

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 consistent good accuracy in the whole speed range including high speeds, low speeds, temporary standstill, 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 forming, our process forms the shape by extrusion and milling, thus breaking the limitation of size 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 AI code to enable the intelligent agent 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 (PCB) 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** 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.