SIYUAN (SYLVESTER) ZHANG

www.siyuanzhang.com | (646) 225-8775 | sz3297@columbia.edu

EDUCATION

Columbia University *New York City, NY*
Master of Science in Mechanical Engineering (Robotics and Control), 08/2024 ~ 06/2026 (Expected)
Research Assistant in Creative Machine Lab, Advisor: Prof. Hod Lipson

Sun Yat-sen University *Shenzhen, CN*
Bachelor of Engineering in Aeronautical and Astronautical Engineering, 09/2020 ~ 06/2024

RESEARCH KEYWORDS

Self-Reproducing Robot, Rehabilitation Exoskeleton, Soft Robotics, Bio-Inspired System, Robotic Material, Modular Robotics

PUBLICATION

- *Helical Genesis: An Intelligent Self-Reproducing Robot Evolving from 2-D Lattices into 3-D DNA-Inspired Architectures*
  Siyuan Zhang, Hod Lipson
  Manuscript in Preparation
- *From Structural Design to Dynamics Modeling: Control-Oriented Development of a 3-RRR Parallel Ankle Rehabilitation Robot*
  Siyuan Zhang, Yufei Zhang, Junlin Lyu, Sunil K. Agrawal
  Manuscript in Preparation
- *Enhancing Grasping Diversity with a Pinch-Suction and Soft-Rigid Hybrid Multimodal Gripper*
  Yuwen Zhao, Jiaqi Zhu, Jie Zhang, Siyuan Zhang, Yimu Liu, Jianing Wu, Zhigang Wu, Jinxiu Zhang
  IEEE Transactions on Robotics. DOI: 10.1109/TRO.2025.3577014
- *Synergizing Structural Stiffness Regulation with Compliance Contact Stiffness: Bioinspired Soft Stimuli-Responsive Metamaterials Design for Soft Machines*
  Ke Ma, Jie Zhang, Ruotong Sun, Binhan Chang, Siyuan Zhang, Xiaojun Wang, Jianing Wu, Jinxiu Zhang
  Advanced Engineering Materials. DOI: 10.1002/adem.202400461
- *Transporting Dispersed Granules by a Soft Gripper: Physical Intelligence Inspired by an Elephant Trunk*
  Yuwen Zhao, Jie Zhang, Siyuan Zhang, Peng Zhang, Guixin Dong, Jianing Wu, Jinxiu Zhang
  Advanced Intelligent Systems. DOI: 10.1002/aisy.202300182

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 pipeline from concept to prototype for scalable, autonomous robotic swarms.

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 rehabilitation through modular mechanical design.

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.

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.

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.

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 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.

TEACHING EXPERIENCE

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.

PROFESSIONAL EXPERIENCE

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.

Mechanical & Aerodynamic Engineer *Shenzhen, CN*
Sun Yat-sen University | Aeromodelling Club 03/2022 ~ 09/2022

- 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.

TECHNICAL PROFICIENCY

- Programming: Python, C, MATLAB, C++, ROS, Linux, 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