

# Zhihai Bi

☎ (+86)15651819986 | ✉ zhihaibi90@gmail.com | 🏠 <https://zhihaibi.github.io/> | 📄 Google Scholar

## SUMMARY

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**Research Interests:** My interest mainly lie in the robot **motion planning and control** in humanoid, quadrupedal robots, UAV and autonomous vehicles. My goal is to push the boundaries of what robots can achieve and bring them closer to human capabilities.

**Highlights:** Six years of robotics study experience, three years of research experience in robot planning and control, one semester of experience in robot arm teaching.

**Relevant Courses:** Robot Software Engineering(A), Principles of Automatic Control(A), Nonlinear Dynamics(A-), Geometry&Algebra(100), Advanced Mathematics(A), C++ Programming(A).

## EDUCATION

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- **Southeast University (985, Double First-Class University)** Nanjing, China  
*Bachelor in Robot Engineering, School of Automation. (Top 3 in China as ARWU) Sept 2017 – Jun 2021*  
**GPA:** 3.81/4.00, **Ranking:** 12/156 (7.6%)  
**Final Year Project:** Path planning and physical simulation for snake-like and worm-like robots.
- **Fudan University (QS Ranking: 34 in 2023)** Shanghai, China  
*MPhil, Computer Applied Technology, Institute of AI and Robotics Sept 2021 – Jun 2024*  
**Supervisor:** Prof. Hongbin Fang  
**GPA:** 3.57/4.00, **Ranking:** 5/18  
**MPhil Project:** Design, modeling, motion planning and control of a Worm-Snake-Inspired Metameric robot.

## PUBLICATIONS

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- *Journal Papers*
  1. **A Worm-Snake-Inspired Metameric Robot for Multi-Modal Locomotion: Design, Modeling, and Unified Gait Control**  
Z.h. Bi, Q.y. Zhou, H.b. Fang. *International Journal of Mechanical Sciences* (Q1,Top,IF=7.3), 2023. [\[Link\]](#)
  2. **Dynamic models for Planar Peristaltic Locomotion of a Metameric Earthworm-like Robot**  
Q.y. Zhou, H.b. Fang, Z.h. Bi, J. Xu  
The International Journal of Robotics Research.(Under review). [\[Link\]](#)
  3. **A Multi-Modal Metameric Earthworm-Like Robot for Locomotion in Complex Terrain**  
Z.h. He, Q.w. Zhang, Z.h. Bi, and H.b. Fang  
IEEE/ASME Transactions on Mechatronics. (Under review).
  4. **Multi-Modal planning and control framework for Worm-Snake-Inspired Metameric Robot.**  
Z.h. Bi, Q.y. Zhou, H.b. Fang  
IEEE Robotics and Automation Letters. (In preparation).
- *Conference Papers*
  1. **Design and path planning for a Worm-Snake-Inspired Metameric(WSIM) robot**  
Z.h. Bi, J. Xu, H.b. Fang  
IEEE International Conference on Robotics and Biomimetics(ROBIO), 2022 (oral) [\[Link\]](#)
- *Invention Patents*
  1. **A Method for Indoor Unmanned Aerial Vehi-cles Formation Flight Based on Frame-by-Frame Recognition and Generation of Raw Point Clouds.**  
D.x. Chen, Y.q. Zhao, Z.h. Bi, G.b. Shao, & W.w. Yu  
Chinese Patent, CN 111580554 B. (Authorized)

## PROJECTS

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- **Multi-modal planning and control for the WSIM robot** *Oct 2022 – Present*
  - Proposed multi-modal planning method for a Worm-Snake-Inspired Metameric (WSIM) robot, in which the topological guidelines are used as heuristic functions for Hybrid A\* considering mode selection and kinematics constraint.
  - Optimized the trajectories and modes simultaneously, utilizing the extended feasible region and the quadratic programming based on the proposed cost function.
  - Proposed a multi-modal control method using the prediction of refined dynamics models of two locomotion modes, which achieved higher tracking accuracy compared with the other methods.
  - Conducted comprehensive experiments with large scenarios, which further demonstrates the effectiveness of the proposed multi-modal planning and control framework.
- **Design, modeling and gait generation for the bio-inspired robot** *Aug 2021 – Oct 2022*
  - Designed and built the WSIM robot, which can perform both snake-like and worm-like locomotion and five different gaits in total.
  - Modeled the kinematics and dynamics of the WSIM robot in two different locomotion modes, which were further validated through the numerical simulation and experimentation.
  - Proposed a unified gait generation framework, which simplifies the control logic by unifying the gait signals of worm-like and snake-like locomotion modes using the parameter vector.
- **Path planning and simulation for the metameretic robot.** *Oct 2020 – Jun 2021*
  - Developed a novel metameretic robot in the Webots simulator using the URDF, Which takes into account kinematics, friction, etc.
  - Proposed an improved A\* algorithm for the metameretic robot considering the slender body and the cost of robot orientation.
  - Built a co-simulation system for algorithms and simulators, allowing for rapid iteration of algorithms.

## TEACHING AND ACTIVITIES

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- **Introduction to Robotics INFO130371.01, Fudan University** *Teaching Assistant*
  - Responsible for robot arm kinematics, dynamics modeling, and trajectory planning *Spring 2022*
- **IEEE International Conference on Robotics and Biomimetics(ROBIO)** *Oral*
  - Present a novel design and the path-planning algorithm for the WSIM robot, which is suitable for both open and narrow terrains. *Dec 2022*

## HONORS AND AWARDS

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- Outstanding Graduate Student Award of Southeast University (Top 3% of 200 students) *2021*
- Principal's scholarship of Southeast University (Top 3% of 200 students) *2017 – 2018*
- Merit student of Southeast University *2018*
- The 10th University Robotics Competition, Jiangsu Province (Province, 1st place) *2019*
- China ICV Algorithms Challenge: LKA lateral control (National, 1st place) *2022*
- The 15th National Student Intelligent Vehicle Competition (National, 2nd prize) *2020*
- Outstanding Student Scholarship of Fudan University(Grade 1) *2021 – 2022*
- Cyrus Tang Scholarship (four consecutive years) *2017 – 2021*

## SKILLS

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- **Robot design:** Solidworks, STM32, Altium Designer
- **Robot modeling:** Kinematics and dynamics modeling, Newton Euler and Lagrange
- **Robot simulation:** Webot, RViz, Matlab Robotics Toolbox...
- **Robot Programming:** ROS, C/C++, Python, Matlab, Eigen, Docker, OOQP, OSQP...
- **Self-learning courses:** Convex Optimization I(Prof. Boyd), Motion Planning for Mobile Robots(Prof. Fei Gao), Optimal Control 2022(Prof. Zachary)...
- **Language:** Cantonese(native), Mandarin, English(IELTS 7.0: L8.5, R7.0, W6.0, S6.0)