

SIYUAN (SYLVESTER) ZHANG

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EDUCATION

Columbia University

New York City, NY

Master of Science in Mechanical Engineering (Robotics and Control)

08/2024 ~ 06/2026 (Expected)

Coursework: Control Theory, Robot Studio, Data Science for Mechanical System, Robotics Theory, Robot Learning, Mechatronics and Embedded System, Advanced Robotics

Sun Yat-sen University

Shenzhen, CN

Bachelor of Engineering in Aeronautical and Astronautical Engineering

09/2020 ~ 06/2024

Coursework: The Amazing Smart Bionic World, Basis of Mechanical Design, Finite Element Method and Programming, Theoretical Mechanics, Intelligent Manufacturing, Method of Numerical Computation, Space Robotics Technology, Aerodynamics

RESEARCH EXPERIENCE

Design of An Intelligent Self-Reproducing Robot

New York City, NY

Columbia University | Advisor: Hod Lipson

01/2025 ~ present

- Designed DNA-inspired modular self-replicating robots, enabling 3D-2D folding via magnetic coupling and 6-DOF actuation.
- Developed a six-stage R&D pipeline from concept to prototype for scalable, autonomous robotic swarms.
- Preparing manuscript for *Science Robotics* submission.

Development of a 3-RRR Parallel Ankle Rehabilitation Robot

New York City, NY

Columbia University | Advisor: Sunil K. Agrawal

01/2025 ~ present

- Developed a novel wearable 3-RRR spherical parallel ankle rehabilitation robot.
- Designed and simulated inverse kinematics and Jacobian-based control, enabling precise motion tracking for multi-axis ankle support.
- Implemented therapist-inspired assistance/resistance modes, supporting both passive and active rehabilitation through modular mechanical design.
- Preparing manuscript for *IEEE ICRA* submission.

Design of the joint of an advanced adaptive Tendon- Actuated robot manipulator

Shenzhen, CN

Sun Yat-sen University | Advisor: Prof. Deshan Meng

11/2023 ~ 05/2024

- Focusing on building a lever arm amplification joint to improve torque output for tendon-driven robotic arms in space applications.
- Optimized lightweight components and conducted kinematic analysis for precise control.
- Prototyped and validated the robotic arm, succeeding in high adjustability and reliable performance across varying joint angles.
- Research directed as my undergraduate thesis.

Enhancing Grasping Diversity with a Pinch-Suction and Soft-Rigid Hybrid Multimodal Gripper

Shenzhen, CN

Sun Yat-sen University | Advisor: Prof. Jianing Wu, Prof. Jinxiu Zhang

04/2023 ~ 04/2024

- Designed a soft-rigid hybrid gripper with multiple manipulation modes, enabling effective handling of objects of varying sizes and weights.
- Integrated gripping and suction mechanisms to increase stability and controllability during object manipulation.
- Facilitated tasks such as strong gripping, gentle gripping, and adaptable suction through multimodal functionality.
- Published results in *IEEE Transactions on Robotics* (DOI: 10.1109/TRO.2025.3577014).

Bioinspired Stiffness-Regulating Materials for Soft Machines

Shenzhen, CN

Sun Yat-sen University | Advisor: Prof. Jianing Wu, Prof. Jinxiu Zhang

06/2023 ~ 01/2024

- Built a composite structure combining soft materials and stimuli-responsive materials for dynamic stiffness control in soft robotics.
- Prototyped a gripper by using elastomer and shape memory alloys, integrating stiffness control programming.
- Evaluated stiffness performance and stress-strain behavior across different states.
- Explored applications in adaptive grippers and wearable devices.
- Published results in *Advanced Engineering Materials* (DOI: 10.1002/adem.202400461).

Transporting Dispersed Granules by a Soft Gripper: Physical Intelligence Inspired by an Elephant Trunk

Shenzhen, CN

Sun Yat-sen University | Advisor: Prof. Jianing Wu, Prof. Jinxiu Zhang

05/2022 ~ 06/2023

- Designed and prototyped a soft pneumatic gripper inspired by elephant trunk mechanics for efficient handling of dispersed granules.
- Optimized critical actuation pressures, lifting speeds, and heights to achieve a 90%+ success rate and reduce operation time by ~50%.
- Utilized ANSYS for performance simulation and SOLIDWORKS for iterative design improvements.
- Published results in *Advanced Intelligent Systems* (DOI: 10.1002/aisy.202300182).

PROJECT EXPERIENCE

Design and Gait Optimization of a Quadruped Spider Robot for Robotics Studio

New York City, NY

Columbia University | Advisor: Prof. Hod Lipson

09/2024 ~ 12/2024

- Designed a 4-legged robotic system with 2 DOF per leg, powered by 8 servomotors (240° range) and controlled via a Raspberry Pi.
- Created a parametric CAD model in SOLIDWORKS, converted it to a URDF file, and optimized the robot's gait using PyBullet simulations and parallel hill climber algorithms.
- Implemented control algorithms in Python to actuate servos, enabling sim-to-real to optimize walking patterns.
- Built and tested the prototype operating 3D printing for rapid iterations, attaining a final walking speed of 29 cm/s with high stability.

Design of a Biomimetic Spherical Robot with Multi-Motion Modes for Space Exploration

Shenzhen, CN

Sun Yat-sen University | Advisor: Prof. Jinxiu Zhang

05/2023 ~ 01/2024

- Built a multi-modal spherical robot combining the benefits of hexapod and spherical robots for planetary exploration, addressing challenges such as adaptability, terrain navigation, and obstacle crossing.
- Designed a modular structure enabling dual motion modes: spherical rolling for flat terrain and hexapod crawling for rugged environments.
- Developed a collapsible leg mechanism for seamless transitions between motion modes to adapt to varied terrains.
- Conducted structural design and simulations to boost durability, obstacle-crossing ability, and terrain adaptability.

Design of a Bionic Flapping-Wing Robot Inspired by Birds

Shenzhen, CN

Sun Yat-sen University | Advisor: Prof. Zhenbo Lu

09/2022 ~ 12/2023

- Developed a lightweight, foldable, and low-noise flapping-wing robot inspired by small birds, integrating principles of bionics.
- Devised and simulated the mechanical model using SOLIDWORKS and ANSYS, modifying structural performance and aerodynamics.
- Implemented a closed-loop control system to achieve stable and controlled flight.

Design of a Foldable, Adhesive Crawling CubeSat for Space Station Operations

Shenzhen, CN

Sun Yat-sen University | Advisor: Prof. Jinxiu Zhang, Jianing Wu

03/2022 ~ 08/2023

- Led a team of 5 in designing a spider-inspired CubeSat with foldable claws, mechanical legs, and detection modules for surface inspection, debris removal, and damage repair.
- Optimized mechanical structure through SOLIDWORKS and explored electrostatic adsorption for secure attachment in space environments.
- Attained 3rd prize in the IAF-CSA Space Universities CubeSat Challenge 2.0 for innovative design and engineering solutions.

PROFESSIONAL EXPERIENCE

Graduate Research Assistant

New York City, NY

Columbia University – Creative Machines Lab

01/2025 ~ present

- Design a Self-reproducing Robot in Creative Machines Lab under the supervision of Prof. Hod Lipson. Developing autonomous systems with 6-DOF modular architecture for potential space applications.
- Designed modular self-reproducing robot system with 10+ identical modules.
- Implemented recursive replication algorithms with structural fidelity testing.

Graduate Teaching Assistant

New York City, NY

Columbia University

01/2025 ~ 06/2025

- Teaching Assistant for Robotics Studio by Prof. Hod Lipson for 2025 Spring semester. Supporting 30+ **students** across undergraduate and graduate levels in hands-on robotics projects.
- Assist with weekly laboratory sessions for multiple groups.
- Help develop course materials covering ROS, Python, and embedded systems.
- Maintain positive student feedback in course evaluations.

Structural Design Engineer Intern

Shenzhen, CN

Insta360

01/2024 ~ 03/2024

- Conducted requirements analysis to translate product specifications into feasible structural designs, ensuring functionality, manufacturability, and cost-effectiveness.
- Constructed and finalized detailed 3D models and mechanical drawings operating Creo.
- Collaborated on prototyping and testing of product structures, improving design iterations and efficiency.

Undergraduate Research Assistant

Shenzhen, CN

Sun Yat-sen University | Bio-Inspired Interfaces and Future Manufacturing Laboratory

05/2022 ~ 06/2024

- Conducted focused research on end-effector design for soft robots and bio-inspired robotic systems, addressing challenges in adaptability and precision manipulation.
- Formulated and simulated robotic components and mechanisms by SOLIDWORKS and ANSYS.
- Created experimental platforms and instruments to evaluate end-effector kinematics, mechanical properties, and interaction dynamics, systematically collecting and analyzing data for iterative improvements.

- Created and improved aerodynamic models for enhanced flight performance using principles of fluid mechanics and material engineering.
- Built and tested prototypes, improve structural stability and reduce performance inefficiencies through iterative development.
- Cooperated with a team to complete projects and participate in competitions, ensuring effective collaboration and technical execution.

PUBLICATION

- Yuwen Zhao, Jiaqi Zhu, Jie Zhang, **Siyuan Zhang**, Yimu Liu, Jianing Wu, Zhigang Wu, Jinxiu Zhang. *Enhancing Grasping Diversity with a Pinch-Suction and Soft-Rigid Hybrid Multimodal Gripper*. IEEE Transactions on Robotics. DOI: 10.1109/TRO.2025.3577014.
- Ke Ma, Jie Zhang, Ruotong Sun, Binhan Chang, **Siyuan Zhang**, Xiaojun Wang, Jianing Wu, Jinxiu Zhang. *Synergizing Structural Stiffness Regulation with Compliance Contact Stiffness: Bioinspired Soft Stimuli-Responsive Metamaterials Design for Soft Machines*. Advanced Engineering Materials. DOI: 10.1002/adem.202400461.
- Yuwen Zhao, Jie Zhang, **Siyuan Zhang**, Peng Zhang, Guixin Dong, Jianing Wu, Jinxiu Zhang. *Transporting Dispersed Granules by a Soft Gripper: Physical Intelligence Inspired by an Elephant Trunk*. Advanced Intelligent Systems. DOI: 10.1002/aisy.202300182.

TECHNICAL PROFICIENCY

- Programming: Python, C, MATLAB, C++, ROS, Linux, LaTeX, Arduino IDE
- Software: Auto CAD, MATLAB, ANSYS, SOLIDWORKS, PTC Creo, CATIA, NX CAD
- Engineering Techniques: FEA, DFM, DFA, FA, DOE, GD&T
- Manufacturing Techniques: FDM 3D Printing, Stereolithography (SLA), Laser Cutting, CNC Machining