Teng Zhang, Ph.D Candidate (Will graduate in September, 2025)

Personal homepage: https://zhangteng-hust.github.io/
Google Scholar: https://scholar.google.com/citations?user=aPbXN-cAAAAJ&hl=en

Basic Information

Birth: 06/12/1998 **Domicile**: Inner Mongolia Autonomous Region
Email: tengzhanghust@126.com **Tel:** (+86)18551813183

Research Interests

Now

- Robotic machining system hierarchical error sensing and cooperative accuracy control;
- Knowledge extraction, distillation, and transfer methods in multitasking domains;
- CPS and DT applications for multi-source data fusion.

Future

- Embodied Intelligence and its application to real-world scenarios;
- Multimodal data fusion and high-dimensional understanding (semantics, relationships, intentions, etc.).

Education

- **Huazhong University of Science and Technology** 2020.09 – 2025.09
  Ph.D., Supervised: Fangyu Peng and Xiaowei Tang
  Major: Mechanical Engineering, School of Mechanical Science & Engineering
  GPA: 3.94/4, Rank: 1/144
- **Nanjing University of Aeronautics and Astronautics** 2016.09 – 2020.06
  B.E., Supervised: Lida Shen and Yinfei Yang
  Major: Mechanical Engineering, College of Mechanical & Electrical Engineering
  GPA: 4.1/5, Rank: 2/313

Publications (Accepted)

1. **T. Zhang**, F. Peng, Z. Yang, et al. UGP-KD: An unsupervised generalized prediction framework for robot machining quality under historical task knowledge distillation for new tasks, ***Comput. Ind.***, 2025
2. **T. Zhang**, F. Peng, R. Yan, et al. An uncertainty quantification and accuracy enhancement method for deep regression prediction scenarios, ***Mech. Syst. Signal Proc.***, 2025
3. **T. Zhang**, F. Peng, J. Wang, et al. Spatial–temporal feature fusion for intelligent foreknowledge of robotic machining errors, ***Robot. Comput. - Integr. Manuf***., 2025
4. **T. Zhang**, H. Sun, F. Peng, X. Tang, et al. An online prediction and compensation method for robot position errors embedded with error-motion correlation, ***Measurement***, 2024
5. **T. Zhang**, F. Peng, R. Yan, X. Tang, et al. Quantification of uncertainty in robot pose errors and calibration of reliable compensation values, ***Robot. Comput. - Integr. Manuf***., 2024
6. **T. Zhang**, F. Peng, X. Tang, et al. An active semi-supervised transfer learning method for robot pose error prediction and compensation, ***Eng. Appl. Artif. Intell.***, 2024
7. **T. Zhang**, F. Peng, X. Tang, et al. A sparse knowledge embedded configuration optimization method for robotic machining system toward improving machining quality, ***Robot. Comput. - Integr. Manuf.***, 2024
8. **T. Zhang**, F. Peng, X. Tang, et al. CME-EPC: A coarse-mechanism embedded error prediction and compensation framework for robot multi-condition tasks, ***Robot. Comput. - Integr. Manuf.***, 2024
9. **T. Zhang**, H. Sun, F. Peng, et al. A deep transfer regression method based on seed replacement considering balanced domain adaptation, ***Eng. Appl. Artif. Intell.***, 2022

10. R. Deng, X. Tang, **T. Zhang***, et al. An effective robotic processing errors prediction method considering temporal characteristics, ***Journal of Advanced Manufacturing Science and Technology***, 2024.

Publications (Others)

1. **T. Zhang**, F. Peng, Z. Yang, et al. Digital twin-driven staged error prediction and compensation framework for the whole process of robotic machining, ***J. Manuf. Syst.***, 2025 (Revised)
2. **T. Zhang**, X. Tang, F. Peng, et al. A physical informed strategy for distributed prediction and compensation of robotic machining errors, ***Reliab. Eng. Syst. Saf.***, 2025 (Under review)
3. **T. Zhang**, X. Tang. Advances in artificial intelligence-enabled robot machining accuracy improvement technology, ***CAAI Communications*** (Invited), 2024.

Academic presentations and conferences

1. *MOSS*: An integrated system for robotic machining error Measurement, Optimization, Sensing and Supervision enabled by cyber-physical system, ICIFT2025 & CIRP DET2025, Chendu, China, 2024, ***Oral***.
2. An unsupervised prediction of robotic machining error for new tasks under historical tasks knowledge distillation, CIRP Conference on Modeling of Machining Operations ***(CMMO)***, Mons, Belgium, 2025, ***Oral***.
3. A Knowledge-Embedded End-to-End Intelligent Reasoning Method for Processing Quality of Shaft Parts, International Conference on Intelligent Robotics and Applications ***(ICIRA)***, Hangzhou, China, 2022, ***Oral***.
4. A transfer learning based geometric position-driven machining error prediction method for different working conditions, International Conference on Mechatronics and Machine Vision in Practice ***(M2VIP, online)***, Shanghai, China, 2021, ***Oral***.

Grants

✓ **Title**: Aerospace complex parts robotization de-support key technology research, (YCJJ20241201), 2024.05 – 2025.05
Funding: Fundamental Research Funds for the Central Universities **Principal**

✓ **Title:** A lightweight robot driven by multi-frequency modulated dynamics for dynamic loading operations in a weak gravity environment on the lunar surface, 2026 – 2028
Funding: China National Postdoctoral Program for Innovative Talents *Application*

✓ **Title**: Theoretical and methodological study on process data-driven robotic milling of complex segments of aircrafts, (U20A20294), 2021.01–2024.12
Funding: National Natural Science Foundation of China (NSFC) *Key participant*

✓ **Title**: Intelligent decision-making technology and system for the whole process of intelligent machining line, (2018YFB1701904), 2019.06–2022.05
Funding: National Key Research and Development Program of China *Key participant*

Honors and Awards

2025.05	**Wuxi Huishan Taihu Scholarship**
	People's Government of Wuxi, Wuxi, Jiangsu, China
2024.12	**National Scholarship**
	Ministry of Education of the People's Republic of China, Beijing, China
2023.12	**Weichai Power Scholarship**
	Weichai Power Co., Ltd, Weifang, Shandong, China
2019.11	**First Prize of Challenge Cup Science and Technology Work Competition**
	Ministry of Education of the People's Republic of China, Beijing, China
2019.10/	**National Scholarship**

2017.10 Ministry of Education of the People's Republic of China, Beijing, China

Social work

Reviewer for journals such as *J. Manuf. Syst.*, *Reliab. Eng. Syst. Saf.*, *CMC-Comput. Mat. Contin.*, *Adv. Eng. Mater.*, *Mach. Sci. Technol.*, and International Journal of Modeling, Simulation, and Scientific Computing.

Mentoring students

- **Zhang Chi**, Master's Degree (Academic), United Imaging Healthcare Technology Co., Ltd.
  Thesis: Calibration of point cloud measurement system and generation of coating trajectory for robot repairing the inner wall of hydraulic turbine, 2023.06.
- **Li Bingbing**, Master's Degree (Professional), Huawei Technology Co., Ltd.
  Thesis: Research and verification on complex compartment feature recognition and robot processing trajectory generalization based on point cloud, 2024.06.
- **Runpeng Deng**, Master's Degree (Academic), China Academy of Engineering Physics (CAEP)
  Thesis: Offline optimization and online compensation of milling errors in spacecraft segment interior robot machining, 2025.06.

Research Skills

- ***Robotics***: KUKA, Staubli, ABB
- ***Measuring***: Leica Tracker, Point cloud measurement devices, various types of sensors.
- ***Industrial control equipment***: Beckhoff, TwinCAT, Simulink
- ***Software***: SolidWorks, Unity, Spatial Analyzer
- ***Artificial Intelligence Technology***: DL (PyTorch), ML, Transfer Learning,
- ***Programming***: Python, C/C++, Latex, Matlab, Markdown

Referees

Dr. Fangyu Peng	Professor, Supervisor of Ph.D. Degree School of Mechanical Science & Engineering Huazhong University of Science and Technology, Wuhan, China No. 1037 Luoyu Road, Wuhan, 430074, China **Tel**: (+86) 13986168308, **Email**: pengfy@hust.edu.cn
Dr. Lida Shen	Professor, Supervisor of B.E. Degree, instructors of the competition College of Mechanical & Electrical Engineering Nanjing University of Aeronautics and Astronautics, Nanjing, China No. 29 Yudao Road, Nanjing, 210016, China **Tel**: (+86) 18951892566, **Email**: ldshen@nuaa.edu.cn
Dr. Xingkai Ma	General Manager, Cooperator for research Beckhoff Automation Company Ltd. Jing'an District, 200072, Shanghai China **Tel**: (+86) 021-66312666, **Eamil**: x.ma@beckhoff.com.cn

Cover letter

Dear Prof. Chalvatzaki

I am writing to express my profound interest in SIREN, and to convey my strong motivation to contribute to this groundbreaking research initiative. With a Ph.D. in Mechanical Engineering from Huazhong University of Science and Technology (HUST), specializing in robotic machining systems, error sensing, knowledge distillation, and digital twin applications, I believe my research background and technical expertise align exceptionally well with the goals of SIREN.

Research Background and Alignment with SIREN

My doctoral research has centered on hierarchical error sensing, uncertainty quantification, and knowledge-driven accuracy control in robotic machining systems. I have developed multiple frameworks that integrate physical modeling, deep learning, and transfer learning to enable robust and adaptive robotic behaviors under dynamic and uncertain conditions.

For instance:

- I proposed an unsupervised knowledge distillation framework (UGP-KD) for predicting machining quality in new tasks by leveraging historical task knowledge, which directly resonates with SIREN's goal of modular task-adaptive behaviors and generalization.
- I designed a coarse-mechanism embedded error prediction and compensation framework (CME-EPC) that combines physical priors with data-driven models, echoing SIREN's emphasis on physics-aware representations.
- My work on uncertainty quantification and reliable compensation values for robot pose errors aligns with SIREN's focus on modular uncertainty estimation for robustness.

These experiences have equipped me with a deep understanding of multi-source data fusion, cyber-physical systems, and embodied intelligence, which are central to SIREN's vision of a unified robot-environment representation.

Why SIREN?

SIREN represents a paradigm shift in robotic learning by treating the robot and environment as an integrated system, governed by shared physical laws and information flow. This holistic view resonates strongly with my own research philosophy, which emphasizes the interplay between physical mechanisms and data-driven intelligence.

I am particularly drawn to SIREN's objectives to:

- Develop information-driven and physics-aware models for embodied perception and action,
- Incorporate modular uncertainty quantification for robust decision-making,
- Ground high-level semantic information (e.g., from foundation models) into actionable robotic behaviors.

My previous work on **transfer learning**, **domain adaptation**, and **digital twin-driven**

error compensation has prepared me to contribute meaningfully to these challenges. For example, my research on **active semi-supervised transfer learning** and **spatial-temporal feature fusion** directly supports SIREN's aim to enable continuous learning in unstructured environments.

Proposed Contributions

I am eager to bring my expertise in the following areas to the SIREN project:

- Unified Representation Learning: Leveraging my experience in multi-modal data fusion and digital twin systems to help build a holistic robot-environment representation.
- Uncertainty-Aware Control: Applying my background in uncertainty quantification and robust compensation to enhance the reliability of robotic skills.
- Knowledge Transfer and Generalization: Contributing to the development of modular, composable skills that can adapt to new tasks and environments.

Proposed Contributions

My future research interests lie at the intersection of embodied intelligence, multimodal understanding, and real-world robotic applications. SIREN offers an ideal platform to pursue these goals within a world-class research environment. I am particularly excited about the prospect of working with humanoid mobile manipulators and advancing their capabilities in highly dynamic, human-centric settings.

Conclusion

I am deeply impressed by the ambition and innovation of the SIREN project, and I am confident that my background in robotic systems, machine learning, and cyber-physical integration positions me to make significant contributions to your team. I am eager to bring my skills, enthusiasm, and collaborative spirit to this endeavor and to help realize SIREN's vision of holistic robotic embodied intelligence.

Thank you for considering my application. I look forward to the opportunity to discuss how I can contribute to your pioneering work.

Sincerely,

Teng Zhang
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Huazhong University of Science and Technology
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Research statement

1. Introduction & Core Research Alignment

The SIREN project's vision of a holistic robot-environment system, governed by intertwined information and physical laws, presents a paradigm shift that directly addresses the limitations I encountered in my PhD research on robotic machining. My work focused on mitigating uncertainty in dynamic physical processes (e.g., milling, drilling) by developing frameworks that fuse mechanistic models with data-driven learning. SIREN's principles of structured interactive perception, physics-aware models, and modular uncertainty quantification provide the comprehensive theoretical foundation I seek to generalize my research beyond machining into broader, unstructured human environments.

2. Proposed Research Ideas within the SIREN Framework

I propose to contribute to SIREN by developing methods for Uncertainty-Aware Embodied Interaction in Dynamic Environments. My approach will leverage my background in multi-source fusion and knowledge transfer to create robust, adaptive perceptual-control loops.

Idea 1: Physics-Informed Perception for Interaction Dynamics

Concept: Extend my work on spatial-temporal feature fusion for error prediction to model the dynamics of robot-environment contact during manipulation tasks (e.g., pushing, assembling). I will develop perception models that use tactile, visual, and force feedback, grounded not only in data but also in physical constraints (e.g., friction, deformation models). This directly supports SIREN's aim for information-driven and physics-aware models.

SIREN Integration: This contributes to building a unified representation that encodes both perceptual states and their physically plausible interactions.

Idea 2: Modular Uncertainty Quantification for Robust Skill Execution

Concept: Apply and extend my uncertainty quantification frameworks for robot pose errors to the learning of mobile manipulation skills. I will investigate separating epistemic (model) and aleatoric (data) uncertainty within SIREN's modular architecture. This allows the system to know "what it doesn't know," triggering behaviors like exploration or human assistance when uncertainty exceeds a safety threshold.

SIREN Integration: This provides the crucial robustness layer for reliable operation in unpredictable environments, a core objective of SIREN.

Idea 3: Knowledge Distillation for Generalizable Affordance Learning

Concept: Build upon my UGP-KD framework to distill "interaction knowledge" from foundation models (e.g., pre-trained vision-language models) and historical task data. The goal is to ground high-level semantic affordances (e.g., "graspable," "pushable") into low-level, uncertainty-aware robot policies that generalize to novel objects and scenes.

SIREN Integration: This directly addresses the challenge of grounding semantic information into actionable and adaptive behaviors, enabling scalable generalization.

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Academic Transcript

Name: Zhang Teng
Student ID: D202080288
College: School of Mechanical Science and Engineering
Major: Mechanical Engineering

Date of Enrollment: September, 2020
Date of Printing: May, 2024
Academic Program: Doctoral Program

NO.	Courses Name	Hours	Credit	Score	Duration of Study

Remarks: Two grading systems we employ are as follows:

1. The Percentage System: 60 is passing, 100 is full mark;
2. Two-Degree Grading: pass or fail.
3. Courses weighted average score = $\frac{\sum(\text{Degree Course Credits} * \text{grade})}{\sum \text{Degree Course Credits}}$, only count marks of the Percentage System.

Dean:

Graduate School
Huazhong University of Science and Technology

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Date of Enrollment: September, 2020
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NO.	Courses Name	Hours	Credit	Score	Duration of Study
1	Foreign language (English)	32	2.0	exemption	Autumn of 2020
2	Engineering Measurement and Signal Analysis	32	2.0	100	Autumn of 2020
3	Introduction to Environmental Engineering	16	1.0	94	Autumn of 2020
4	Theory of matrices	48	3.0	91	Autumn of 2020
5	Branding Strategy and Design	32	2.0	88	Autumn of 2020
6	Numerical Methods	48	3.0	94	Autumn of 2020
7	Advanced Manufacturing Engineering	64	4.0	95	Autumn of 2020
8	Modern Control Engineering	32	2.0	91	Autumn of 2020
9	Numerical Control Programming &Robot Machining Technology	32	2.0	95	Autumn of 2020
10	Advanced Manufacturing Technology	32	2.0	95	Autumn of 2020
11	English Academic Writing	24	2.0	exemption	Autumn of 2020
12	Manufacturing Equipment Intelligent Technology	32	2.0	91	Autumn of 2020
13	Theory and Practice of Socialism with Chinese Characteristics	36	2.0	94	Autumn of 2020
14	Dialectics of Nature	18	1.0	84	Autumn of 2020
15	The Test of Chinese Level	0	0.0	pass	Spring of 2021
16	Design psychology	32	2.0	92	Autumn of 2021
17	Chinese Marxism	36	2.0	88	Autumn of 2021

Total credits: 34.00
Courses weighted average score: 92.7

Dean:

Graduate School
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華中科技大學
中华人民共和国 湖北 武汉

March 08, 2025

ENROLLMENT CERTIFICATION

This is to certify that Mr.Zhang Teng, born on June 12, 1998, ID number: 152626199806121517, was enrolled as a doctoral candidate in the School of Mechanical Science and Engineering, Huazhong University of Science and Technology in September 2020, majoring in Mechanical Engineering. His student number is: D202080288.

He is expected to graduate in June 2025, after completing all the requirements for the doctoral degree.

Graduate School

Huazhong University of Science and Technology

华中科技大学研究生院 证明专用章

5-Contact details of academic references

Dr. Fangyu Peng	Professor, Supervisor of Ph.D. Degree School of Mechanical Science & Engineering Huazhong University of Science and Technology, Wuhan, China No. 1037 Luoyu Road, Wuhan, 430074, China **Tel**: (+86) 13986168308, **Email**: pengfy@hust.edu.cn
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