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.3] **Minho Jang**, M. Kim, and S. Park
  A Look Angle-based Nonlinear Model Predictive Control Guidance with Target Input Estimation — Under review
  IEEE Transactions on Aerospace and Electronic Systems (TAES)

- [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

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
- Submitted the research as a journal paper in collaboration with graduate researchers at Sejong University [J.3]
- 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

Technical Skills

Programming Languages:

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

Frameworks & Tools:

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