.05.054

14. (2017) Lee, G†., & Kim, H.R*. Numerical investigation and comparison of the rectangular, cylindrical, and helical-type DC electromagnetic pumps. Magnetohydrodynamics, 53(2), 429-438. https://doi.org/10.22364/mhd.53.2.23

15. (In preparation) Lee, G†*., & Kanemura, T. CNN-MLP Surrogate Modeling for Real-Time Thermal Limit Prediction of Rotating Beam Dumps.

PATENTS

1. (2021) Kim, H.R., Kang. T & Lee, G. Thermal storage heat exchanger using liquid metal. Republic of Korea – Registration No. 10-2237876 / Application No. 10-2019-0171058
2. (2019) Kim, H.R., & Lee, G. Conductive material transfer device. Republic of Korea – Registration No. 10-1971612 / Application No. 10-2017-0075794
3. (2019) Kim, H.R., & Lee, G. Conductive material transfer device. Republic of Korea – Registration No. 10-2017117 / Application No. 10-2017-0063580
4. (2018) Kim, H.R., & Lee, G. Conductive material transfer device. Republic of Korea – Registration No. 10-1860895 / Application No. 10-2017-0025724
5. (2018) Kim, H.R., & Lee, G. Conductive material transfer device. Republic of Korea – Registration No. 10-1860898 / Application No. 10-2017-0015538
6. (2018) Kim, H.R., & Lee, G. Electromagnetic pump. Republic of Korea – Registration No. 10-1908115 / Application No. 10-2016-0177052

JOURNAL & CONFERENCE PROCEEDINGS

Peer-review journal: 1, Conference: 33

1. (2025) Lee, G†*., Kim, T., Kim, Y., & Kim, G. Design and Analysis of an OLED Display Susceptor System Using Reinforcement Learning, Journal of Korean Applied Artificial Intelligence, 1(2), 1-6, https://doi.org/10.23343/JAAI.2025.1.2.1.
2. (2025) Lee, G†*., Song, J., Patil, M., Quispe-Abad, R., Bultman, N., & Kanemura, T. Design Improvements of a Minichannel Beam Dump Wing through AI-Driven Genetic Algorithms, 16th International Conference on Heavy Ion Accelerator Technology.
3. (2025) Lee, G†*., Song, J., Patil, M., Quispe-Abad, R., Bultman, N., & Kanemura, T. Design Optimization of the FRIB Beam Dump through Reinforcement Learning with Genetic Algorithm, 2025 American Nuclear Society Annual Conference.
4. (2025) Wei, J.[1]*., Alleman, C., Ao, H., Arend, B., Barofsky, D., Beher, S., Berryman, J.S., Bollen, G., Brandon, J., Bultman, N., Casagrande, F., Chang, W., Cheng, H., Choi, Y., Cogan, S., Cole, P., Compton, C., Cortesi, M., Curtin, J., Davidson, K., Di Carlo, S., Dombos, A., Du, X., Elliott, K., Ewert, B., Facco, A., Ferrell, F., Fila, A., Fukushima, K., Gade, A., Ganni, V., Ganshyn, A., Ginter, T., Glasmacher, T., Gonzalez, A., Guo, J., Gutierrez, E., Hao, Y., Hartung, W., Hasan, N., Hausmann, M., Holland, K., Hseuh, H.C., Ikegami, M., Iwai, R., Jager, D., Jones, S., Joseph, N., Kahl, D., Kanemura, T., Kim, J., Kim, S.H., Knowles, C., Konomi, T., Kortum, B., Kulkarni, N., Kwan, E., Lange, T., Larmann, M., Larter, T., Laturkar, K., LaVere, M., Laxdal, R.E., Lee, G., LeTourneau, J., Li, Z.-Y., Lidia, S., Machicoane, G., Manwiller, P., Marti, F., Maruta, T., McNanney, D., Metzgar, E., Miller, S., Momozaki, Y., Morton, A.C., Mugerian, M., Morris, D., Nariyoshi, P., Nesterenko, I., Newhart, D., Nguyen, C., Noji, S., Ostroumov, P., Patil, M., Plastun, A., Popielarski, L., Portillo, M., Powers, A., Priller, J., Rao, X., Reaume, M., Rodriguez, S., Rogers, S., Saito, K., Sherrill, B.M., Smith, M.K., Song, J., Steiner, M., Stolz, A., Tarasov, O., Timko, G., Tousignant, B., Wakai, E., Walker, R., Wan, J., Wang, L., Wang, X., Wenstrom, J., West, G., Wright, M., Xu, T., Yeck, M., Zegers, R.G.T., Zhang, D., Zhang, T., Zhao, Q., & Zhao, S. FRIB OPERATIONS: FIRST THREE YEARS, 16th International Conference on Heavy Ion Accelerator Technology.
5. (2025) Song, J., Bultman, N., Cole, D., Jockheck, N., Kanemura, T., Larmann, M., Lee, D., Lee, G., Miller, S., Patil, M., Portillo, M., Quispe-Abad, R., Reaume, M., Simon, J., Steiner, M., & Wei, J. A SINGLE-SLICE ROTATING GRAPHITE TARGET AT FRIB, 16th International Conference on Heavy Ion Accelerator Technology.
6. (2025) Kanemura, T[1]*., Abdelmegied, B., Bultman, N., Fletcher, E., Ginter, T., Iwai, R., Jockheck, N., LaVere, M., Lee, G., Marti, F., Maruta, T., Miller, S., Momozaki, Y., Ostroumov, P., Patil M., Plastun, A., Quispe-Abad, R., Reaume, M., Simon, D., Song, J., Wakai, E., Wang, X., Wei, J., & Zhao, Q. HIGH POWER TARGETRY DEVICES AT FRIB: CHALLENGES, STATUS AND PLAN, 16th International Conference on Heavy Ion Accelerator Technology.
7. (2023) Lee, G., Yu, Y., Kim, H.G., & Kim, T. Application of Deep Learning Reinforcement Learning for Enhancement of Thermal Fluid Topology Optimization Performance, 3rd Applied Artificial Intelligence Conference.
8. (2023) Lee, G., Yu, Y., & Kim, H.G. Design of the Optimal Nuclear Heat Exchanger using Deep Reinforcement Learning, 10th Korea-China Workshop on Nuclear Reactor Thermal-Hydraulics.

9. (2023) Kim, D.H[1]*., Lee, G†., Cho, S.Y., Lee, S.H., Kim, D., Kim, H.S., Kwon, H.J., Yu, Y. Machine Learning-based Anomaly Detection in Drift Tube Quadrupole Operation for the KOMAC Linac, The 25th International Conference on Accelerators and Beam Utilizations.

10. (2023) Lee, G†*., Yu, Y., & Kim, H.G. Optimal Design of Nuclear Heat Exchanger Using 3D Printing-Based Deep Learning Reinforcement Learning, 2023 Korean Institute of Metals and Materials Fall Conference.

11. (2023) Lee, S.U[1]*., Kim, H.G., Lee, G., Kim, H., Yu, S., Oh, H., & Kim, Y. Development of Nuclear Component Manufacturing and Hybrid Fabrication Technology for Dissimilar Materials, 2023 Korean Institute of Metals and Materials Fall Conference.

12. (2023) Lee, G†*., & Kim, T. Formation of the LCD susceptor heat exchanger path using the deep reinforcement learning, 2nd Applied Artificial Intelligence Conference.

13. (2022) Jeon, B[1]*., Ryu, S., Seo, H., Kim, M., Kim, S., Lee, G†., Lim, H., & Yu, Y. Development of Deep Learning-based Operator Support Systems for HANARO, 2022 HANARO Symposium.

14. (2022) Lee, G†*., Yu, Y., Kim, T., & Kim, S. Formation of a thermofluid temperature equalization flow path using reinforcement learning, 1st Applied Artificial Intelligence Conference.

15. (2022) Lee, G†*., Yu, Y., & Kim, H.G. Development of 3D Printing AI-Based Component Optimization Design Technology for Small Nuclear Reactor Materials, 2022 Korean Institute of Metals and Materials Spring Conference.

16. (2021) Lee, G†*., Joo, Y., Kim, H.G., & Yu, Y. The Analysis of Topology Optimized 3D Printing Heat Exchanger for the Small Nuclear Reactor, 2021 Korean Nuclear Society Autumn Meeting.

17. (2020) Lee, G†*., & Kim, H.R., THE ELECTROMAGNETIC VARIABLE ANALYSIS OF 10 KW MHD GENERATOR, 47th IEEE International Conference on Plasma Physics.

18. (2020) Lee, G†*., & Kim, H.R., A Tendency of Electromagnetic Field Change in MHD Plasma Fluid Generator, 2020 Korean Physical Society Spring Meeting.

19. (2019) Kang, T[1]*., Lee, G., & Kim, H.R., Review Study on Reduction of Nox by Combining Thermal Power and Plasma MHD Power Generation, 2019 Korean Institute of Electrical Engineers Fall Conference.

20. (2019) Lee, G†*., Kang, T., & Kim, H.R., Simulation Analysis of the Characteristics of an Experimental MHD Generator, 2019 Korean Institute of Electrical Engineers Fall Conference.

21. (2019) Lee, G†*., & Kim, H.R., THE VARIABLE OPTIMIZATION OF MHD GENERATOR WITH ELECTRIC OUTPUT OF 10 KW, 11th PAMIR International Conference.

22. (2019) Lee, G†*., Kwak, J., & Kim, H.R., The Analysis of Experimental Magnetohydrodynamic Generator for Cogeneration Plant, 2019 Korean Institute of Electrical Engineers Spring Conference.

23. (2018) Lee, G†*., & Kim, H.R., Design Analysis of 10kW Magnetohydrodynamic Generator using Off-gas Plasma, 60th Annual Meeting of the APS Division of Plasma Physics.

24. (2018) Kang, T[1]*., Lee, G., & Kim, H.R., Analysis and Review of Basic Research on MHD Power Generation Technology, 2018 Korean Institute of Electrical Engineers Fall Conference.

25. (2018) Lee, G†*., & Kim, H.R., Characteristic Analysis of 10-kW Electric Output Faraday-type MHD Generator, 6th International Conference on Nuclear and Renewable Energy Resources.

26. (2018) Lee, G†*., & Kim, H.R., Finite Element Method Analysis of Rectangular-type DC Electromagnetic Pump for Active Heat Decay Removal System of Prototype Gen-IV Sodium Fast Reactor, 2018 Korean Physical Society Spring Meeting.

27. (2017) Lee, G†*., & Kim, H.R., The Comparative Analysis of Rectangular- and Helical-type DC Electromagnetic Pump for ADHRS in PGSFR, 2017 Korean Physical Society Autumn Meeting.

28. (2017) Lee, G†*., & Kim, H.R., THE OPTIMIZATION OF HELICAL-TYPE DC ELECTROMAGNETIC PUMP FOR ACTIVE DECAY HEAT REMOVAL SYSTEM, Global 2017 International Nuclear Fuel Cycle Conference.

29. (2016) Lee, G†*., & Kim, H.R., The Pressure and Magnetic Flux Density Analysis of Helical-Type DC Electromagnetic Pump, 2016 Korean Nuclear Society Autumn Meeting.

30. (2016) Lee, G†*., & Kim, H.R., The Numerical Investigation and Comparison of the Rectangular, Cylindrical and Helical Type DC Electromagnetic Pumps, 10th PAMIR International Conference.

31. (2015) Lee, G†*., & Kim, H.R., THE FUNDAMENTAL DESIGN ANALYSIS OF THE RECTANGULAR AND HELICAL TYPE DC CONDUCTION ELECTROMAGNETIC PUMP WITH THE FLOW RATE OF 3L/MIN, 23rd International Conference on Nuclear Engineering.

32. (2014) Lee, G†*., & Kim, H.R., The Design Analysis of the DC Electromagnetic Pump with the Flowrate of 3 L/min, 2014 American Nuclear Society Winter Meeting.

33. (2014) Lee, G†*., & Kim, H.R., The Optimum Design Analysis of the Small DC Electromagnetic Pump with Loop-Supported Type, 2014 Korean Nuclear Society Autumn Meeting.

34. (2014) Lee, G†*., & Kim, H.R., Preliminary Study for Radioactivity Evaluation of MSR compared with LWR, 2014 Korean Nuclear Society Spring Meeting.

ACHIEVEMENTS

Awards

(2019) Doosan Heavy Industries & Construction Research Scholarship. Korean Nuclear Society.

(2016) Excellent Poster Award. Korean Nuclear Society, Korea.

(2015) First Award of Excellence for MAE Research Internship. UNIST.

Invited Talks

(2023) The Optimal Nuclear Heat Exchanger Design through Reinforcement Learning, BrainLink X-lab.

(2023) Optimal design of 3D printing-based heat exchanger using reinforcement learning, UNIST.

(2023) Optimal design of nuclear power plant heat exchanger using 3D printing-based deep learning reinforcement learning, 2023 Korean Institute of Metals and Materials Fall Meeting.

(2022) Optimal design analysis of major reactor parts using AI technology, UNIST.

(2022) Development of Small Nuclear Reactor Main Part, 3D printing AI-based Optimization Design Technology, 2022 Korean Institute of Metals and Materials Spring Meeting.

Program

(2022) Lee, G., Yu, Y, & Kim, T., Heat exchanger path generation program through reinforcement learning. Republic of Korea – Registration No.: C-2022-149451.

License

(2021) Certified AI Expert, Korean Standards Association, No. C-2021-004668.

SERVICE

Journal Reviews

Journal	Index	Count	Period
Energy	SCIE, JCR Top 3.2% (IF: 9.4)	5 reviews	2024–2025
Int. Comm. in Heat and Mass Transfer	SCIE, JCR Top 5.1% (IF: 6.4)	7 reviews	2025–2026
Annals of Nuclear Energy	SCIE, JCR Top 20.7% (IF: 2.3)	4 reviews	2025–2026
Electronic Research Archive	SCIE	6 reviews	2025–2026
J. Korean Physical Society	SCIE	1 review	2023
Energy Engineering	ESCI	2 reviews	2024

Leadership

Student Representative: Department of Nuclear Engineering, UNIST.

TEACHING

Instructor

(2023) Foundation of AI. 2023 International School on Beam Dynamics and Accelerator Technology.

(2016) Nuclear Comprehensive Design Project. UNIST.

Teaching Assistant

(2021) Liquid Metal Magnetohydrodynamics I. UNIST.

(2020) Liquid Metal Magnetohydrodynamics II. UNIST.

(2019) Special Lecture on Nuclear Engineering (MHD electrical power generation). UNIST.

(2019) Fundamental of Electromagnetics. UNIST.

(2018) Fundamental of Electromagnetics. UNIST.

(2017) Fundamental of Electromagnetics. UNIST.

SELECTED RESEARCH PROJECTS

(2023–2026)	Accelerator Operation Labor, FRIB. • Thermal device simulation, optimization and validation
(2023–2026)	AIP Mini-channel and Water beam dump, FRIB. • AI-driven beam dump design optimization
(2023–2026)	AIP Post-target shielding, FRIB. • High power system thermal simulation for the operation
(2022)	Technical support for the application of artificial intelligence to lower module temperature uniformity on next-generation display manufacturing systems, KAERI. • Display susceptor flow channel optimization using artificial intelligence
(2021–2023)	Development of Original 3D Printing Technology for Manufacturing Components of Small Nuclear Reactor Materials, KAERI. • Development of AI-driven 3D printing heat exchanger optimization and experiment
(2021–2023)	Establishment of Intelligent Operation Platform for HANARO and Research Facilities, KAERI. • Anomaly detection in the accelerator system using AI
(2021–2022)	Development of Deep Learning Solver for Reducing Iterations in Topology Optimization, Hyundai. • Supporting the topology optimization simulation
(2020–2021)	Research on the development of prototype lithium charge stripper, Institute for Basic Science. • Design optimization of an electromagnetic pump and liquid lithium film formation system
(2020–2021)	Environmental Radioactivity Monitoring Environment Gyeongju Region, KAERI. • Supporting radiological sample collection
(2018–2021)	Plasma generation technology of high temperature and electric production technology of 10 kW magnetic generator, KEPCO Research Institute. • Investigation of MHD generator technology and design analysis
(2016–2018)	Design and Performance Evaluation about EM Pump for Test of Coolant Loop of Prototype Gen-IV Sodium-cooled Fast Reactor, KAERI. • Feasibility analysis and performance evaluation of DC electromagnetic pumps for SFR
(2016)	Development of Prototype DC Electromagnetic Pump, Institute for Basic Science. • Design optimization of a DC electromagnetic pump