CUNXI DAI

Robotics Institute, School of Computer Science
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EDUCATION

Carnegie Mellon University (CMU)   Pittsburgh, Penn.
Master of Robotics (MSR), <u>Admitted to CMU RI Ph.D. 2025Fall</u>   Sept. 2023 - present
- **GPA: 4.08/4.0,** Advisor: Ralph Hollis
- **Core Courses:** Optimal Control and Reinforcement Learning, Intro to Robot Learning, Visual Learning and Recognition, Mobile Robots, Math Foundation for Robotics, Independent Research.

Southern University of Science and Technology (SUSTech)   Shenzhen, Guangdong
Bachelor of Engineering in Robotics Engineering   Aug. 2019 - Aug. 2023
- **GPA: 3.76/4.0**
- **Core Courses:** Robot Modeling and Control, Linear Algebra, Fundamentals of Control Engineering.

Massachusetts Institute of Technology (MIT)   Cambridge, Mass.
Special Student   Aug. 2021 - Jun. 2022
- **GPA: 5.0/5.0**
- **Core Courses:** Underactuated Robotics, Numerical Computation, Bio-Inspired Robotics, Electronics Mechatronics Systems II, Feedback System Design, Product Engineering Process, Intro to Machine Learning.

PUBLICATIONS AND PREPRINTS

*Equal Contribution
- **C. Dai***, X. Liu*, Z. Li, K. Sreenath and R. Hollis, "Interactive Navigation with Non-Prehensile Mobile Manipulation", in submission to RA-L.
- X. Liu*, **C. Dai***, J. Zhang, A. Bishop, Z. Manchester and R. Hollis, "Wallbounce : Push wall to navigate with Contact-Implicit MPC", ICRA 2025.
- **C. Dai***, X. Liu*, R Shu and R. Hollis, "Wheelchair Maneuvering with a Single-Spherical-Wheeled Balancing Mobile Manipulator", IROS 2024 (**Best Paper Finalist in Mobile Manipulation**).
- **C. Dai***, X. Liu*, J, Zhou*, Z. Liu, and Z. Jia, "SWheg: A Wheel-Leg Transformable Robot with Minimalist Actuator Realization", accepted to *Journal of Field Robotics (JFR)*.
- **C. Dai**, X. Liu, J, Zhou, Z. Liu, Z. Zhu, and Z. Jia, "SWhegPro: A Novel Robust Wheel-Leg Transformable Robot", published at ROBIO 2022.
- **C. Dai,** P. Fu, B. Zhong, K. Guo, and M. Zhang, "Human-Exoskeleton Misalignment Reduction on Knee Joint via an RPR Mechanism-Based Device", *ICARM* 2022 (**Best Paper Finalist**).
- Z. Liu, **C. Dai**, X. Liu, J. Zhou, and Z. Jia, "A Hybrid Wheel-Leg Transformable Robot with Minimal Actuator Realization", published at *ARM* 2022.
- H. Wang, S. Wang, **C. Dai**, Z. Jia, "SWhegPro3: A Three-Impeller Wheel-Leg Transformable Robot with Variable Robust Adaptability to Stair Dimensions", *published at ROBIO* 2023.
- H. Wang, **C. Dai**, S. Wang, X. Zhang, Z. Zhu, X. Liu, J. Zhou, Z. Liu, Z. Jia, "Ubiquitous Field Transportation Robots with Robust Wheel-Leg Transformable Modules", in submission.

RESEARCH EXPERIENCE

Microsystems Dynamics Lab, CMU Robotics Institute,   Pittsburgh, Penn. USA
Graduate Researcher Assistant under Prof. Ralph Hollis   Sept. 2023–present
- ➢ *Wheelchair Manipulation with Ballbot*
- Developed a control framework for a dynamic bimanual mobile manipulator to maneuver cart-like systems with non-holonomic constraints. Formulated whole-body motion optimizer based on online system identification for wheelchair inertia parameters with EKF. Accepted to *IROS 2024* as *oral presentation* -- nominated as *Best Paper Finalist in Mobile Manipulation*.
- ➢ *Navigation Among Movable Objects with Learned Adaptive Dynamics*
- Proposed a holistic framework for dynamic interactive navigation that leverages learned representations for rapid adaptation to object dynamics, and utilizes model-based prediction to inform decision-making. In submission to *ICRA 2025*.
- ➢ *WallBounce: Push wall to navigate with Contact-Implicit MPC*
- Propose a bi-level MPC framework (CI-MPC + Hybrid MPC) that enables non-periodic upper-body contact to achieve more dynamic and agile locomotion. In submission for *ICRA 2025*.

Biomechatronics Group, MIT Media Lab   Cambridge, Mass. USA
  Undergraduate Researcher Assistant under Prof. Hugh Herr   Jan. 2023–June 2023
  ➢ *2-DoF Powered Ankle-Foot Prosthesis*
  - Designed a force-sensing tendon for the SEA actuation. The design was optimized based on finite element analysis and large force bandwidth analysis of the system.
  - Redesigned the mechatronics of the power management module, making it 25% smaller in size and 20% larger in battery capacity compared to the previous design. Paper in preparation.

SUSTech Institute of Robotics   Shenzhen, China
  Undergraduate Researcher under Prof. Zhenzhong Jia   Feb. 2021–Aug. 2023
  ➢ *SWheg Series: S-Shaped Wheel-Leg Transformable Robots*
  - Developed wheel-leg transformable robots with different actuation methodologies, integrating the advantages of wheels and legs seamlessly on a single platform.
  - **SWheg robot:** A tendon-driven wheel-leg transformable robot with minimalist actuation, using only one actuator to transform all wheels. Journal paper accepted to the *Journal of Field Robotics (JFR)*.
  - **SWhegPro/SWhegPro3 robot:** A novel robust wheel-leg transformable robot using electric push rods. Paper published at *ROBIO 2022* and *ROBIO 2023*.
  ➢ *Wheeled Bipedal Robot Control with E-jet Assistance*
  - Developed trajectory optimization and MPC controller for the e-jet-assisted underactuated wheeled bipedal robot in long-distance jumping, which first demonstrated the effectiveness of e-jet in enabling more agile maneuvers. Paper in preparation.

  Undergraduate Researcher under Prof. Mingming Zhang   Apr. 2020–Jun. 2021
  ➢ *Human-Exoskeleton Misalignment Reduction on Knee Joint*
  - Developed the first lightweight wearable measuring device for human exoskeleton knee joint motion characterization based on the RPR mechanism that weighs only 252 grams.
  - Achieved 51% misalignment reduction compared to the single revolute knee joint.
  - Published a first-author paper at *ARM 2022* -- nominated as *Best Paper Finalist*.

HONORS AND AWARDS

  - Best Paper Finalist in Mobile Manipulation, IROS 2024   Oct. 2024
  - Honorary Undergraduate Thesis of SUSTech   Jun. 2023
  - Best Paper Finalist, ARM 2022   Mar. 2022
  - SUSTech Outstanding Student Scholarship (2019, 2020)   Aug. 2020
  - SUSTech-MIT Scholarship (Top 0.1%, ~70,000 USD)   Aug. 2019

SELECTED PROJECTS AND INTERNSHIPS

Engineering Vehicle in Robomaster   Shenzhen, China
Team Leader   Aug. 2019–Sept. 2020
  - The engineering vehicle is an omnidirectional high-payload platform equipped with auto-aiming aided by computer vision, pneumatic grippers, and a novel step-climbing mechanism (fastest in that year).

Agjunction Inc. & University of Notre Dame   Remote
Summer Intern, supervised by Prof. Bill Goodwine   Aug. 2020–Mar. 2021
  - Developed a realistic tractor model with suspension dynamics and controllers for autosteering. The model was identified with data acquired from field experiments, with IMUs placed on real tractors.

NAMC: Neural Adaptive Motion Control under Unknown Disturbance   Pittsburgh, Penn. USA
Course Project (16824 Intro to Robot Learning, CMU. Instructor: Deepak Pathak)   Sept. 2023–Jan. 2024
  - A novel feedforward-feedback-adaptive policy architecture and training pipeline for RL-based controllers to track arbitrary trajectories. The policy is trained on ground-truth disturbance in a simulator, and such a disturbance is estimated on the fly using closed-loop EKF in validation simulation experiments.

Robook (Robotics Community in SUSTech)   Shenzhen, China
Founder   April. 2023–present
  - A robotics handbook for beginners. Contents include introductions to robotics, robotics competitions, and undergraduate research opportunities. Achieved 25000+ views and comments.