Jingxian Wang

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EDUCATION

Ph.D. in Mechanical Engineering, Northwestern University 09/2021 – Present

- Instructor: Prof. Michael Rubenstein
- Research focus: full-stack novel robot design, minimalism in robotics, swarm robot, modular robot.

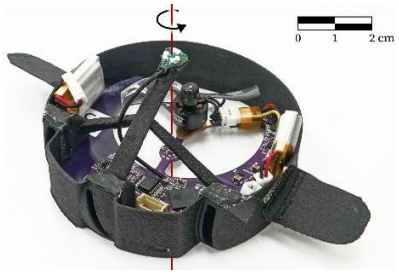
Bachelor of Science in Physics, School of Physics, Peking University (PKU) 09/2017 – 07/2021

- Major courses: Theoretical Mechanics, Electrodynamics, Quantum Mechanics, Computational Physics, Modern Physics Lab I and II, Fundamentals of Electronics Circuits and Experiments, Solid Mechanics, etc.

RESEARCH EXPERIENCE

Major research projects:

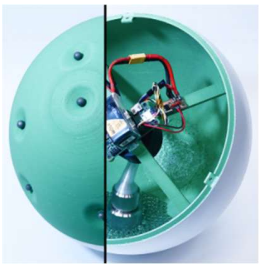
Fall 2021 – present: Development of Single Motor Drone Swarm System



This research demonstrates the first single motor drone swarm capable of autonomous flight using peer-to-peer (P2P) communication and sensing. Each drone, weighing only 20g and containing just one moving part, can fly independently with full control, featuring onboard P2P communication and precise positioning enabled by a novel infrared-based system. The drone is 10x lighter than all previous systems with comparable P2P positioning accuracy. I am the only student on this project and carried out:

- Kalman filter based state estimator + LQR based flight controller design.
- Sensitive (100nA), high-speed (10Mbps) free-space IR communication circuit design.
- Relative position sensing mechanism design. (concept from my advisor, Prof. Rubenstein)
- PCB and structural design.
- Custom and mission-specific communication protocol design and its implementation on Lattice FPGA.
- Embedded software development on ESP32-S3 platform.
- Swarm localization and sensing algorithm design.

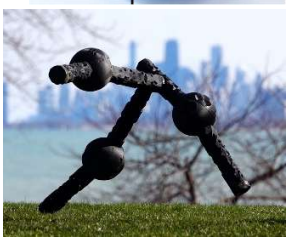
Fall 2023 – present: Development of Single Motor Spherical Robot



This research presents the first single motor spherical robot, Rollbot, and its control strategy. Rollbot minimize mechanical complexity and cost and can be used as fail-safe strategy for conventional spherical robots in the case of motor failures. My role in this project includes:

- Came up with the concept of underactuated spherical robot.
- Independently developed the analytical equation and quasi-stable approximation.
- Independently developed the hardware and feedback control algorithm.
- Collaboratively developing the RL-based control algorithm for better agility.

Spring 2024 – present: Development of Reconfigurable Legged Metamachine



This research introduces autonomous modular legs: agile yet minimal, single-degree-of-freedom jointed links that can learn complex dynamic behaviors and may be freely attached to form legged metamachines at the meter scale. This research enables rapid repair, redesign, and recombination of highly dynamic modular agents that move quickly and acrobatically through unstructured environments. My role in this project includes:

- Lead development of the docking mechanism and electrical and mechanical hardware.
- Helped with development of RL-based metamachine control algorithm.
- Collaboratively developing the next generation, self-reconfigurable legged metamachine

Fall 2020 – Fall 2022: Development of underwater localization system based on electrostatic field.

This research proposed a bio-mimetic method to use electrostatic field for P2P localization and communication, which has benefits in size and cost comparing to sonar-based solutions. My role in this project includes:

- Developed the theory and algorithm for 6-DoF underwater localization using electrostatic field.
- Developed the hardware for high sensitivity (1uV), high dynamic range (10^6) underwater signal capture

Other significant research projects:

Fall 2022 – Spring 2023: Research on film grain rendering and parameter estimation.
Fall 2021 – Spring 2022: Research on PCB-based minimalist robot PCBot.
Fall 2018 – Spring 2021: Research on light-actuated soft flying robot.
Fall 2018 – Spring 2020: Construction of an optical tweezer with trapping strength measurement system and research of phase-adjustable SPPs optical tweezer array.

Reviewer of T-RO, RSS, R-AL.

PUBLICATIONS AND PRE-PRINTS

- Chen Yu*, David Matthews*, **Jingxian Wang***, et.al. "Reconfigurable legged metamachines that run on autonomous modular legs." *arXiv preprint arXiv:2505.00784* (2025) (under-review at PNAS).
- **Jingxian Wang**, Andrew G. Curtis, Mark Yim, and Michael Rubenstein. "A single motor nano aerial vehicle with novel peer-to-peer communication and sensing mechanism." *Robotics: Science and Systems (RSS)* (2024).
- **Jingxian Wang**, and Michael Rubenstein. "Rollbot: a spherical robot driven by a single actuator." *arXiv preprint arXiv:2404.05120* (2024). (under-review at ICRA, presented poster at MWRW conference.)
- Kaixuan Zhang*, **Jingxian Wang***, Daizong Tian, and Thrasyvoulos N. Pappas. "Film grain rendering and parameter estimation." *ACM Transactions on Graphics (ToG)* 42, no. 4 (2023): 1-14.
- Kaixuan Zhang*, **Jingxian Wang***, Daizong Tian, and Thrasyvoulos N. Pappas. "Real time film grain rendering and parameter estimation." U.S. Patent Application 18/608,381, filed September 19, 2024.
- **Jingxian Wang**, and Michael Rubenstein. "PCBot: a minimalist robot designed for swarm applications." IROS 2022, pp. 1463-1470. (best paper finalist, best student paper finalist, best mechanisms and design paper finalist)
- Junzheng Zheng, **Jingxian Wang**, et.al. "Biomimetic electric sense-based localization: A solution for small underwater robots in a large-scale environment." *IEEE Robotics & Automation Magazine* 29, no. 4 (2022): 50-65.
- **Jingxian Wang**, Tianye Wang, Wei Wang, Xiwang Dong, and Yandong Wang. "Distributed localization without direct communication inspired by statistical mechanics." *arXiv preprint arXiv:2006.02658* (2020).
- **Jingxian Wang**, Shuneng Ran, Kun Xun; "Another kind of high sensitive state of DL-8 high-pressure ionization gauge", *Physics Experimentation* 2018, no. 5 (2018): 8-12.

*Notes: * means co-first author.*

AWARDS AND HONORS

• IROS 2022 Best Paper Award and Best Mechanisms and Design Paper Award Finalist	10/2022
• PKU Scholar in Physics, PKU	06/2021
• Outstanding Project on “Light-actuated soft flying robot”, School of Engineering, PKU	01/2021
• Wenxin Zhang Scholarship, PKU	09/2020
• Award for Outstanding Research, PKU	09/2019
• Pivot of Merit Student, PKU	09/2018
• Leo Koguan Scholarship (6th place out of 201 students), PKU	09/2018
• The Second Prize of Freshman Scholarship, PKU	09/2017
• Gold Medal in the 18th Asian Physics Olympiad (APhO)	05/2017

PROFESSIONAL SKILLS

Specialty: Architecting and analyzing novel robot systems, rapid prototyping of hardware and algorithms, multi-paradigm data processing.

Advantages: Rich experience in novel system design and software-hardware joint development, exposure to latest ideas in robotics, solid background in physics.

Professional Skills: Proficient in embedded system design and embedded programming in C/C++, especially on ESP32 platform. Proficient in CAD with Autodesk Fusion/Inventor. Proficient in circuit design and validation using LTSpice or TINA, and further PCB drawing using Autodesk Eagle PCB. Highly proficient in using Wolfram Mathematica for regular programming, analytics, publication-quality visualization, data and image processing, 3D modeling and printing, etc. Experienced in FPGA design in Verilog. Experienced in simulation software like COMSOL or Ansys Fluent. Experienced in software like LaTeX, Python, etc.

English Proficiency: TOEFL iBT 114 (out of 120), GRE 327 (out of 340).