

Ziyan Zhao

Ph.D. Candidate in Mechatronic Engineering

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EDUCATION

Department of Mechanical Engineering

Ph.D. in Mechatronic Engineering.

Tsinghua University

Aug. 2021 - Jun. 2026 (Expected)

- **Ph.D. Supervisor:** Prof. Chuxiong Hu.
- **Fields of Interest:** Sensorless control; Precision motion control; Robotics; Embedded development; Deep Reinforcement learning.
- **GPA:** 3.95/4.0; ranking 5 of 112 (Top 5%).
- **Honor:** National Scholarship for Postgraduate, Oct. 2023. (Top 2%)

Department of Mechanical Engineering

Bachelor of Engineering, Mechanical Engineering.

Tsinghua University

Aug. 2017 - Aug. 2021

- **GPA:** 3.80/4.0; ranking 6 of 133 (Top 5%).
- **Honors:**
 - * Tsinghua Future Scholar Scholarship, Aug. 2021. (Top 5%)
 - * Beijing Outstanding Undergraduate Award, Jul. 2021. (Top 5%)
 - * Tsinghua Excellent Undergraduate Award, Jun. 2021. (Top 10%)
 - * Excellent Graduation Thesis of Tsinghua University, Jun. 2021. (Top 5%)

Department of Computer Science and Technology

Minor in Computer Science.

Tsinghua University

Aug. 2018 - Aug. 2021

- **GPA:** 3.92/4.0.
- **Core Courses:** Data structures (4.0); Computer Hardware Technology (4.0); Computer Graphics (4.0); Software Engineering (4.0); Operating Systems (4.0); Introduction to Artificial Intelligence (4.0).

RESEARCH AND PROJECTS

Precision Mechatronics and Control Lab

Supervisor: Prof. Chuxiong Hu

Tsinghua University

- **Research on Ideal Sensorless Control of IPMSM** Jun. 2022 - Jun. 2023
 - * Proposed the concept of "ideal sensorless control (ISC)", which aims to be applicable across the entire speed range, robust to motor parameter variations, and high in electrical efficiency.
 - * Proposed a novel fundamental PWM excitation-based rotor position estimation algorithm that satisfies ISC.
 - * Realized the algorithm using FPGA. Experimental results demonstrate that the ISC offers superior advantages over traditional methods, and can be more extensively applied in the field of servo control.
 - * The proposed ISC method has the potential for integration with existing industrial systems.
- **Back EMF-based Sensorless Control Over Whole Speed Range** Jun. 2021 - Jun. 2022
 - * Sensorless control technology can reduce costs, simplify the system, and prolong the service life.
 - * Traditionally, the poor performance in the low-to-zero speed region limits the application range.
 - * Proposed a novel back EMF-based mover position estimator to achieve consistently good accuracy in the whole speed range including high speeds, low speeds, temporary standstills, and speed reversals.
 - * Built the entire sensorless drive and control system to verify the proposed algorithm.

Numerical Control Technology and Intelligent Equipment Lab

Supervisor: Dr. Ze Wang

Tsinghua University

- **Ceramic Additive-Subtractive Composite Manufacturing Equipment** Jun. 2021 - Dec. 2021
 - * Designed a new ceramic manufacturing process, summarized as Extrusion-Curing-Milling.
 - * Compared to traditional photo-cured ceramic 3D printing which uses LCD screen formation, our process forms the shape by extrusion and milling, thus breaking the size limitation caused by the light source.
 - * Developed the Alpha prototype of the ceramic manufacturing equipment.

Extracurricular Science and Technology Competitions

- **SnakeGo — The 26th Tsinghua University Agent Competition (THUAC)** Jan. 2022 - Mar. 2022
 - * Wrote thousands of lines of AI code to enable the intelligent agent to win a game named SnakeGo.

- * Wrote a local visualization interface of the game using visual C++.
- * The algorithm framework is developed based on the minimax tree search and the alpha-beta pruning.
- **Resource Defense Battle — Meituan Cup 23rd Electronic Design Competition** **Oct. 2021 - Dec. 2021**
 - * Crafted a smart car based on STM32 to compete for virtual resources on the game map.
 - * Designed and manufactured printed circuit boards (PCBs) for electrical connections.
 - * Used Kalman filter to estimate the actual position and rotation angle of the car.
 - * All algorithms are written by myself from scratch, including the low-level motor control loop and the high-level perception, decision-making, and planning algorithms.

INTERNSHIPS

3D Vision Hardware Group

Mech-Mind Robotics

Supervisor: Ting Wang

Beijing, China

- **Precision motion control of stepper motors for laser mirrors** **Jun. 2021 - Sep. 2021**
 - * Contributed to replacing traditional costly galvanometer motors with more compact and economical stepper motors in structured light scanning systems.
 - * Deployed Iterative Learning Control (ILC) algorithms to achieve satisfactory scanning precision.
 - * Conducted experiments on STM32 platforms to prove the efficacy of the proposed method.

COMPETITION AWARDS

- **Best Paper Award** of 2023 *IEEE Conference on Industrial Electronics and Applications*. **Aug. 2023**
- **First Prize** of Tsinghua University Agent Competition (**2nd Place** out of 100+ competitors). **Mar. 2022**
- **Special Award** of Meituan Cup 23rd Electronic Design Competition (**ranking 1/32**). **Dec. 2021**
- **First Prize** of the 11th TI-Cup Tsinghua Digital System Innovation Design Competition. **Oct. 2021**
- **First Prize** of 2021 Beijing-Tianjin-Hebei Collegiate Electronic Assembly Competition. **May. 2021**
- **First Prize** of Tsinghua University Hardware Design Competition. **Sep. 2019**

PUBLICATIONS

- [1] **Z. Zhao**, C. Hu, Z. Wang, S. Wu, Z. Liu and Y. Zhu, "Back EMF-Based Dynamic Position Estimation in the Whole Speed Range for Precision Sensorless Control of PMLSM," *IEEE Transactions on Industrial Informatics*, vol. 19, no. 5, pp. 6525-6536, May 2023, doi: [10.1109/TII.2022.3205941](https://doi.org/10.1109/TII.2022.3205941). (**SCI, IF=12.3**)
- [2] **Z. Zhao**, C. Hu, S. Wu, Y. Wang, Z. Wang and Y. Zhu, "A Novel Fundamental PWM Excitation-Based Rotor Position Estimation Method for Precision Sensorless Control of IPMSMs," 2023 IEEE 18th Conference on Industrial Electronics and Applications (ICIEA), Ningbo, China, 2023, pp. 28-33, doi: [10.1109/ICIEA58696.2023.10241791](https://doi.org/10.1109/ICIEA58696.2023.10241791). (**EI, Best Paper Award**)
- [3] **Z. Zhao**, C. Hu, S. Wu, Z. Wang, and Y. Zhu, "Ideal Sensorless Control of IPMSM over Whole Speed and Load Range: A Parameter-Free Approach without Signal Injection," *IEEE Transactions on Industrial Informatics*, 2024. (**SCI, Under review**)
- [4] S. Wu, C. Hu, **Z. Zhao** and Y. Zhu, "High-Accuracy Sensorless Control of Permanent Magnet Linear Synchronous Motors for Variable Speed Trajectories," *IEEE Transactions on Industrial Electronics*, vol. 71, no. 5, pp. 4396-4406, May 2024, doi: [10.1109/TIE.2023.3288145](https://doi.org/10.1109/TIE.2023.3288145).
- [5] S. Wu, C. Hu, **Z. Zhao**, R. Zhou and Y. Zhu, "A Novel Flux Estimator Using $\alpha - \beta$ Orthogonality Drift Elimination for High Performance Full-Speed-Range Sensorless Control," 2022 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM), Sapporo, Japan, 2022, pp. 1315-1320, doi: [10.1109/AIM52237.2022.9863297](https://doi.org/10.1109/AIM52237.2022.9863297).
- [6] Y. Wang, C. Hu, Z. Wang, S. Lin, **Z. Zhao**, W. Zhao, K. Hu, Z. Huang, Y. Zhu, Z. Lu, "Optimization-based non-equidistant toolpath planning for robotic additive manufacturing with non-underfill orientation," *Robotics and Computer-Integrated Manufacturing*, 2023, doi: [10.1016/j.rcim.2023.102599](https://doi.org/10.1016/j.rcim.2023.102599).
- [7] Y. Wang, C. Hu, Z. Wang, S. Lin, **Z. Zhao** and Y. Zhu, "Slice Extension for High-Quality Hybrid Additive-Subtractive Manufacturing," *IECON 2023- 49th Annual Conference of the IEEE Industrial Electronics Society*, Singapore, Singapore, 2023, pp. 1-6, doi: [10.1109/IECON51785.2023.10311641](https://doi.org/10.1109/IECON51785.2023.10311641).

PRACTICAL SKILLS

- **Languages:** C++; Python; C#; Java; Verilog HDL; MATLAB.
- **Modeling:** Simulink; AutoCAD; Solidworks; Ansys; Maxwell; Unity3D.
- **Embedded development:** Linux; ROS; ARM; FPGA; PCB design & assembly.
- **AI frameworks:** Pytorch; OpenCV.