Ziyan Zhao

Ph.D. Candidate in Mechatronic Engineering

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Education

Department of Mechanical Engineering — **Tsinghua University**
Ph.D. in Mechatronic Engineering. — **Aug. 2021 - Jun. 2026 (Expected)**

- **Ph.D. Supervisor**: Prof. Chuxiong Hu.
- **Fields of Interest**: Sensorless control; Precision motion control; Robotics; Deep Reinforcement learning.
- **GPA**: 3.95/4.0; ranking 4 of 111 (Top 5%).
- **Honor**: **National Scholarship for Postgraduate**, Oct. 2023. (Top 2%)

Department of Mechanical Engineering — **Tsinghua University**
Bachelor of Engineering, Mechanical Engineering. — **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 — **Tsinghua University**
Minor in Computer Science. — **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 — **Tsinghua University**
Supervisor: Prof. Chuxiong Hu

- **Research on Ideal Sensorless Control of IPMSM** — **Jun. 2022 - Jun. 2023**
  - Shaft position sensors such as encoders perform an important role in motor servo control, but can increase space and cost. Sensorless control, which uses electric signals to estimate position, is becoming attractive.
  - 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.
  - 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.
  - This work has won the **Best Paper Award** of *2023 IEEE Conference on Industrial Electronics and Applications*.
- **Back EMF-based Sensorless Control Over Whole Speed Range** — **Jun. 2021 - Jun. 2022**
  - Back EMF-based sensorless control technology can reduce costs, simplify the system, and prolong the service life. Still, the poor performance in the low-to-zero speed region is a severe drawback.
  - Proposed a novel back EMF integration-based sensorless controller 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.
  - The results were published in *IEEE Transactions on Industrial Informatics* **(IF=12.3)**.

Numerical Control Technology and Intelligent Equipment Lab — **Tsinghua University**
Supervisor: Dr. Ze Wang

- **Ceramic Additive-Subtractive Composite Manufacturing Equipment** — **Jun. 2021 - Dec. 2021**
  - Traditional ceramic 3D printing uses precision ultraviolet LCD to solidify the liquid slurry containing ceramic particles layer by layer to form the shape. However, the LCD is costly and limits the maximum printable size.
  - Designed a new ceramic manufacturing process, summarized as Extrusion-Curing-Milling.
  - Our process does not require accuracy during the curing process, but forms the shape by extrusion and milling.
  - Developed the Alpha prototype, proving that we have broken the limitations caused by traditional LCDs.

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.

- The algorithm framework is developed based on the minimax tree search and the alpha-beta pruning.
- Finally won the **2nd place** out of over a hundred competitors.

- **Resource Defense Battle — Meituan Cup 23rd Electronic Design Competition** **Oct. 2021 - Dec. 2021**
  - Crafted a smart car based on STM32 and PCB design to compete for virtual resources on a 3m*3m game court.
  - All hardware and software design are done from scratch. Written algorithms include the low-level motor control loop and the high-level perception, decision-making, and planning algorithms.
  - **Won 1st place as a solo participant** among 32 teams comprising 1-4 members.

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. (**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. (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.

[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.

[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.

[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.

PRACTICAL SKILLS

- **Coding**: 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; OpenAI Gym; OpenCV.
- **English**: TOEFL (101).