Linan Deng

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Research Interests

My research centers on enabling robots to perform *dexterous manipulation in unstructured, contact-rich environments*, where perception, physical interaction, and decision-making must be tightly coupled. Specifically, I work on: (i) designing *flexible tactile sensors* that capture rich contact information during interaction; (ii) developing *learning-based manipulation policies* that fuse visual and tactile feedback for tasks such as grasping deformable objects, in-hand reorientation, and excavation in granular media; and (iii) translating these capabilities to *real-world platforms* including soft grippers, dexterous hands, and humanoid robots. Looking forward, I am interested in building dexterous manipulation systems that combine *tactile perception*, *robot learning*, and *sim-to-real transfer* to operate robustly in daily environments.

Education and Appointments

The Hong Kong University of Science and Technology, Hong Kong, CHN Aug. 2025 – Aug. 2026

Postdoctoral Fellow at Cheng Kar-Shun Robotics Institute Host: Prof. Fumin Zhang
Research focus: Developing proprioceptive learning frameworks for fault-tolerant dexterous manipulation on the LEAP Hand, and humanoid robot projects on Unitree G1 and Booster T1.

Huazhong University of Science and Technology, Wuhan, CHN Sept. 2019 – Jun. 2025

Ph.D. in Mechanical Engineering Advisors: Prof. Han Ding, Prof. Ye Yuan
Dissertation: *Research on Tactile Sensitivity-Enhanced Perception and Grasping Methods of Robotic Hand for Buried Objects in Granular Media*

Huazhong University of Science and Technology, Wuhan, CHN Sept. 2018 – Jun. 2019

M.E. in New Energy Science and Engineering Advisor: Prof. Ye Yuan (*Direct M.E.–Ph.D. Program*)

Huazhong University of Science and Technology, Wuhan, CHN Sept. 2014 – Jun. 2018

B.E. in Marine Engineering

Research Experience

Perception and Grasping of Buried Objects in Granular Media 2023 – 2025

Lead Researcher Ph.D. Dissertation Project, HUST

Investigated how robots can locate and retrieve objects buried in granular materials (e.g., sand, soil), where vision alone fails due to occlusion.

- Developed a robotic tactile excavation system that utilizes sensitivity-enhanced tactile feedback to infer buried object geometry and pose during digging, demonstrating 71% success rate.
- Designed a visual-tactile diffusion policy for grasping semi-buried objects with 80% success rate.

Flexible Tactile Sensor Design for Deformable Object Recognition 2022 – 2024

Lead Researcher Ph.D. Dissertation Project, HUST

Developed flexible tactile sensor arrays and active-learning pipelines to recognize the physical properties (e.g., stiffness, shape) of deformable objects grasped by soft hands.

- Designed microfluidic tactile sensors integrated into a soft gripper, enabling classification of deformable objects with 98% accuracy across 8 object classes.
- Introduced an active-learning-aided design framework that reduces the number of training samples required for finding sensor recipes with high sensitivity.

Modeling and Control of Underwater Soft Manipulators 2022 – 2023

Co-lead Researcher With Dr. Yi Shen

Co-led a grant-funded project on data-driven modeling and control of fiber-reinforced soft manipulators for underwater grasping.

- Co-developed a kinematic controller for crossed-fiber-reinforced soft manipulators, achieving sub-5mm tip positioning error in underwater conditions.
- Co-designed planning and motion control for an underwater bimanual soft manipulator.

Wearable Soft Sensing for Hand Assistance 2021 – 2022

Lead Researcher Research Project, HUST

Developed a lightweight wearable glove (Sen-Glove) with soft joint sensing for hand monitoring.

- Designed soft resistive joint sensors that capture full finger motion while remaining comfortable to wear.

PUBLICATIONS

My work has been published in robotics venues including IEEE/ASME T-MECH (3), IEEE RA-L, IEEE TIM, ICRA, etc.

Journal Papers

[J1] Liu, X., Dong, Y., Wan, J., **Deng, L.**, Hua, F., Shen, Y., Yu, M., Ma, G., Cheng, C., Song, H., Ding, H., & Yuan, Y. (2026). DexAnyTwist: Learning General Dexterous Twisting with Hybrid Manipulation System Identification. *National Science Review* (under second round review).

[J2] Liu, X., Wan, J., **Deng, L.**, Dong, Y., & Deng, Z. (2026). Leveraging Large Language Models for Policy Sequence Planning in In-Hand Reorientation. *Neurocomputing* (under second round review).

[J3] **Deng, L.**, Wang, Y., Yue, Z., & Li, Z. (2025). A robotic tactile excavation system for excavating objects buried in granular materials. *IEEE/ASME Transactions on Mechatronics*, 30(6), 7112-7124.

[J4] **Deng, L.**, Zhang, J., Yue, Z., Li, Z., Yuan, Y., & Ding, H. (2024). Active learning-aided design of a flexible tactile sensor array for recognizing properties of deformable objects. *IEEE Transactions on Instrumentation and Measurement*, 73, 1-11.

[J5] Shen, Y., Tai, R., Zhang, J., **Deng, L.**, Yuan, Y., Su, R., Zhang, F., & Ding, H. (2023). Planning and Motion Control for Underwater Bimanual Soft Manipulator in Underwater Grasping Task. *IEEE/ASME Transactions on Mechatronics*, 29(4), 2487-2498.

[J6] Shen, Y., **Deng, L.**, Yuan, Y., Zhang, F., & Ding, H. (2022). Kinematic control for crossed-fiber-reinforced soft manipulator using sparse Bayesian learning. *IEEE/ASME Transactions on Mechatronics*, 27(2), 611-622.

[J7] **Deng, L.**, Shen, Y., Fan, G., He, X., Li, Z., & Yuan, Y. (2022). Design of a soft gripper with improved microfluidic tactile sensors for classification of deformable objects. *IEEE Robotics and Automation Letters*, 7(2), 5607-5614.

Conference Papers

[C1] **Deng, L.**, & et al. BlindDexGrasp: Learning Proprioceptive Exploration and Dexterous Grasping via Observation Degradation. (In preparation)

[C2] **Deng, L.**, & et al. Learning Resilient In-Hand Rotation via Fault Injection Domain Randomization. (Under submission)

[C3] **Deng, L.**, Liu, X., Dong, Y., Ma, G., Hua, F., Cheng, C., & Yue, Z. (2025, August). Visual-Tactile Fusion-Driven Diffusion Policy for Robotic Excavation of Semi-buried Object in Granular Media. In *International Conference on Intelligent Robotics and Applications (ICIRA)* (pp. 447-459). Springer.

[C4] Yang, J., Shen, Y., & **Deng, L.** (2023, July). Continual Contrastive Anomaly Detection under Natural Data Distribution Shifts. In *2023 8th International Conference on Automation, Control and Robotics Engineering (CACRE)* (pp. 144-149). IEEE.

[C5] Liu, M., Hong, Y., & **Deng, L.** (*corresponding author*, 2022, August). Research on Data Construction and Classification of Deformable Objects Grasped by Soft Hand with Multi-source Information Fusion. In *2022 34th Chinese Control and Decision Conference (CCDC)* (pp. 6272-6276). IEEE.

[C6] **Deng, L.**, Shen, Y., Hong, Y., Dong, Y., He, X., Yuan, Y., Li, Z., & Ding, H. (2022, May). Sen-Glove: A Lightweight Wearable Glove for Hand Assistance with Soft Joint Sensing. In *2022 International Conference on Robotics and Automation (ICRA)* (pp. 5170-5175). IEEE.

[C7] Fan, G., Tang, X., Shen, Y., & **Deng, L.** (2021, July). Model predictive control method for multi-motor system with dead zone. In *2021 6th International Conference on Automation, Control and Robotics Engineering (CACRE)* (pp. 333-337). IEEE.

National Invention Patents

[N1] CN112880547B. Yuan, Y., **Deng, L.**, Shen, Y., Fan, G., & Hong, Y. Liquid metal-based tactile sensor, array and preparation method thereof.

[N2] CN113576832B. Yuan, Y., **Deng, L.**, Shen, Y., Fan, G., & Liu, M. Cable-driven modular soft rehabilitation glove.

[N3] CN110400306B. Deng, Z., Dong, Y., **Deng, L.**, Tang, X., Deng, L., & Cao, R. Non-woven fabric defect detection method based on morphological filtering and convolutional neural network.

[N4] CN112229553B. Yuan, Y., Fan, G., Shen, Y., **Deng, L.**, & Tang, X. Flexible tactile sensor based on light attenuation, array and preparation method thereof.

[N5] CN120516695A. Yuan, Y., Sun, X., Ding, H., Cheng, C., **Deng, L.**, Yue, Z., Hua, F., Yang, Z., Liu, X., Wang, S., & Ma, G. Reorientation method of aviation parts with dexterous hands based on reinforcement learning and imitation learning.

[N6] CN118330773A. Yuan, Y., Deng, Z., Sun, X., and **Deng, L.** Underwater object detection method and system.

[N7] CN112454421A. Yuan, Y., Shen, Y., **Deng, L.**, Dong, Y., & Tang, X. Pneumatic worm-like soft manipulator and preparation method thereof.

[N8] CN114274162A. Yuan, Y., Zhang, J., Shen, Y., & **Deng, L.** Dielectric elastomer actuator, flexible foot, and starfish-like soft robot.

Projects Participation

[P1] **Research and Development of Multimodal Perception and Soft Grippers for Logistics Sorting** Jan. 2026 – Dec. 2027, my participation: Jan. 2026 – Aug. 2026

Member Supported by JD.com

Developing a universal soft gripper for SKU grasping in JD's pharmaceutical warehouses, addressing challenges in handling diverse packaging shapes and materials.

[P2] **Locomotion and Calibration for Humanoid Robots in Industrial Environments** Jan. 2026 – Dec. 2027, my participation: Jan. 2026 – Aug. 2026

Member Supported by the Baosteel Group Corporation

Developing core algorithms for a humanoid robot platform (Booster T1, 29+12 DoF), including mapping, navigation, kinematic calibration, and walking-accuracy calibration for deployment in steel-plant scenarios.

[P3] **Frontier and Human-centric AI and Robotics Technology for Geriatric Care** Jan. 2025 – Dec. 2029, my participation: Aug. 2025 – Aug. 2026

Member Supported by the Research Grants Council (RGC)'s Areas of Excellence (AoE) Scheme

Developing motion planning algorithms for a humanoid robot platform (Unitree G1, 29+14 DoF) deployed in geriatric care environments, supporting tasks such as guiding exercises, offering companionship, assessing mental and physical conditions, and providing daily assistance.

[P4] **Research on Design, Sensing, Modeling and Control of Underwater Soft Robots** Jan. 2022 – Dec. 2023

Principal Investigator Supported by the Fundamental Research Funds for the Central Universities

Developing flexible sensors, soft robots, and controllers for underwater grasping.

[P5] **Real-time Detection System for Non-woven Fabric Defects** Feb. 2019 – Sep. 2019

Member Supported by CHTC Jiahua Nonwoven Co., Ltd.

Developing a real-time detection system for non-woven fabric defects based on area-array cameras and an industrial personal computer.

[P6] **Highway Intelligent Traffic Video Surveillance System** Jun. 2018 – Sep. 2018

Member Supported by Henan Expressway Development Co., Ltd.

Developing modules for foreign object monitoring and alarm in highway intelligent traffic video surveillance systems based on OpenCV and PyTorch.

Honors and Awards

- *Scholarship for Outstanding Doctoral Students*, HUST Dec. 2023
- *Bronze Prize (HUST round)*, China International College Students' "Internet+" Innovation Entrepreneurship Competition Sept. 2023
- *Best Student Poster Award*, Artificial Intelligence Conference and Entrepreneurs Summit Forum of China's Optics Valley Aug. 2022
- *National Third Prize*, China Postgraduate Robot Innovation and Design Competition Aug. 2022
- *Third Prize of Zhixing Scholarship*, HUST Dec. 2022
- *Excellent Postgraduate Cadre*, HUST Nov. 2021
- *Outstanding Graduate*, HUST Jun. 2018
- *National Second Prize*, Chinese Mathematics Competitions Nov. 2015

Academic Service

Session Organizer: 19th International Conference on Intelligent Robotics and Applications (ICIRA 2026).
Journal Reviewer: IEEE Transactions on Instrumentation and Measurement (TIM), IEEE Robotics and Automation Letters (RA-L).
Conference Reviewer: IEEE International Conference on Robotics and Automation (ICRA), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), IEEE-RAS International Conference on Soft Robotics (RoboSoft), Chinese Control and Decision Conference (CCDC).

Miscellaneous

- Programming Languages: Python, PyTorch, MATLAB, C, C++, LaTeX
- Robotics & Simulation: Isaac Lab / Sim / Gym, PyBullet
- CAD & Engineering: SolidWorks, Inventor, AutoCAD, Ansys, KeyShot
- Hardware: flexible sensor design, actuator development, soft robot prototyping
- Google Scholar: https://scholar.google.com/citations?user=28u-d90AAAAJ
- ORCID: https://orcid.org/0000-0003-1311-4632
- Academic Website: https://linan-deng.github.io
- GitHub: https://github.com/linan-deng