

RESEARCH INTERESTS

Autonomous Mission Planning and Intelligent Decision-making

- Learning-based route planning and scheduling of multiple agents under dynamic environments

Deep Reinforcement Learning for Optimization Problems

- Efficient learning of heuristics for approximate solutions to combinatorial optimization with physical constraints

Mathematical Programming Formulation and Techniques

- Design of mathematical formulation for real-world optimization such as *autonomous systems*, *intelligent transportation systems*, and *safe control of multi-agent systems*

EDUCATION

Korea Advanced Institute of Science & Technology (KAIST)

Daejeon, Korea

Master of Science (MS) in Aerospace Engineering (Advisor: Prof. Jae-myung Ahn)

Sep. 2020 – Aug. 2022

- Thesis: Multiple UAV Routing for Re-planning under Dynamic Environment using Deep Reinforcement Learning
- GPA: 4.11/4.30

Bachelor of Science (BS) in Aerospace Engineering

Sep. 2012 – Feb. 2017

- GPA: 3.92/4.30, *Magna Cum Laude*
- Class Rank: 56/573, Top 9.8%

RESEARCH EXPERIENCES

Strategic Aerospace Initiative, KAIST 🌀

Daejeon, Korea

Research Assistant (Advisor: Prof. Jae-myung Ahn)

Sep. 2020 - Present

1. Routing problems considering value system for exploration missions

- Proposed a data-efficient online methodology to train a Transformer-based policy network for solving routing problems via deep reinforcement learning [JR1], [C1-2]

2. Data-driven flow modeling and analysis

- Developed a deep-learning model for efficient prediction of aerodynamic coefficients under extreme flow conditions [JR2], [C3]

Aerospace Technology Research Institute, ADD 🌀

Daejeon, Korea

First Lieutenant (Research Officer for National Defense[†]) (Mentor: Dr. Woohyuk Chang)

Jun. 2017 – May. 2020

1. Autonomous Navigation and Mission Management Technology

- Developed mission planning algorithm for UAVs operating in dynamic environment [J1], [C4-5]
- Formulated UAV planning problem as MILP and solved via Gurobi optimizer
- Developed a parallel genetic algorithm for fast online planning on GPU

2. Autonomous Mission Planning System Simulator

- Developed an autonomous mission planning program for UAV simulator on Linux [P1]

Unmanned Systems Research Group, KAIST 🌀

Daejeon, Korea

Undergraduate Research Intern (Advisor: Prof. David Hyun-chul Shim)

Dec. 2015 – Sep. 2016

1. Development of Modular Drone with Self-Configuration

- Designed and constructed a 3D-printable modular drone that can configure itself before flight
- Received *Excellent Award* among 53 projects in Undergraduate Research Participation (URP) program

[†] ROND: Korean research program modeled after Israel's Talpiot program, selecting 20 undergraduates across the country to serve their military duties as research officers at Agency for Defense Development (ADD)

JOURNAL PUBLICATIONS

- [J1] **Lee, D. H.**, Jang, H., Kim, S. H., & Chang, W. (2020). Multi-UAV Mission Allocation and Optimization Technique Based on Discrete-Event Modeling and Simulation. *Journal of the Korean Society for Aeronautical & Space Sciences*, 48(2), 159-166.

JOURNALS UNDER REVIEW

- [JR1] **Lee, D. H.** & Ahn, J. (2022). Multi-Start Team Orienteering Problem for UAS Mission Re-Planning with Data-Efficient Deep Reinforcement Learning. *Journal of Intelligent & Robotic Systems*.

CONFERENCE PROCEEDINGS

- [C1] **Lee, D. H.**, & Ahn, J. A Deep Reinforcement Learning Approach to solve the Vehicle Routing Problem with Resource Constraints. In *AIAA Scitech Forum 2023*, Maryland, USA. (Session: Autonomy IV, to appear)
- [C2] Moon, C. H., **Lee, D. H.**, & Ahn, J. Truck-Drone Delivery Using Heterogeneous Vehicle Routing Problem Based on Deep Reinforcement Learning. In *AIAA Scitech Forum 2023*, Maryland, USA. (Session: Autonomous Mission Management Concepts and Technologies II, to appear)
- [C3] **Lee, D. H.**, Lee, D. U., Lee, J., Lee, B. J., & Ahn, J. Prediction of Multiple Aerodynamic Coefficients of Missiles using CNN. In *AIAA Scitech Forum 2022*, San Diego, USA. (Session: Learning, Reasoning, and Data Driven Systems III)
- [C4] **Lee, D. H.**, Chang, W., & Byun, J. An Optimization Technique for Discrete Event Model-based UAV Real-Time Heterogeneous Mission Allocation. In 2018 *Proceedings of the Korean Society for Aeronautical and Space Sciences, Fall Conference*, Jeju, Korea.
- [C5] **Lee, D. H.**, Chang, W., & Byun, J. Discrete-event Modeling and Simulation of Autonomous Multi-UAV Mission Management. In 2018 *Avionics Systems Symposium Korea (ASSK)*, Yeosu, Korea.

PATENTS (REGISTERED)

- [P1] Chang, W., **Lee, D. H.**, Jang, H., Method and apparatus for optimization of unmanned vehicle mission allocation, KR102063851 (Jan. 2020)

AWARDS & HONORS

- **Excellent Paper Award**, ASSK 2018 *July. 2018*
- **Excellence in Leadership & Volunteer Activity**, KAIST *Mar. 2016*
 - Granted to top 5% students with active participation in the leadership programs.
- **Excellent Award in URP**, KAIST *Aug. 2016*
- **Dean's List**, College of Engineering, KAIST *Feb. 2016*
 - Awarded to top 3% (GPA: 4.22/4.3)

SCHOLARSHIPS

- **National Scholarship for Graduate Study**, KAIST *2020 - 2022*
 - Full support for graduate school tuition and monthly stipends
- **Department Honors Scholarship**, KAIST *Feb. 2016*
 - Dean's list for 2015 Fall
- **The Boeing Company-KAIST Undergraduate Scholarship**, KAIST *2014 - 2016*
 - Merit-based scholarship which offered \$1,500 per semester for academic excellence
- **National Scholarship for Science & Engineering**, Korea Student Aid Foundation (KOSAF) *2015 - 2016*
 - Full support for university tuition and \$8,700 scholarship as a *ROND* cadet
- **National Scholarship for Undergraduate Study**, KAIST *2012 - 2014*

TEACHING

Teaching Assistant @KAIST

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|-------------------------------------|---------------------------------|
| – AE201 Introductory Flight Project | <i>Spring 2021</i> |
| – HSS024 Advanced English Writing | <i>Spring 2015–Spring 2016</i> |
| – HSS025 Advanced English Reading | <i>Spring 2015–Spring 2016</i> |
| – LG-KAIST Science Camp | <i>Summer 2015</i> |
| – Academic English Camp | <i>Winter 2014; Winter 2015</i> |

LEADERSHIP EXPERIENCES

Graduate Student Association, Department of AE

Vice President *Feb. 2021 - Feb. 2022*

ROND Cadet Association

President *Aug. 2015 - Mar. 2017*

Undergraduate Student Council, KAIST

Student Representative, Bureau of International Relations *Aug. 2014 - Dec. 2014*

KISA(KAIST International Students Association), KAIST

Head, Bureau of Public Relations *2015*

EXTRACURRICULAR ACTIVITIES

KAIST-Saudi Aramco Mentoring Program

Mentor *Feb. 2015 - Dec. 2015*

- Mentor for prospective freshmen from Saudi Arabia and UAE during their preparatory first year

LANGUAGES

Fluent in **English** and native in **Korean**

- GRE: 326 (Verbal: 159, Quantitative: 167, Writing: 4.5)
- TOEFL: 115 (Reading: 29, Listening: 29, Speaking: 27, Writing: 30)

PROGRAMMING SKILLS

Python {PyTorch, NumPy, Matplotlib}, MATLAB, C/C++, NVIDIA CUDA, \LaTeX