Minho Jang

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About Me

Passionate about missile defense, I specialize in guidance, navigation, and control (GNC) systems grounded in optimal control theory.

My expertise lies in designing guidance and control systems for missiles. I specialize in model predictive control (MPC) for optimizing online trajectory decisions, and Kalman filter (KF) techniques for accurate state estimation under uncertainty. I have also developed interacting multiple model (IMM) algorithms to robustly track maneuvering targets. Recently, I have been exploring the integration of reinforcement learning and deep neural networks to enhance adaptability and decision-making capabilities in complex environments.

With a solid foundation in modeling & simulation for missile defense systems and a strong research background, I'm committed to advancing next-generation missile GNC technologies and addressing complex aerospace challenges.

Areas of Expertise

- Missile Guidance, Navigation, and Control
- Guidance Law Design: Nonlinear Model Predictive Control, Optimal Trajectory Generation
- Navigation Filtering: Extended Kalman Filter Design, Interacting Multiple Model Algorithms
- Autopilot Design (Three-Loop Architecture) and Trajectory Optimization
- 6-DOF Missile Modeling and Simulation
- Data-Driven and Learning-Based Control: Reinforcement Learning, Deep Neural Networks

Education

M.S. **Sejong University** Seoul, Republic of Korea

Aerospace Engineering Sep. 2021 – Aug. 2025

- Advisor: Prof. Sungsu Park
- Lab: Flight Dynamics and Control Laboratory
- **Thesis** : Nonlinear Model Predictive Control for Guidance Law with Target Input Estimation
- Coursework: Flight Dynamics and Control; Guidance, Navigation, and Control (GNC); Optimal/Nonlinear Control; Orbital Mechanics; Classical Mechanics

B.S. **Chonnam National University** Gwangju, Republic of Korea

Electronics and Computer Engineering Mar. 2015 – Aug. 2021

- Advisor: Prof. Jinyoung Kim
- Lab: Intelligent Electronics Laboratory

- GPA: 3.91/4.5
- Coursework: Control Theory; Digital Signal Process (DSP); Electrical/Electronic Circuit Theory; Microprocessor; Dynamics

Experiences

Sejong University Seoul, Republic of Korea

Graduate Research Assistant & Teaching Assistant Sep. 2021 – Aug. 2025

- Research Assistant:

- Member of Flight Dynamics and Control (FDCL) Lab.
- Development of Localization Technology for Wind Power Control Systems
- Fundamental Research on Electromagnetic Modeling for Electronic Warfare Systems [EW42: Modeling of Radar-Guided Systems for Electronic Warfare]

- Teaching Assistant:

- AE006885 – Flight Mechanics
- AE002390 – Aerospace Software Applications I
- AE004642 – Dynamics
- Assisted with grading, programming assignments, and practical instruction across multiple key aerospace engineering courses

Seoul National University Seoul, Republic of Korea

Exchange Student Program, Department of Mechanical and Aerospace Engineering Sep. 2020 – Dec. 2020

- Completed advanced coursework in model predictive control as part of a control systems curriculum (ECE430.456)
- Bridged academic backgrounds in electronics engineering with aerospace applications through coursework in Aerospace Traffic and Navigation Systems (MAE2795.004600)
- Gained interdisciplinary exposure to modern control theory and aerospace engineering, deepening understanding of autonomous systems and guidance technologies

Chonnam National University Gwangju, Republic of Korea

Glocal Specialization Exploration Program CA, USA

Jul. 2017 – Aug. 2017

- Selected for a university-sponsored overseas program aimed at exploring global research environments and cutting-edge industrial technologies
- Visited the Robotics & Mechanisms Laboratory (RoMeLa) at UCLA, led by Prof. Dennis Hong, to observe research on robotics and AI-based autonomous systems
- Explored the Stanford University campus to gain insight into Silicon Valley's innovation ecosystem and global academic culture in electronics and computer engineering
- Visited Google headquarters to discuss industrial applications and future directions of artificial intelligence and deep learning with an engineering expert
- At Tesla headquarters, engaged with a Korean engineer working on autonomous driving systems and deepened understanding of computer vision and image processing technologies applied in real-world automotive systems

Publications

Journal

- [J.2] **Minho Jang**, M. Kim, D. Jang, and S. Park
  Capturability Analysis of the Composite Pursuit Guidance Law — Accepted
  IEEE Transactions on Aerospace and Electronic Systems (TAES)

- [J.1] M. Kim, **Minho Jang**, and S. Park
  A Data-Driven Model Predictive Control for Wind Farm Power Maximization — Jul. 2024
  IEEE Access

Conference

- [C.5] **Minho Jang**, M. Kim, H. Lim, D. Lee, and S. Park
  Study on Missile Evasion for Unmanned Aircraft using Artificial Potential Field — 2023
  Conference of the Korean Society for Aeronautical and Space Sciences (KSAS)

- [C.4] H. Lim, M. Kim, **Minho Jang**, D. Lee, and S. Park
  Research on Halo Phasing Orbit Design based on Optimal Control — 2023
  Conference of the Korean Society for Aeronautical and Space Sciences (KSAS)

- [C.3] D. Lee, M. Kim, **Minho Jang**, H. Lim, and S. Park
  Lambert's Problem Solver Using Physics-Informed Neural Network — 2023
  Conference of the Korean Society for Aeronautical and Space Sciences (KSAS)

- [C.2] M. Kim, H. Lim, **Minho Jang**, D. Lee, and S. Park
  Wind Speed and Wind Direction Prediction Using LSTM Model — 2023
  Conference of the Korean Society for Aeronautical and Space Sciences (KSAS)

- [C.1] M. Kim, **Minho Jang**, H. Lim, and S. Park
  A Study on Deep Neural Network-Based Wake Modeling for Wind Farms — 2022
  Conference of the Korean Wind Energy Association (KWEA)

Project Experiences

Safe Reinforcement Learning for Threat-Responsive Satellite Maneuvering — Oct. 2025 – Feb. 2026

Funded by: National Research Foundation of Korea (NRF)

Managing Institution: Sejong University

- Development of reinforcement learning–based control policies that satisfy Lyapunov stability conditions
- Implementation of an autonomous GNC framework capable of handling diverse orbit and threat scenarios
- Construction of a real-time simulation environment using Basilisk for policy verification and validation
- Design of generalized algorithms applicable to various missions, including military satellites, service drones, and relay satellite operations

- Tools & Software Used: Python, Basilisk, Pytorch, Gymnasium, RLlib

Development of Localization Technology for Wind Power Control Systems Sep. 2021 – Feb. 2025

Funded by: Ministry of Trade, Industry and Energy (MOTIE)

Managing Institution: Korea Institute of Energy Technology Evaluation and Planning (KETEP)

- Designed and deployed the FAST.Farm mid-fidelity simulator for wind farm dynamics, enabling online environmental modeling and data collection
- Applied dynamic mode decomposition (DMD) to reduce the dimensionality of high-fidelity wind flow field data from FAST.Farm, improving computational efficiency for control algorithms
- Implemented Kalman Filter-based state estimation to enhance predictive accuracy of reduced-order wind field models
- Developed a model predictive control framework to maximize total wind farm power output using the estimated flow field states
- Engineered real-time socket communication (ZeroMQ) between the central control server and distributed wind turbine controllers
- Published the research as a journal paper in collaboration with graduate researchers at Sejong University [J.1]
- Tools & Software Used: MATLAB, Fortran, Python, OpenFAST, FAST.Farm, ZeroMQ

Fundamental Research on Electromagnetic Modeling for Electronic Warfare Systems Sep. 2021 – Dec. 2021
[EW42: Modeling of Radar-Guided Systems for Electronic Warfare]

Funded by: Defense Acquisition Program Administration (DAPA)

Managing Institution: Agency for Defense Development (ADD)

- Assisted in the design and evaluation of guidance algorithms for anti-ship missiles, supporting analysis through simulation and system modeling
- Supported the development and implementation of missile engagement modeling and visualization using the Unity engine, enabling online scenario simulation
- Tools & Software Used: MATLAB/Simulink

Independent Research

Design of Nonlinear Model Predictive Control-Based Guidance Law Mar. 2025 – Present

- Designed a look angle-based nonlinear model predictive control guidance framework tailored for strapdown seekers
- Developed an adaptive extended Kalman filter (AEKF) using look angle measurements from the strapdown seeker, and implemented an interacting multiple model (IMM) algorithm to estimate target inputs
- Tools & Software Used: Julia, JuMP.jl, Ipopt.jl

Missile Aerodynamic Prediction Based on a Semi-Empirical Method Dec. 2024 – Mar. 2025

- Measured the geometric features (e.g., length, diameter) of the PAC-3 MSE missile using a 3D CAD tool to generate accurate input data
- Generated aerodynamic coefficients of the missile using Missile DATCOM based on

the extracted geometry

- Constructed a look-up table (LUT) for aerodynamic coefficients, including control derivatives, and developed a neural network surrogate model to approximate and replace the LUT
- Tools & Software Used: Julia, Missile DATCOM, Autodesk Fusion, Pytorch

Development of a 6-DOF Missile Defense System Simulation Framework Jun. 2024 – Apr. 2025

- Developed a 6-DOF missile defense simulation framework under an the WGS-84 Earth model, incorporating centrifugal and Coriolis accelerations as well as a zonal gravity model
- Implemented the equations of motion for a ballistic missile using aerodynamic data extracted from the PRODAS missile analysis software
- Designed an LQR-based autopilot for the interceptor missile to achieve stable trajectory control
- Integrated Google Earth terrain data to visualize and analyze missile trajectories and attitudes
- Tools & Software Used: Julia, PRODAS, Google Earth

Capturability Analysis of Composite Pursuit Guidance May. 2024 – Jul. 2025

- Analyzed the capturability of pure proportional navigation to identify its limitations, and designed a hybrid guidance law combining pursuit guidance to ensure a full-range capture region
- Submitted the research as a journal paper in collaboration with graduate researchers at Sejong University [J.2]
- Tools & Software Used: Matlab/Simulink, Python

A Study on Missile Evasion Strategies for Unmanned Aircraft Feb. 2023 – Nov. 2023

- Implemented and applied an artificial potential field (APF) algorithm, a classical collision avoidance technique, to enable missile evasion maneuvers
- Published the research as a conference paper in collaboration with graduate researchers at Sejong University [C.5]
- Explored missile evasion strategies using reinforcement learning approaches to enhance autonomous response capabilities
- Tools & Software Used: Python, Tensorflow, Pytorch

Awards

2020 Capstone Design Competition Dec. 2020

Chonnam National University

- Recognized for developing an innovative engineering project in the 2020 Capstone Design Competition hosted by the Engineering Education Innovation Center

Activities

LIG Nex1 Co., Ltd. Jul. 2023

Future Space Navigation & Satellite Technology Research Center

Industry–Academia Internship Program

- Completed on-site internship training program focused on advanced technologies in space navigation and satellite technology

Samsung Electronics Aug. 2015

Design Your Dream Corporate Experience Program

- Completed the "Design Your Dream" university corporate experience camp organized by Samsung Electronics, Gwangju Volunteer Center

Technical Skills

Programming Languages:

- MATLAB/Simulink
- Julia
- Python
- Fortran
- C/C++

Frameworks & Tools:

- Missile DATCOM
- OpenFAST
- FAST.Farm
- JuMP.jl
- Ipopt.jl
- ZeroMQ
- Pytorch
- Basilisk