Muhammad Hanif

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Last updated: 04 November 2024

Education

Institute of Science Tokyo (formerly Tokyo Institute of Technology) — **Tokyo, Japan**
Ph.D. in Systems and Control Engineering — *Oct 2022 – Present*

Advisor: Prof. Takeshi Hatanaka

Tokyo Institute of Technology — **Tokyo, Japan**
M.Eng. in Systems and Control Engineering — *Oct 2020 – Sept 2022*

Advisor: Prof. Takeshi Hatanaka
Thesis: Real-Time Optimization for Dynamic Multi-Target Allocation & Tracking with Heteregeneous Robot Systems

Bandung Institute of Technology — **Bandung, Indonesia**
B.Sc. in Electrical Engineering — *Aug 2014 – Jul 2018*

GPA: 3.75/4.00 | **Advisor:** Prof. Bambang Riyanto & Dr. Egi Hidayat
Thesis: Design and Implementation of Control System in Hybrid Underwater Glider Vehicle in ROS Environment

Research & Industry Experience

Tokyo Institute of Technology — **Tokyo, Japan**
Research Assistant, Hatanaka Laboratory — *May 2021 – Present*

- **Angle-Aware Coverage Control for 3D Map Reconstruction using Drone Networks**: Developed a coverage control algorithm for multiple UAVs to be used in 3D map reconstruction applications. The simulation was implemented using ROS/ROS2 and tested both in a testbed environment and in a real agricultural farm setting [J1,J2,C4].
  Highlight: ROS/ROS2, Unity, Python, C#, Coverage Control, Multi-UAV, 3D Map Reconstruction.
- **Multi-Robot Task Allocation for Equipment Inspection (in collaboration with Yokogawa Electric)**: Developed a simulator using Unity and ROS2 to simulate multi-robot task allocation scenarios in a factory environment.
  Highlight: ROS2, Unity, Python, C#, Path Planning, Multi-Robot Task Allocation.
- **Drone Coverage Control for Moving Target Tracking Application (in collaboration with Fujitsu)**: Enhanced drone coverage control methods for dynamic target tracking applications by adapting the drone's altitude and detection model in real-time [C3,D5].
  Highlight: ROS, Python, Coverage Control, Drone Target Tracking, TensorFlow.
- **Safe Autonomous Ship Control Method in a Port (in collaboration with Kawasaki Heavy Industry)**: Designed control methods for autonomous ship operation in a port with safety certificates using a combined approach of Model Predictive Control (MPC) and Control Barrier Function (CBF). [B1,C5].
  Highlight: MATLAB, Simulink, Control Barrier Function, Model Predictive Control.
- **Predictive Multi-Robot Task Allocation for Radiation Monitoring (in collaboration with the University of Seville)**: Implemented a high-level control method for multiple heterogeneous robots (UAVs and UGVs) for solar irradiance monitoring tasks in a thermosolar plant. [J3,C7,T1]
  Highlight: ROS, Gazebo, Python, Optimization-based Control.

IROS Tech — **Bandung, Indonesia**
Co-Founder & Drone Engineer — *Apr 2019 – May 2020*

- Co-founded a service UAV (Unmanned Aerial Vehicle) company for aerial surveillance applications. Incubated by LPIK ITB and obtained funding support from the Ministry of Research and Higher Education of Indonesia.
  Highlight: 3D Reconstruction, Mapping, UAV.

Bandung Institute of Technology — **Bandung, Indonesia**
Research Assistant, Advanced Robotics Research Laboratory — *July 2018 – May 2020*

- **Design & Development of Autonomous Hybrid Underwater Glider**: Designed and developed autonomous Hybrid Underwater Vehicle (HUG) for long-distance surveillance missions and conducted lake testing. Led the design team to iterate all engineering aspects of the vehicle, including software, hardware, and mechanical components [T2,P1].
  Highlight: Hybrid Underwater Glider (HUG), Waypoint Tracking, ROS, C++, Python.

Research Assistant, Biomedical Research Group *May 2018 – Nov 2018*

- **Automatic Diabetic Retinopathy Classifier**: Built algorithms and machine learning models using TensorFlow for automatic grading of diabetic retinopathy severity [C8].
- **CNN-based Brain Tumor Classifier**: Developed automatic brain tumor classification from a brain tumor dataset into three classes using deep learning [C9].
  Highlight: Machine Learning, X-ception, CNN, Tensorflow, Keras, OpenCV.

Research Assistant, CentrUMS (Center for Unmanned System Studies) *Aug 2016 – Nov 2018*

- **Development of High Altitude Long Endurance (HALE) UAV**: Implemented a control and monitoring system for a HALE (High Altitude Long Endurance) UAV with a wingspan of 21 meters. Conducted several flight tests, including testing a mini prototype UAV at an altitude of 10,000 feet.
  Highlight: Pixhawk, Mission Planner, Waypoint Tracking, Real-Time Monitoring Streaming, Antenna Tracker.

Researcher, Aksantara Drone Research Team *Aug 2015 – June 2017*

- **Design & Development of Tube-launched Folding-Wing UAV**: Built control and guidance systems for the folding-wing tube-launched drone. Achieved best design recognition at the national drone competition in 2017 [C10].
  Highlight: Folding-Wing UAV, Pixhawk, Mission Planner, Python
- **Hybrid Vertical Take-Off Landing (VTOL) UAV** : Built multifunctional Hybrid VTOL (Vertical Take-Off and Landing) UAV. Led a team of 10 diverse engineers to develop the UAV system from scratch, achieving 1st Runner-Up in the National Drone Competition in 2016.
  Highlight: Pixhawk, Mission Planner, Hybrid VTOL, Multirotor, Fixed-Wing

Aero Terra Scan **Bandung, Indonesia**

Software Developer Intern *June 2017 – Aug 2017, Internship*

- Designed and implemented the back-end program for the Ground Control System (GCS) for UAV (Unmanned Aerial Vehicle) mapping missions using C#.
  Highlight: Mission Planner, Visual Studio, C#, Pixhawk

Publications & Patents

Book, Book Chapter, Editing

[B1] Otsuki, Satoshi, Naoki Hatta, Muhammad Hanif, Riku Funada, Kenichi Nakashima, and Takeshi Hatanaka. "**Hierarchical Vessel Safe Operation in A Port through CBF, MPC and RRT-like Spatiotemporal Path Planning**" In *Nonlinear and Constrained Control - Applications, Synergies, Challenges and Opportunities, E. Garone, I.V. Kolmanovsky, and T.W. Nguyen (eds), Springer Nature*, to be published (2024)

Journal Papers

[J1] Muhammad Hanif, Takumi Shimizu, Zhiyuan Lu, Masaya Suenaga, and Takeshi Hatanaka. "**Efficient Angle-Aware Coverage Control for Large-Scale Map Reconstruction using Drone Networks.**" *SICE Journal of Control, Measurement, and System Integration* 17, no. 1 (2024): 144-155 [Paper] [Video]

[J2] Lu, Zhiyuan, Muhammad Hanif, Takumi Shimizu, and Takeshi Hatanaka. "**Angle-Aware Coverage with Camera Rotational Motion Control.**" *SICE Journal of Control, Measurement, and System Integration* 17, No. 1 (2024): 211–221 [Paper]

[J3] Martin, J. G., Muhammad Hanif, T. Hatanaka, J. M. Maestre, and E. F. Camacho. "**Predictive receding-horizon multi-robot task allocation applied to the mapping of direct normal irradiance in a thermosolar power plant.**" *Solar Energy* 263 (2023): 111911. [Paper] [Video]

Preprints

[X1] Lu, Zhiyuan, Muhammad Hanif, Takumi Shimizu, and Takeshi Hatanaka. "**Angle-Aware Coverage with Camera Rotational Motion Control.**" *arXiv preprint arXiv:2404.13915* (2024) [Paper]

International Conference Papers

[C1] M. Suenaga, Muhammad Hanif, K. Uto, and T. Hatanaka. "**Hierarchical Multi-Robot Data Sampling for Environmental State Estimation through Online Gaussian Process.**" *Proc. 2025 European Control Conference*, submitted (2024)

[C2] Muhammad Hanif, T. Sumino, K. Uto, D. Ichihashi, K. Cheng, and T. Hatanaka. "**Impact of Real-time Map Feedback on Coordinated Image Sampling for 3D Reconstruction.**" *Proc. 2025 European Control Conference*, submitted (2024)

[C3] Muhammad Hanif and Takeshi Hatanaka. "**Real-time Adaptation of Drone Altitude and Object Detection Model for Moving Target Tracking.**" *SICE Annual Conference*, to be published (2024) [Paper]

[C4] Lu, Zhiyuan, Muhammad Hanif, and Takeshi Hatanaka. "**Angle-Aware Full 3D Coverage Control with ADMM-based Dynamic Assignment of Charging Stations.**" *SICE Annual Conference*, to be published (2024) [Paper]

[C5] Otsuki, Satoshi, Naoki Hatta, Muhammad Hanif, Takeshi Hatanaka, and Kenichi Nakashima. "**Hierarchical Vessel Autonomous Operation in a Port with Safety Certificates: Combined MPC and CBF Approach.**" In *IFAC-PapersOnLine* 56, no. 2 (2023): 3138-3145. [Paper] [Video]

[C6] Asavasirikulkij, Chanun, and Muhammad Hanif. "**Human Workload Evaluation of Drone Swarm Formation Control using Virtual Reality Interface.**" In *Companion of the 2023 ACM/IEEE International Conference on Human-Robot Interaction*, pp. 132-136. 2023. [Paper] [Video]

[C7] Martin, Javier G., Muhammad Hanif, Takeshi Hatanaka, Jose M. Maestre, and Eduardo F. Camacho. "**Predictive receding-horizon multi-robot task allocation with moving tasks.**" In *2022 European Control Conference (ECC)*, pp. 2030-2035. IEEE, 2022. [Paper]

[C8] Lazuardi, Rachmadio Noval, Nyoman Abiwinanda, Tafwida Hesaputra Suryawan, Muhammad Hanif, and Astri Handayani. "**Automatic diabetic retinopathy classification with efficientnet.**" In *2020 IEEE REGION 10 CONFERENCE (TENCON)*, pp. 756-760. IEEE, 2020. [Paper]

[C9] Abiwinanda, Nyoman, Muhammad Hanif, S. Tafwida Hesaputra, Astri Handayani, and Tati Rajab Mengko. "**Brain tumor classification using convolutional neural network.**" In *World Congress on Medical Physics and Biomedical Engineering 2018: June 3-8, 2018, Prague, Czech Republic (Vol. 1)*, pp. 183-189. Springer Singapore, 2019. [Paper]

[C10] Ahmad Fadlillah Muzammil, Nurhayyan Halim Rosid, Muhammad Hanif, Naufalino Fadel, Nathan, Tobias S., Tegar S., M.Agoes Moelyadi, and Agus Budiyono. "**Design and Development of Tube-Launched Unmanned Aerial Vehicle.**" In *International Conference on Intelligent Unmanned Systems*, August, 2018. [Paper]

Domestic Conference Papers

[D1] Muhammad Hanif. "**Empowering Precision Agriculture: Efficient Angle-Aware Coverage for 3D Structure Reconstruction with Drone Teams.**" WISE SSS (Tokyo Tech) x IAT (RWTH Aachen) Exhange Meeting, Tokyo Institute of Technology, February 29, 2024. [Poster]

[D2] Muhammad Hanif. "**Empowering Precision Agriculture: Efficient Angle-Aware Coverage for 3D Structure Reconstruction with Drone Teams.**" SSS Matching Workshop, Tokyo Institute of Technology, November 29, 2023. [Poster]

[D3] Muhammad Hanif. "**Empowering Precision Agriculture: Efficient Angle-Aware Coverage for 3D Structure Reconstruction with Drone Teams.**" SSS Global Forum 2023: Future of Super Smart Society, Tokyo Institute of Technology, November 3, 2023. [Poster]

[D4] Muhammad Hanif. "**Human-collaborative Control of Drone Networks with Virtual Reality.**" SSS Matching Workshop, Tokyo Institute of Technology, November 16, 2022. [Poster]

[D5] Muhammad Hanif. "**Real-time Adaptation of Drone Altitudes and Object Detection Models for Aerial Target Tracking.**" SSS Matching Workshop, Tokyo Institute of Technology, June 8, 2022. [Poster]

[D6] Muhammad Hanif. "**Computationally Inexpensive UAV/UGV Allocation for Radiation Monitoring over Mega Solar Power Plants.**" SSS Matching Workshop, online, June 9, 2021.

Thesis

[T1] Muhammad Hanif. "**Real-Time Optimization for Dynamic Multiple Target Allocation and Tracking with Heteregeneous Robotic Systems.**" M.Eng. Thesis, Department of Systems and Control Engineering, Tokyo Institute of Technology, Aug 2022. [Thesis]

[T2] Muhammad Hanif. "**Design and Implementation of Control System in Hybrid Underwater Glider Vehicle in ROS Environment.**" B.Sc. Thesis, Department of Electrical Engineering, Bandung Institute of Technology, July 2018. [Thesis]

Patents

[P1] Sapto Adi Nugroho, Natsir Habibullah, Simon Siregar, Bambang Riyanto Trilaksono, Egi Muhammad Idris Hidayat, Fachry Ahmad Efendi Yakin, Muhammad Hanif, Muhammad Faisal Sagala, et al., "**Buoyancy Engine using Fluid Bags on a Hybrid Autonomous Underwater Glider and Method for Operating It**," Indonesia Patent No. P00202102652, April 13, 2021. [Patent]
Description: Invented a buoyancy engine for a Hybrid Autonomous Underwater Glider (HAUG) using fluid bags and described methods for its operation. The system uses a hydraulic pump, valves, sensors, and internal and external fluid bags to control buoyancy.

Awards & Recognition

WISE SSS Doctoral Leadership Scholarship: Funding support awarded by WISE SSS Tokyo Tech for enrolled students with high research ability and outstanding potential (Oct 2023 – Feb 2024)

Japanese Government MEXT Scholarship: Scholarship awarded by Japanese Government to conduct graduate study in Japan (Oct 2020 – Sept 2025)

Indonesia Aerial Robotics Competition 2017 - Best Design: Won Best Design awards in the national aerial robotics competition for building Folding-Wing Tube-Launched UAV (Sept 2017)

Smart City Robot Innovation Challenge - Champion: Won the first champion in the domestic robotics competition for developing Vertical Take-Off Unmanned Aerial Vehicle (Apr 2017)

Indonesia Aerial Robotics Competition 2016 - 1st Runner Up: Won 1st Runner-Up Champion in the national aerial robotics competition for building Hybrid VTOL UAV (Sept 2016)

Bandung Institute of Technology - Outstanding Student Award: Awarded to students who have been to be the top 1% for the academic performance among the year. (Aug 2015)

Indonesia National Science Olympiad 2013 - Bronze Medal Won bronze medal at the Indonesia National Science Olympiad 2013 in the field of mathematics. (Aug 2013)

International Young Mathematician Convention India 2012 - Silver Medal Won silver medal at the International Mathematics Competition in India 2012 (Nov 2012)

International Mathematics Contest Singapore 2011 - Silver Medal Won silver medal at the International Mathematics Contest Singapore in 2011 (Aug 2011)

Invitational World Youth Mathematics Intercity Competition 2011 - Bronze Medal Won bronze medal at the IWYMIC Indonesia in 2011 at the Individual Contest(July 2011)

Invitational World Youth Mathematics Intercity Competition 2010 - Bronze Medal Won bronze medal at the IWYMIC South Korea in 2010 at the Team Contest (July 2010)

Teaching Experience

Department of System and Control Engineering, Tokyo Institute of Technology

- **Optimal Control** by Prof. Takeshi Hatanaka, Teaching Assistant (Spring 2024)
- **Cyber Physical Innovation**, Teaching Assistant (Fall 2022)

Department of Electrical Engineering, Bandung Institute of Technology

- **Image Processing** by Prof. Tati Rajab Mengko & Dr. Astri Handayani, Teaching Assistant (Fall 2018)

Mathematics Education Clinic, Bogor, Indonesia

- **Math Olympiads for Elementary and Middle Schools**, Tutor (2012 - 2014)

Technical Skills

Languages: English (Proficient C1), Japanese (Basic N4), Arabic (Intermediate), Indonesian (Native)
Programming: C/C++, C#, Python, MATLAB, JavaScript, LaTeX
Software: Systems (Linux, Windows, ROS/ROS2), Tensorflow, CUDA, OpenCV, Git, Visual Studio, Unity, Gazebo, Eagle, Altium Designer, Mission Planner, Ardupilot
Hardware: Raspberry-Pi, Arduino, Beaglebone, Udoo, Pixhawk, Ardupilot, DJI Mavic, Parrot Bebop

Selected Research Highlighted in Media

- Article: "ARNADYAKSA, Mini 'Submarine' by ITB Students", by Ahmad Fadil, ITB News, 2018
- Article: "Mahasiswa ITB Ciptakan Kapal Selam Mini Tanpa Awak", by Kumparan News, 2018
- Article: "Mahasiswa ITB Buat Robot Pesawat yang Sayapnya Bisa Dilipat", by Kumparan News, 2017
- News: "Nirawak Pesawat Lipat Karya Mahasiswa ITB", by detikcom, 2017

Professional & Social Activities

Professional Membership

- IEEE Control Systems Society, IEEE Student Member
- SICE (The Society of Instrument and Control Engineers) Student Member

Organization Experience

2023 ***Student Executive Committee***, WISE SSS Tokyo Tech
Student committee responsible for organizing events within WISE SSS Tokyo Tech.

2022 ***Vice Chairman***, Tokyo Tech Muslim Community
Student committee responsible for organizing events to address the needs of Muslim students at Tokyo Institute of Technology.

2020 ***Chairman***, Muslim Hackfest by OpenUmma
Organized the virtual hackathon event in Indonesia. The event included Open Source Discussions, four Grand Webinars, and a Hackathon. Around 140 ideas were submitted, and approximately 250 participants attended the webinars. Held in January 2021.

2019 ***Co-Founder and Head of Curriculum Division***, Rumah Muda Inspirasi (RUMI)
Rumah Muda Inspirasi (RUMI), translated as "Residence of Young Inspiration," is a scholarship in form of a residence and technopreneurship coaching for university student.

2018 ***Co-Founder***, Young Intellectual Salman ITB
Established a community to provide guidance and information for students pursuing graduate studies both domestically and internationally.

2017 ***Vice Minister of Academic and Advocacy Division***, Electrical Engineering Student Association
Coordinated training and events to enhance academic performance and provided academic advocacy for Bandung Institute of Technology electrical engineering student members (HME ITB).

2016 ***Project Lead***, Technology Development Division - Aksantara Research Group
Led team of 12 students to conduct research about UAV technology development for competing in Indonesian Aerial Robotics Competition 2016.

2015 ***Chairman***, Regional Students University Association from Bogor Area
Led the association representing students from Bandung Institute of Technology residing in the Bogor area, organizing events with the aim of supporting high school students in Bogor.

2013 ***Coordinator***, High School Mathematics Olympiad Student Community
Coordinated the math Olympiad team for domestic competitions, arranged the syllabus, and taught it to the team members.

Volunteer Experience

- Gave a talk about career, graduate study, and scholarship seminars for Indonesian student communities. 2020 - 2024.
- Taught Quran and Arabic for primary and junior high school Indonesian students in Japan, 2022 - 2024.
- Gave a talk about robotics seminar for high school students in SMK Pertanian Lembang, Indonesia. January 17, 2020.
- Conducted a career inspiration class for primary school students in South Garut, Indonesia. Senyum Indonesia, June 1, 2018.

External Links

- Website: https://mhd-hanif.github.io
- Google Scholar: https://bit.ly/hanif-scholar
- Github: https://github.com/mhd-hanif
- LinkedIn: https://www.linkedin.com/in/muhammad-hanif-6189b0157/