

# WEI ZHU

Assistant Professor at the Department of Robotics, School of Engineering, Tohoku University, Sendai, Japan

+86-189-0215-1725 | [zhu.wei.c1@tohoku.ac.jp](mailto:zhu.wei.c1@tohoku.ac.jp) | <https://www.weizhu996.com>

## INTEREST

My research focuses on developing intelligent and adaptive control systems for legged and mobile robots operating in complex, dynamic, and human-centered environments. I am particularly interested in **deep reinforcement learning (DRL)** for **quadrupedal and humanoid locomotion on uneven terrains**, **social navigation for legged robots using DRL**, and **mobile robot navigation in highly dynamic environments**. My ultimate goal is to enable robots to **interact naturally and safely with humans**, contributing to the development of robots that can **serve and assist human societies**.

## WORK

- **Tohoku University** [🌐] April 2025 - Present  
Sendai, Japan  
*Assistant Professor*
  - Embodied AI
  - Social navigation for mobile, quadrupedal, and humanoid robots
  - Humanoid whole-body loco-manipulation
  - **Teaching:** Neuro Robotics, Exercises in Computer-Aided Problem Solving
- **Georgia Institute of Technology** [🌐] April 2024 - March 2025  
Atlanta, USA  
*Postdoctoral Researcher*
  - Collaborator: Ye Zhao
  - Research: Social navigation for bipedal robot using DRL
- **Jingdong Logistics** October 2023 - March 2024  
Beijing, China  
*Algorithm Engineer*
  - Path planning for service robots and self-driving vehicles
- **Panasonic AI Lab** [🌐] May 2022 - September 2022  
Osaka, Japan  
*Internship*
  - Vision-based robotic manipulation using DRL

## EDUCATION

- **Tohoku University** October 2020 - September 2023  
Sendai, Japan  
*PhD in Robotics*
  - Supervisor: Mitsuhiro Hayashibe
  - Research: mobile robot navigation in dynamic environments using DRL
- **Nankai University** September 2017 - June 2020  
Tianjin, China  
*Master in Control Science and Technology*
  - Supervisor: Yongchun Fang
  - Research: snake-like robots
- **Nankai University** September 2013 - June 2017  
Tianjin, China  
*Bachelor in Intelligent Science and Technology*

## SELECTED PUBLICATIONS

- [1] W. Zhu and M. Hayashibe, **Autonomous Navigation System in Pedestrian Scenarios using a Dreamer-based Motion Planner**, *IEEE Robotics and Automation Letters (RA-L)*, vol. 8, no. 6, pp. 3836-3843, 2023.
- [2] W. Zhu and M. Hayashibe, **A Hierarchical Deep Reinforcement Learning Framework with High Efficiency and Generalization for Fast and Safe Navigation**, *IEEE Transactions on Industrial Electronics (TIE)*, vol. 70, no. 5, pp. 4962-4971, 2023.
- [3] W. Zhu, X. Guo, D. Owaki, K. Kutsuzawa, and M. Hayashibe, **A Survey of Sim-to-Real Transfer Techniques Applied to Reinforcement Learning for Bioinspired Robots**, *IEEE Transactions on Neural Networks and Learning Systems (TNNLS)*, vol. 34, no. 7, pp. 3444-3459, 2023.
- [4] W. Zhu, X. Guo, Y. Fang, and X. Zhang, **A Path-Integral-Based Reinforcement Learning Algorithm for Path Following of an Autoassembly Mobile Robot**, *IEEE Transactions on Neural Networks and Learning Systems (TNNLS)*, vol. 31, no. 11, pp. 4487-4499, 2020.
- [5] W. Zhu and M. Hayashibe, **Learn to Navigate in Dynamic Environments with Normalized LiDAR Scans**, in *IEEE International Conference on Robotics and Automation (ICRA)*, 2024, pp. 7568-7575.

- [24.J] Z. Yao, X. Chen, M. Hayashibe, N. Xu, T. Yuan, and W. Zhu, **Spatiotemporal Feature-Encoded Navigation for USVs in Unpredictable Maritime Scenarios**, *IEEE Transactions on Vehicular Technology (TVT)*, accepted, 2025.
- [23.J] I. T. Kurniawan, W. Zhu, D. Owaki, and M. Hayashibe, **Learning Perceptive Legged Robot Locomotion in the Real World: A Systematic Survey**, *IEEE Robotics and Automation Magazine (RAM)*, accepted, 2025.
- [22.C] Z. Gu, W. Zhu\*, and M. Hayashibe, **Multi-Object Loco-Manipulation using Body Holding Primitives for Humanoids**, *IEEE/SICE International Symposium on System Integration (SII)*, accepted, 2025.
- [21.J] F. W. X. Nal, J. Jang, W. Zhu, Z. Gu, A. Wu, and Y. Zhao, **Learn to Teach: Sample-Efficient Learning for Humanoid Locomotion Over Real-World Uneven Terrain**, *IEEE Robotics and Automation Letters (RA-L)*, vol. 10, no. 9, pp. 9048-9055, 2025.
- [20.J] Z. Yao, X. Chen, M. Hayashibe, W. Zhu, and N. Xu, **Local Collision Avoidance for Unmanned Surface Vehicles Based on an End-to-End Planner With a LiDAR Beam Map**, *IEEE Transactions on Intelligent Transportation Systems (TITS)*, vol. 26, no. 6, pp. 7990-8005, 2025.
- [19.C] W. Zhu and M. Hayashibe, **Learn to Navigate in Dynamic Environments with Normalized LiDAR Scans**, in *IEEE International Conference on Robotics and Automation (ICRA)*, 2024, pp. 7568-7575.
- [18.T] W. Zhu, **Prior Knowledge-free Robot Navigation in Dynamic Environments through Deep Reinforcement Learning**, *PhD Thesis*, 2023.
- [17.J] W. Zhu and M. Hayashibe, **Autonomous Navigation System in Pedestrian Scenarios using a Dreamer-based Motion Planner**, *IEEE Robotics and Automation Letters (RA-L)*, vol. 8, no. 6, pp. 3836-3843, 2023.
- [16.J] W. Zhu and M. Hayashibe, **A Hierarchical Deep Reinforcement Learning Framework with High Efficiency and Generalization for Fast and Safe Navigation**, *IEEE Transactions on Industrial Electronics (TIE)*, vol. 70, no. 5, pp. 4962-4971, 2023.
- [15.J] W. Zhu, X. Guo, D. Owaki, K. Kutsuzawa, and M. Hayashibe, **A Survey of Sim-to-Real Transfer Techniques Applied to Reinforcement Learning for Bioinspired Robots**, *IEEE Transactions on Neural Networks and Learning Systems (TNNLS)*, vol. 34, no. 7, pp. 3444-3459, 2023.
- [14.C] W. Zhu, F. Raza, and M. Hayashibe, **Reinforcement Learning based Hierarchical Control for Path Tracking of a Wheeled Bipedal Robot with Sim-to-Real Framework**, in *IEEE/SICE International Symposium on System Integration (SII)*, 2022, pp. 40-46.
- [13.P] Y. Fang, W. Zhu, X. Guo, and X. Zhang, **Auto-assembly Modular Robot**, *Chinese Patent*, 2022, Grant No. ZL 2019 1 0083530.X.
- [12.P] Y. Fang, W. Zhu, X. Guo, and X. Zhang, **A Claw-bolt-baffle Mechanism**, *Chinese Patent*, Grant No. ZL 2019 1 0083528.2, 2022.
- [11.J] F. Raza, W. Zhu, and M. Hayashibe, **Balance Stability Augmentation for Wheel-Legged Biped Robot Through Arm Acceleration Control**, *IEEE Access*, vol. 9, pp. 54022-54031, 2021.
- [10.J] W. Zhu, X. Guo, Y. Fang, and X. Zhang, **A Path-Integral-Based Reinforcement Learning Algorithm for Path Following of an Autoassembly Mobile Robot**, *IEEE Transactions on Neural Networks and Learning Systems (TNNLS)*, vol. 31, no. 11, pp. 4487-4499, 2020.
- [9.J] W. Zhu, X. Guo, Y. Fang, and X. Zhang, **Development of a Reconfigurable Modular Snake-like Robot and Research on Multiple Motion Modes**, *Information and Control*, vol. 49, no. 1, pp. 69-77, 2020.
- [8.C] X. Zhang, X. Guo, Y. Fang, and W. Zhu, **Reinforcement Learning-based Hierarchical Control for Path Following of a Salamander-like Robot**, in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2020, pp. 6077-6083.
- [7.T] W. Zhu, **Mechanical Design and Intelligent Control of Modular Snake-like Robots**, *Master Thesis*, 2020.
- [6.J] X. Guo, W. Zhu, and Y. Fang, **Guided Motion Planning for Snake-like Robots Based on Geometry Mechanics and HJB Equation**, *IEEE Transactions on Industrial Electronics (TIE)*, vol. 66, no. 9, pp. 7120-7130, 2019.
- [5.C] X. Guo, W. Zhu, and Y. Fang, **Any Curve Path Following of Snake-like Robots**, in *IEEE International Conference on Robotics and Biomimetics (ROBIO)*, 2019, pp. 1286-1291.
- [4.C] X. Zhang, Y. Fang, W. Zhu, and X. Guo, **A Novel Locomotion Controller Based on Coordination Between Leg and Spine for a Quadruped Salamander-Like Robot**, in *International Workshop on Robot Motion and Control (RoMoCo)*, 2019, pp. 68-73.
- [3.J] Y. Fang, W. Zhu, and Xian Guo, **Target-Directed Locomotion of a Snake-Like Robot Based on Path Integral Reinforcement Learning**, *Pattern Recognition and Artificial Intelligence*, 2018.
- [2.C] W. Zhu, X. Guo, and Y. Fang, **Design of a Modular Snake Robot and Control with Internet of Things**, in *International Workshop on Robot Motion and Control (CAC)*, 2017, pp. 850-854.
- [1.T] W. Zhu, **The Design of a Distributed Controller for the Modular Snake Robot**, *Bachelor Thesis*, 2017.

## SUBMISSIONS

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- [1] W. Zhu, A. Raju, A. Shamsah, A. Wu, S. Hutchinson, and Y. Zhao, **EmoBipedNav: Emotion-aware Social Navigation for Bipedal Robots with Deep Reinforcement Learning**, *IEEE/ASME Transactions on Mechatronics (T-MECH)*, reject and resubmit, 2025.
- [2] T. Yuan, W. Zhu\*, and M. Hayashibe\*, **Iterative Adversarial Learning with Chaser Agents for Time-efficient Crowd-aware Navigation**, *IEEE Robotics and Automation Letters (RA-L)*, under review, 2025.
- [3] I. T. Kurniawan, W. Zhu, and M. Hayashibe, **Functional Roles of Postural Reflex and Exteroception in Learning-Based CPG-Driven Quadrupedal Locomotion**, *Scientific Reports*, under review, 2025.

## HONORS AND AWARDS

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- FY2023 JSME Graduate Research Encouragement Award, September 2023
- Graduate National Scholarship, Top 3%, November 2019
- Chinese Challenge Cup, National Third Prize, November 2019

## ACADEMIC SERVICES

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- Reviewer of IEEE Robotics and Automation Letters (RA-L)
- Reviewer of IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- Reviewer of IEEE International Conference on Robotics and Automation (ICRA)
- Reviewer of IEEE Transactions on Industrial Electronics (TIE)
- Reviewer of IEEE Transactions on Neural Networks and Learning Systems (TNNLS)
- Reviewer of IEEE Transactions on Industrial Informatics (TII)
- Reviewer of IEEE/ASME Transactions on Mechatronics (T-MECH)
- Reviewer of IEEE Transactions on Intelligent Transportation Systems (TITS)
- Reviewer of Scientific Report