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

- Develop Genetic Algorithms (GA) and Reinforcement Learning (RL) frameworks to optimize heat removal systems.
- Optimize thermo-fluid devices and validate for practical implementation.

Postdoc
Aug 2021 – Dec 2023
Daejeon, Korea

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

- Optimized SMR heat exchangers (PCHE) using RL-based Topology Optimization.
- Designed flow channels for Samsung OLED susceptors using RL models.
- 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, Heat Exchangers, Electromagnetic Pumps, Additive Manufacturing, Small Modular Reactors, Accelerators

SCIE JOURNAL (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

PATENT

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 & CONFERENCES (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 on Electrical Machines and Energy Conversion Systems*.
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 on Electrical Machines and Energy Conversion Systems*.
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 on Power Systems, Power Economics, and Power System Protection*.
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 of the Power Technology Division.*
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

Energy	SCIE JCR Top 3.2% (IF: 9.4)	5 reviews	2024-2025
International Communications 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
Journal of the 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 Assistance

(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