刘知瑾

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教育经历

清华大学　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　北京
硕士在读 - 机械工程系机电所 - 精密/超精密制造装备及控制北京市重点实验室　　2021.09 - 2024.06
- **核心课程:** 现代机电工程、机电智能控制工程、现代控制理论与方法概述;*GPA: 3.73*
- **研究领域:** 精密/超精密控制、轮廓误差、压电驱动器、碳基材料
- **奖学金:** *2022 年清华大学研究生综合优秀二等奖学金;*
  2023 年清华大学研究生港澳台特等奖学金候选人 (院系推荐 1 人,港澳台学生最高荣誉,全校每年 10 人);
  2023 年清华大学研究生特等奖学金院系推荐人 (院系推荐 1 人,清华大学全体研究生最高荣誉,全校每年 10 人)

湖南大学　　　　　　　　　　　　　　　　　　　　　　　　　　　　　长沙,湖南
学士学位 - 机械与运载工程学院 - 整车先进设计制造技术国家重点实验室　　2017.09 - 2021.06
- **研究领域:** 水凝胶基柔性传感器、轴承故障诊断、基于深度学习的黑色素瘤图像分割
- **奖学金:** 中国国家教育部奖学金(*2018, 2019, 2020*)、湖南大学单项突出奖学金(科研,*2018*)
- **荣誉称号:** 湖南大学优秀毕业设计(*Top 1%*)、湖南大学优秀毕业生、湖南大学优秀社会实践个人(国合处,*2021*)

项目经历

- **一种无模型、高精度的超精密压电控制算法**　　　　　　　　2022 年 12 月-至今,清华大学
  - **本人分工:** 理论推导、算法设计、平台搭建、实验验证、论文撰写
  - **工作内容:** 面向以原子力显微镜为代表的纳米尺度测量仪器,提出了一种无需迟滞模型的压电驱动器通用控制算法,其重复控制精度与国际公认最佳控制方法之一的 ILC 相当,同时能够保持良好的轨迹泛化性,无需耗时的预实验或复杂的数学建模,有望进一步推广至实际平台。关于压电 XY 轴耦合,以轮廓误差为优化目标同时进一步提高抗扰性相关论文正在撰稿中。
  - **相关论文:** **C. Liu**, C. Hu, et al. *"Model-Free Adaptive Nonlinearity and Hysteresis Compensation Control Strategy with Application to a Nano-Precision Piezoelectric Stage"[C]. 2023 IEEE ICCMA, In press, Oral report.*

- **一种超快速极高温煤基纳米导电纳米薄膜重构方法及其在水处理领域中的应用**　2022 年 1-11 月,清华大学
  - **本人分工:** 超快升温实验平台搭建、工艺优化、材料表征、性能分析、后端验证、论文撰写
  - **工作内容:** 针对低品质煤热值低、利用难、污染高的问题,提出了一种高效、环保、易拓展的碳化增值方法,该碳化方法升温速率可达 9000℃/min,最高温度可达 1500℃,仅需 15s 即可实现了对目标煤基薄膜内部微纳孔结构快速调控。增值后的产品导电、多孔、稳定,可以有效应用于污废水处理,获得了相关领域专家清华大学环境学院长聘教授的高度赞扬。
  - **相关论文:** **C. Liu**, R. Chen, Y. Wei, et al. *"Reconstructing the Nanoscale Porous Structures in Coal-based Membranes by Ultrafast High-Temperature Sintering for Solar-driven Water Treatment"[J]. Nano Energy, 2023: 108634.* **(IF:17.6)**

- **一种基于人工肌肉(TCPF)的小型索驱并联机器人**　　　　　　2021 年 9-12 月,清华大学
  - **本人分工:** 人工肌肉设计制作、小型索驱机器人设计制作、驱动器设计制作、算法设计与部署、论文撰写
  - **工作内容:** 带领三名研究生同学,针对微操作、微组装任务,利用新式人工肌肉作为驱动源,开发了一种微型索驱 Delta 机器人,并成功实现了其空间轨迹跟踪任务。拥有极高能量比,可以成功操纵高达其自重 100 倍(0.5g)的物体。相关论文已发表至 **IEEE RCAR(2022)**,并被提名为会议最佳论文(***Best Paper in Control Finalist***)
  - **相关论文:** **C. Liu**, C. Hu, Z. Liu, H Han, Z. Wang, *"Small Parallel Cable-Driven Robot Based on TCPF Design and Control Research"[C]. 2022 IEEE RCAR: 118-123. (Oral report, Best Paper in Control Finalist).*

- **本科科研经历:整车先进设计制造技术全国重点实验室**　　　　　2019 年-2021 年,湖南大学
  - **本人内容:** 新型水凝胶材料开发、基于深度学习的图像分割前处理
  - **工作成果:** 利用氧化石墨烯与炭黑掺杂(SC-PDA 体系),成功提高了水凝胶的 GF 值与自愈合性能;
    利用 CNN 与 Attention 机制结合,提高了针对黑色素瘤图像分割的准确性
  - **毕业设计:** 基于柔性传感器(水凝胶)下的多轴机械臂远程控制与姿态解算
  - **毕业成果:** 将柔性传感器与六轴机械臂相结合,成功实现了其在特殊工况下的远程操控并在不同姿态下实现特殊抓取需求

社会活动

- **清华大学乡村振兴工作站赴湖南湘乡支队 - 队长**　　　　　　　2022 年 7 月-8 月,湘乡,湘潭
  - 首次实践带领来自 20 名来自 9 所高校不同专业的同学深入湖南乡村开展社会实践,为后续支队打下了坚实基础。
  - 产出废弃建筑改造图 18 份,文创设计 9 份,研究报告 3 份,调研报告 2 份,相关成果已实际投产。

- **弘扬传统文化,学习川剧变脸**　　　　　　　　　　　　　　　　　2021 年-至今,湖南
  - 持续学习中国传统戏剧文化-川剧变脸超过两年,利用寒暑假时间在农村进行过多次义演。

- **机自 1701 班长**　　　　　　　　　　　　　　　　　　　　　　2019 年-2021 年,湖南大学

其他技能

- **外语能力:**　英语(C1)
- **编程能力:**　Python, C, Latex
- **软件能力:**　Matlab, Simulink, SolidWorks, Altium Designer

Chih-Chin (Zhijin) Liu

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Job Intention: Mechanical Engineer & Trainee

EDUCATION

Tsinghua University <div style="text-align: right">Beijing, China</div>

Master in Mechanical Engineering <div style="text-align: right">*09.2021 - Expected June, 2024*</div>

Department of Mechanical Engineering - Lab of Precision Equipment & Control

- ***Core Courses:*** *Introduction to Modern Control Theories and Methods, Advanced Numerical Analysis, Mechatronic Intelligent Control Engineering, Modern Mechatronics System.*
- ***Research Field:*** *Piezoelectric Actuator, Ultra-precision Control, Carbon material.*
- ***Scholarship:***
  - *Outstanding Postgraduate Award of Tsinghua University, Minor Award, 2022.*
  - *Outstanding Postgraduate Award of Tsinghua University, Grand Prize Candidate (**Highest Honor for all Students**, 10 Persons in the school every year), 2023.*
  - *Outstanding Taiwan Graduate students Award of Ministry, Grand Prize Candidate (**Highest Honor for Taiwan Students**, 4 Persons in the school every year), 2023.*

Hunan University <div style="text-align: right">Changsha, China</div>

Bachelor in Mechanical Engineering <div style="text-align: right">*09.2017 - 06.2021*</div>

College of Mechanical & Vehicle Engineering - State Key Laboratory of Advanced Design

- ***Research Experiences:*** *Flexible Sensor, Fault Diagnosis, Deep learning*
- ***Scholarships:***
  - *Ministry of Education scholarship: Major Award - 2020, Minor Award - 2018, 2019.*
  - *Outstanding Undergraduate Students Award of Hunan University: Minor Award, 2020.*
  - *Individual outstanding (Research) scholarship of Human University, 2018*
- ***Honors:***
  - *Outstanding Graduation Design of Hunan University (Top 1%).*
  - *Outstanding Graduates of Hunan University, 2021.*
  - *Outstanding Volunteer of Social Practice, National Cooperation Office.*

PUBLICATIONS AND PATENTS

[1] **C. Liu**, R. Chen, Y. Wei, Y. Huang, Z. Zhang, Y. Zhao, et al. *"Reconstructing the Nanoscale Porous Structures in Coal-based Membranes by Ultrafast High-Temperature Sintering for Solar-driven Water Treatment"[J]. Nano Energy, 2023: 108634.*

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

[3] **C. Liu**, C. Hu, et al. *"Model-Free Adaptive Nonlinearity and Hysteresis Compensation Control Strategy with Application to a Nano-Precision Piezoelectric Stage"[C].*
2023 IEEE ICCMA, Accepted, Oral report.

[4] **Z. Liu**, K. Zhao, W. Tian *"A Moxibustion Instrument with Automatic Cleaning"[P].*
CN213608199U, 2021-07-06.

[5] **C. Liu**, C. Hu, Z. Wang, et al. *"Accelerated Iteration Algorithm Based Contouring Error Estimation for Piezoelectric Stage Control"[J]. In preparation, Expected Nov.*

[6] Z. Zhao, C. Hu, Z. Wang, S. Wu, **Z. Liu**, Y. Zhu, *"Back EMF-Based Dynamic Position Estimation in the Whole Speed Range for Precision Sensorless Control of PMLSM"[J].*
IEEE Transactions on Industrial Informatics, 2022.

[7] 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"[J]. Advanced Science, 2023: 2302479.*

Research and Projects

Research on Piezoelectric Nano-Precision Control   2022 - 2024, THU
- Proposed a novel nonlinearity compensation scheme that exhibits a comparative performance to the iterative learning control (ILC) without abundant time-consuming off-line iterations or complex hysteresis modeling while enhancing the robustness to trajectory variations.
- Two-axis motion platform was built to further optimize the contour control error while attempting further extend related algorithm 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 and applying it to solar-driven water treatment.
- The approach eliminates complex pre-activation processes, which takes only 30 s, while the ultrafast heating rate exceeds 9000 ℃/min, with a maximum temperature over 1500 ℃.
- Under 1 sun, its final product brings a significant increase ($\sim$8 times) in water evaporation rate than pure water, while exhibiting over 98.2% removal rate of contaminants.

Developing a Small Parallel Cable-Driven Robot Based on TCPF   Sept.-Dec. 2021, THU
- Led two graduate students through the design and fabrication of Twisted and Coiled Polymel 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, has been controlled by Matlab and dSPACE.
- This Robot was driven by current and can perform precise tasks, such as micro assembling. The related paper was nominated as *Best Paper Finalist in Control* by *IEEE RCAR 2022*.

Undergraduate Experiences

State Key Laboratory of Advanced Design and Manufacturing   2019 - 2021, HNU
- The combination of CNN and attention mechanism has been used to improve the accuracy of segmentation of pigmented tumor images (Main work: Data Processing and Model Porting).
- Under the casein sodium salt and polydopamine hydrogel system (SC-PDA), the material conductivity has been improved by doping carbon black (GF$\approx$10), and then has been applied to the human motion signals acquisition and robot remote control (Graduation Design).

Mechanical Fault Diagnosis Laboratory   2019 - 2020, HNU
- Conducted extensive research on fault diagnosis of rotating machinery, specializing in Wavelet Transform and Empirical Mode Decomposition (EMD).
- Acquired basic training in paper writing and research methodologies, demonstrating proficiency in experimental design and data analysis.

Geek Space Innovation Center, Department of Industrial Training   2018 - 2020, HNU
- Led a team of five students from diverse backgrounds in mechanical, electronic, and information 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 $5,000 for the project and published 2 patents.

Activities

Rural Revitalization Workstation, Detachment Leader   July 2022, Xiangxiang, Hunan
- Led 19 members from 10 different universities to conduct social and field research in rural Hunan.
- Produced 18 architectural renderings, 9 creative designs, 3 research works…. Related outcomes are already in actual production and Xiangxiang became an important practice base of Tsinghua University.

Have been learning Face-changing for more than two years   2021 -, Xiangtan, Hunan

Practical Skills

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