Chih-Chin (Zhijin) Liu

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Education

Tsinghua University Beijing, China
Master in Mechanical Engineering; GPA: 3.72/4.0 *2021 - Expected Jun. 2024*
Dept. of Mechanical Engineering - Lab of Precision Equipment & Control

- ***Core Courses:*** *Modern Control Theories and Methods (4.0), Mechatronic Intelligent Control Engineering (4.0), Modern Mechatronics System (4.0).*
- ***Research Field:*** *Ultra-Precision Control, Carbon material.*
- ***Scholarship:***
  - *Outstanding Graduate Award of Tsinghua University, Second Class, 2022.*
  - *Outstanding Graduate Award of Tsinghua University, Grand Prize Candidate (**The Highest Honor for All Graduate Students**, 10 Persons in School Each Year), 2023.*
  - *Outstanding Taiwan Graduate Award, Ministry of Education, Grand Prize (**Ranking 1, The Highest Honor for Taiwan Students,** 4 Persons in School Each Year), 2023.*

Hunan University Changsha, China
Bachelor in Mechanical Engineering, GPA: 3.33/4.0, 10% (3/35) *2017 - 2021*
College of Mechanical & Vehicle Engineering - State Key Laboratory

- ***Research Field:*** *Flexible Sensor, Fault Diagnosis*
- ***Scholarships:***
  - *Individual Outstanding (Research) Scholarship, Hunan University, 2018.*
  - *Outstanding Undergraduate Students Award of Hunan University, 2020.*
  - *The Ministry of National Education Scholarship: 2018, 2019, 2020 (Each Year).*
- ***Honors:*** *Outstanding Volunteer of Social Practice, 2021.*
  Outstanding Graduates of Hunan University, 2021.
  *Outstanding Graduation Design of Hunan University **(TOP 1%)**, 2021.*

Research and Projects

Research on Piezoelectric Nano-Precision Control 2022 - 2024, THU

- Proposed a novel nonlinearity compensation scheme that exhibits a comparative performance to **Iterative Learning Control (ILC)**, without time-consuming off-line iterations or complex hysteresis modeling, while enhancing its adaptivity to trajectory variations.
  The related paper was awarded as ***Best Student Paper*** by *IEEE ICCMA 2023.*
- Two-axis PEA motion platform was established to further optimize the contour control error, while attempting to deploy the relevant algorithms to **Atomic Force Microscopy (AFM).**

Ultrafast Low-Grade Coal Upgrade 2022 - 2023, THU

- Proposed an ultrafast and environmental-friendly approach for upgrading low-grade coal into conductive nanoporous material with successful application to solar-driven water treatment.
- The approach eliminates complex pre-activation process, takes **only 30 s** with an ultrafast heating rate exceeds **9000 °C/min** and a maximum temperature over **1500 °C.**
- The final product brings a significant increase in water evaporation rate than pure water **(∼8 times)**, while exhibiting over **98.2%** removal rate of contaminants.

Small Parallel Cable-Driven Robot Sept. - Dec. 2021, THU

- Led 3 graduate students through the design and fabrication of Twisted and Coiled Polymer Fiber (TCPF), **a type of artificial muscle made from fish-line.**
- A Small Parallel Cable-Driven Robot based on TCPF with an overall dimension of $45 \times 50 \times 90$ mm^3 and a motion space of $20 \times 23 \times 16$ mm^3, was developed and controlled by dSPACE.
- This robot was driven by a current (∼2 A) and can carry millimeter-scale clamping tasks. The related paper was nominated as ***Best Paper in Control*** by *IEEE RCAR 2022.*

Undergraduate Experiences

State Key Laboratory of Advanced Design and Manufacturing for Vehicle 2019 - 2021, HNU

- The combination of CNN and attention mechanism has been used to improve the accuracy of pigmented tumor images segmentation (Main work: Data Processing and Model Porting).
- Under the casein sodium salt and polydopamine hydrogel system (SC-PDA), material conductivity has been improved by carbon black doping (GF≈10), and applied to Motion Signals Acquisition & Robot Remote Control (Graduation Design, **TOP 1%, 2/500**).

Mechanical Fault Diagnosis Laboratory 2019 - 2020, HNU

- Data analysis tools such as Wavelet Transform, Empirical Mode Decomposition (EMD), and Hilbert transform were conducted on fault diagnosis of rotating machinery bearings.

Geek Space Innovation Center, Department of Industrial Training 2018 - 2020, HNU

- Led a team of 5 students from diverse backgrounds, including mechanical, electrical, and software engineering, to successfully apply for and complete a two-year National Student Innovation Project : *"Automatic Ash Cleaning Bird Pecking Moxibustion".*
- Secured a total funding of $10,000 and published 2 patents.

Publications and Patents

[1] **C. Liu**, X. Zang, et al. *"Reconstructing the Nanoscale Porous Structures in Coal-based Membranes by Ultrafast High-Temperature Sintering for Solar-driven Water Treatment."* *Nano Energy, 2023: 108634.*

[2] **C. Liu**, C. Hu, et al. *"Model-Free Adaptive Nonlinearity and Hysteresis Compensation Control Strategy with Application to Nano-Precision Piezoelectric Stage."* *2023 IEEE ICCMA, Best Student Paper.*

[3] **C. Liu**, C. Hu, Ze Wang, et al. *"Small Parallel Cable-Driven Robot Based on TCPF Design and Control Research."* *2022 IEEE RCAR: 118-123. (Oral report, Best Paper Finalist in Control).*

[4] **C. Liu**, K. Zhao, W. Tian. *"Automatic Sparrow Pecking Moxibustion Therapeutic Instrument of Deashing."* *CN Patent Application NO.CN213608199U-2021, Active.*

[5] Z. Zhao, C. Hu, Z. Wang, S. Wu, **Z. Liu**, et al. *"Back EMF-Based Dynamic Position Estimation in the Whole Speed Range for Precision Sensorless Control of PMLSM."* *IEEE TII, 2022: 6525-6536.*

[6] J. Yu, C. Hu, Z. Wang, Y. Wei, **Z. Liu**, et al. *"Printing Three-dimensional Refractory Metal Patterns in Ambient Air: Toward High Temperature Sensors."* *Advanced Science, 2023: 2302479.*

[7] J. Huang, M. Zhang, Q. Li, **Z. Liu**, et al. *"Laser upgraded petroleum/coal tar for smart pavements towards road structural health and traffic monitoring."* *Microsystem & Nanoengineering, Under Review.*

Activities

Rural Revitalization Workstation, Detachment Leader Jul. 2022, Hunan

- Led 19 students from 10 different universities on social volunteering activities in rural areas.
- Produced 18 architectural renderings, 9 creative designs, 3 investigation reports… Related outcomes have been applied in actual production and Xiangxiang became an important practice base of Tsinghua.

Have been learning Face-Changing Opera for more than 2 years 2021 - Now, Hunan

Class President: Leading and Serving more than 30 students 2019 - 2021, Changsha

Practical Skills

- **Languages** English (C1), Chinese (Native)
- **Coding** Python, C, LaTeX
- **Software** MATLAB, Simulink, SolidWorks, Altium Designer

References

- **Master's Supervisor:** Chuxiong Hu, Associate Professor, Deputy Dean, Tsinghua University.
- **Undergraduate Supervisor:** Huigao Duan, Professor, Dean, Hunan University.
- **Co-Supervisor:** Xining Zang, Assistant Professor, Tsinghua University.