JAEHAN IM

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RESEARCH INTEREST & VISIONS

- #Decentralized control #Multi-agent planning #Safe autonomy #Human-machine collaboration
- Game theory based decentralized multi-agent control
- Nature/Human inspired decentralized control schemes
- Safety issues arising from collaboration between intelligent autonomy and human
- Discrete optimization technique for mission level scheduling involving multiple tasks and agents

EDUCATION

The University of Texas at Austin — Aug. 2023 ~ Present
Ph.D. student in Department of Aerospace Engineering — Austin, Texas, USA

Korea Advanced Institute of Science and Technology (KAIST) — Feb. 2020
M.S. in Department of Aerospace Engineering — Daejeon, Korea
- Advisor: Jaemyung Ahn, Ph.D.
- Thesis: "Distributed free-flow air traffic management system based on Nash equilibrium concept"

Delft University of Technology — Feb. 2017
Exchange Student of Department of Aerospace Engineering — Delft, Netherlands

Korea Advanced Institute of Science and Technology (KAIST) — Feb. 2018
B.S. in Department of Aerospace Engineering. — Daejeon, Korea
- Minor in Department of Civil and Environmental Engineering
- Magna Cum Laude

WORK EXPERIENCE

NEARTHLAB Inc. *Research Engineer, Aerospace Department* — Feb. 2020 - May. 2023
Self-motivated problem solver, researcher and developer — Seoul, Korea
- Developed an autonomous flight guidance system for inspection drones
- Aerial vehicle performance evaluation process development (project lead)
- Vibration signal analysis for retrieved image quality assessment (project lead)
- Optimal routing problem research involving multiple drones (project lead)

CnTech Inc. *System Engineer* — Apr 2017 - Apr 2018
Expertise in comprehensive analysis — Daejeon, Korea
- ConOps development for stand-alone generator for IoT devices
- Contributed in PDR process

The First Media *Freelance Technical Writer* — Jan 2017 - Dec 2017
Lowering a barrier of scientific articles; focused on aerospace engineering — Seoul, Korea
- Aerospace science section contributor
- Monthly publication

PUBLICATIONS

Thesis

1. **Distributed free-flow air traffic management system based on Nash equilibrium concept**
   J. Im
   MSc thesis, KAIST, 2020. [link]

Journals

1. **Decentralized Free Flow Traffic Management Based on Nash Equilibrium**
   J. Im, J. Ahn
   Journal of Aerospace Information System (JAIS), 2022. (Published online) [link]
2. **Large and sparsely connected graph VRP for multiple UAV structure inspection path planning**
   J. Im, B.Y. Lee
   Journal of Aerospace Information System (JAIS), 2023 (Accepted, Jan. 2023)
3. **Modeling and simulation of aircraft motion for performance assessment of airborne AESA radar considering wind and vibration**
   D. Lee, J. Im, H. Lee, Y. Jung, J. Jeong, J. Shin, S. Lee, J. Park, J. Ahn
   Journal of the Korean Society for Aeronautical & Space Sciences (JKSAS), 2020. (Published) [link]

Conference

1. **Spatiotemporal VRP for Collision-free Multi-UAV Inspection Planning**
   J. Im, Y. Kim,
   International Conference on Unmanned Aircraft Systems (ICUAS), (Published) [link]

2. **Collision-free Vehicle Routing Problem for multiple drone infrastructure inspection**
   J. Im
   In proceedings of the Korean Society for Aeronautical & Space Sciences fall conference. 2022
3. **VRP based 3D optimal path planning for industrial facility inspection**
   J. Im, J. Lee
   In proceedings of the Korean Society for Aeronautical & Space Sciences spring conference, 2022
4. **Optimal path planning for spatiotemporal space with grid search algorithm**
   J. Im, J. Ahn
   In proceedings of the Korean Society for Aeronautical & Space Sciences fall conference, 2019
5. **Wind and fuselage vibration considered 6DOF flight simulator development for AESA radar testing**
   J. Im, D. Lee, H. Lee, H. Lee, Y. Jung, J. Jeong, H. Park, J. Ahn
   In proceedings of the Korean Society for Aeronautical & Space Sciences spring conference, 2019
6. **Communication-less decentralized ATC with Nash equilibrium strategy and individual observance-based belief system**
   J. Im, J. Ahn
   In proceedings of the Korean Society for Aeronautical & Space Sciences fall conference, 2018

ACADEMIC PROJECTS

1. **Collision-free VRP (2022)**
   - Developed a routing algorithm for multiple drones traveling through a densely located nodes.
   - Collision-free constraint considered *within* the optimization process
   - Algorithm can handle a large number of nodes (1000~2000)
2. **Large and sparse graph routing for infrastructure inspection path planning (2021-2022)**
   - Conventional VRP requires pre-processing the graph into a complete-graph form.
   - Developed a VRP solving algorithm which accelerates overall solution time for large and sparse graphs by reducing a graph pre-processing computation burden.
   - Applied Louvain algorithm and metaheuristic algorithms
3. **Image quality assessment based on vehicle structural vibration signal analysis (2021)**
   - Developed an image quality assessment process
   - Processed and analyzed high frequency vibration data retrieved from IMU.
   - Contributed in improving the image quality acquired from drone flights.
4. **Multi-rotor vehicle flight performance evaluation process development (2020-2021)**
   - Systematic process developed for evaluating multi-rotor vehicle performance
   - Developed both automated program for analysis and systematic procedure manual
   - Provided a quantitative reasoning tool for vehicle design review process
5. **6DOF flight simulation algorithm development for radar performance simulation (2018-2019)**
   - Developed a simulator that mimics the in-flight high frequency vibration
   - Structural vibration reconstructed with actual in-flight PSD data
   - Developed using MATLAB Simulink
6. **GIS aided pilot decision support system in dual engine failure scenario (2017)** - *independent project*
   - Developed a system focused on enhancing the performance of human-machine collaboration
   - The system narrows down vast data into handful amount of meaningful choices. Qualitative final decision made by pilot. Multidisciplinary optimization techniques were implemented.
   - Best term project in class (Introduction to GIS) of 2017
7. **Pilot control performance relation to cockpit instrument arrangement and indicator type (2017)**
   - Investigated effectiveness of cockpit instrument arrangement (HUD, Glass, Analog) and Type (Dial, Graphical)
   - Experiment with 19 subjects was conducted. Quantitative analysis using NASA TLX.
   - Identified key factors which relieves pilot workload of controlling multiple factors (roll, pitch and speed)
   - Best team project in class (Techniques and Methods in Human Engineering) of 2017.
8. **Structure damage proof signaling system (2016) -** *independent project*
   - Inspired by Qantas 32 accident
   - Built a prototype which relays information through the skin of an aircraft
   - Term project with best score in class (Aerospace applied electronics) of 2016

AWARDS & HONORS

Top award (1st place) at 2019 Korea Aerospace Journal Competition 2019.10
- Won the top prize (Minister of Trade, Industry and Energy's award)
- Title: *"Distributed free flow traffic management system based on Nash equilibrium concept"*

Cum Laude (Graduation Honors) 2018.02

3rd place at International Collegiate Design and Innovation Competition(ICDIC) 2016.08
- 3rd place in 'aviation safety' category as a team of five international members
- Title: *"Saving the airplane in the no power scenario"*

Grandprix at Undergraduate Research Program (URP) 2015.12
- Won the top prize (Grandprix) as a team of three members
- Title: *"Perfect efficiency Human Powered Aircraft (HPA) development"*

Best design award in 2015 HPA contest 2015.10
- Won the Best Design Award in 2015 Human Powered Aircraft contest held by KARI (Korea Aerospace Research Institute)
- Worked as a project manager and built an aircraft with a team of 22 members.

Undergraduate Scholarship from Boeing Korea 2014-2016

PATENTS

1. *Jaehan Im, Byungyoon Lee*, **"Drone's route planning method and device for wind turbine inspection"**, KR-Application No. 10-2022-0069332 2022.08
2. *Jaehan Im*, *Byungyoon Lee*, **"Method and apparatus for generating movement routes of drone for inspection of industrial structures"**, KR-Application No. 10-2022-0069334 2022.08
3. *Jaehan Im*, *Byungyoon Lee*, **"Method and apparatus for generating movement routes of multiple drones for inspection of industrial structures"**, KR-Application No. 10-2022-0069335 2022.08
4. *Minwoo Koh, Kiduk Kim, Jaehan Im, Kangmin Sun*, **"Mold Asset Management System"**, KR-Registration No. 10-2205304-0000 2021.01