Muhammad Hanif

hanif@hfg.sc.e.titech.ac.jp | ORCID | LinkedIn | GitHub | Google Scholar | Tokyo, Japan

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Education

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

Advisor: Prof. Takeshi Hatanaka
Thesis: Real-Time Optimization for Dynamic Multiple Target Allocation and Tracking with Heteregeneous Robotic 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 & Work Experience

Tokyo Institute of Technology **Tokyo, Japan**
Research Assistant, Hatanaka Laboratory *May 2022 – Present*

- Multi-Robot Task Allocation Project: Created a simulator using Unity and ROS2 for simulating multi-robot task allocation scenarios.
  Highlight: ROS2, Unity, Python, C#, Path Planning, Multi-Robot Task Allocation.
- Drone Target Tracking Project: Improved drone coverage control methods for dynamic target tracking applications.
  Highlight: ROS, Python, Coverage Control, Drone Target Tracking, TensorFlow.
- Automatic Ship Control Project: Designed control methods for vessel autonomous operation in a port with safety certificates. This project was a joint research collaboration with Kawasaki Heavy Industry
  Highlight: MATLAB, Control Barrier Function (CBF), Model Predictive Control (MPC).

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

- Co-founded a service UAV 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*

- Designed and developed the Hybrid Underwater Vehicle (HUG) for long-distance surveillance missions and conducted sea testing.
- Led the design team to iterate all engineering aspects of the vehicle, including software, hardware, and mechanical components.
  Supervisor: Prof. Bambang Riyanto, Dr. Egi Hidayat, & Dr. Sapto Adi Nugroho
  Highlight: Hybrid Underwater Glider (HUG), Waypoint Tracking, ROS, C++, Python.

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

- Built algorithms and machine learning models using TensorFlow for automatic grading of diabetic retinopathy severity
- Developed automatic brain tumor classification from a brain tumor dataset into three classes using deep learning.
  Supervisor: Prof. Tati Rajab & Dr. Astri Handayani
  Highlight: Machine Learning, X-ception, Tensorflow, Keras, OpenCV.

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

- Implemented Control & Monitoring System for HALE (High Altitude Long Endurance) UAV, with a wingspan of 21 meters.
  Supervisor: Dr. Ing. M. Agoes Moelyadi.
  Highlight: Pixhawk, Mission Planner, Waypoint Tracking, Real-Time Monitoring Streaming, Antenna Tracker.

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

- Folding-Wing UAV Project: Built control and guidance systems for the folding-wing tube-launched drone. Achieved best design recognition at the national drone competition in 2017.
  Supervisor: Ony Arifianto Ph.D.
  Highlight: Folding-Wing UAV, Pixhawk, Mission Planner, Python
- Hybrid VTOL UAV Project: 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.
  Supervisor: Prof. Bambang Riyanto Trilaksono.
  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. Muhammad Hanif and Takeshi Hatanaka. "**Real-time Adaptation of Drone Altitude and Object Detection Model for Moving Target Tracking.**" *SICE Annual Conference*, to be presented (2024)

C2. 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 presented (2024)

C3. 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]

C4. 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]

C5. 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]

C6. 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]

C7. 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]

C8. 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 & Honors

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

West Java Governor Scholarship: Awarded to students who have high academic performance during the undergraduate studies (Dec 2016 – May 2018)

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)

Bogor Senior High School Valedictorian Award: Graduated as the highest ranked student during senior high school. (Jun 2014)

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)

Projects Experience

Aerial Drone Moving Target Tracking Project Sept 2022 - Mar 2023

- Extended a coverage control method to be used for moving target tracking application using UAV.

Autonomous Ship Control for Operation in Port May 2022 - Aug 2022

Joint Research between Hatanaka Laboratory and Kawasaki Heavy Industry Tokyo Institute of Technology

- This project was a joint collaboration with Kawasaki Heavy Industry. Developed a controller using MPC (Model Predictive Control) and CBF (Control Barrier Function) for autonomous ship operation in port with safety certificate.

Multi Robot Task Allocation for Thermosolar Radiation Monitoring Aug 2021 - Apr 2023

Hatanaka Laboratory, supervised by Prof. Takeshi Hatanaka & Prof. J.M. Maestre Tokyo Institute of Technology

- This project was a joint collaboration with Seville University in Spain. Developed a simulator using ROS and Gazebo for the scenario of multi-robot task allocation using UGV (Unmanned Ground Vehicle) and UAV (Unmanned Aerial Vehicle). The project itself was directed for the thermosolar radiation monitoring application for monitoring a dynamic target.

Ganeshblue II : Hybrid Autonomous Underwater Glider July 2018 - May 2020

Advanced Robotics Laboratory, supervised by Prof. Bambang Riyanto Bandung Institute of Technology

- Designed and developed the Hybrid Autonomous Underwater Glider (HAUG) for long-distance surveillance missions and conducted sea testing.

Automatic Screening for Diabetic Retinopathy May 2018 - Dec 2018
Biomedics Research Group Bandung Institute of Technology

- This research project was in collaboration with Eye Hospital Cicendo Bandung to do the early research about diabetic retinopathy automatic detector to be used in enhancing the diagnostic process of DR examination. We worked in the team of four to create deep learning classifier to automatically detect the severity of DR cases. The output of this research was published in the IEEE conference publication.

HALE (High Altitude Long Endurance) UAV Aug 2016 - Nov 2018
CentrUMS (Center of Unmanned System Studies) Bandung Institute of Technology

- Developed HALE (High Altitude Long Endurance) UAV that will operate in the altitude of 30.000 feet mdpl for days mission. The aircraft itself had 21 metres of wing-span with fully autonomous avionics component. I was responsible as the only electrical engineer in the team that need to handle the aircraft's avionics system.

Brain Tumor CNN Classifier Aug 2017 - May 2018
Biomedics Research Group Bandung Institute of Technology

- This project started as the part of final project in the course of "Digital Image Processing" in 2017. We published the result also in the World Congress on Medical Physics & Biomedical Engineering 2018.

Arnadyaksa : Low Cost Autonomous Underwater Vehicle Aug 2017 - Jan 2018

- This project started as the part of tanoto student research competition in 2017. We secured a funding from Tanoto Group to create the prototype of autonomous underwater vehicle to monitor coral reef in the water territory. We succesfully developed 1.6 metres underwater vehicle that had been presented in two national exhibitions and also reported in several online news platforms such as Kumparan.

Autonomous Folding-Wing Tube-Launched UAV Jan 2017 - Nov 2017
Aksantara Research Team & Flight Physics Research Group Bandung Institute of Technology

- Developed the autonomous folding-wing tube-launched UAV. Our project got "1st Runner-Up" and "Best Design" in the Indonesia Aerial Robotics Competition 2017.

Autonomous Hybrid VTOL (Vertical Take-Off Landing) UAV Jan 2016 - Nov 2016
Joint Research between Aksantara Research Team & Aero Terra Scan

- Developed the autonomous hybrid VTOL (Vertical Take-Off Landing) aircraft. Our project got "1st Runner-Up" in the Indonesia Aerial Robotics Competition 2016. Moreover, this project also awarded as a champion in the "Smart-City Robot Innovation Challenge 2017".

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)

Skills

Languages: English (Proficient C1), Japanese (Basic N4), Arabic (Intermediate), German (Basic A2), Indonesian (Native)
Programming: C/C++, C#, Python, MATLAB, VHDL, 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, FPGA, 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 first virtual muslim hackathon 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 Youth 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.

Hobbies

- Kickboxing, Badminton, Football.