Zihan Guo

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Online Portfolio | Youtube Channel | Github Page

EDUCATION

Columbia University, *School of Engineering and Applied Science* — *New York, NY, US*
MS in Mechanical Engineering (Robotics and Control), **GPA**: 3.7/4.0 — Sep 2022 - Jan 2024

- **Main Courses**: MS Proj(A), Robot Learning(A), Robotics Studio(A), Modern Control(A-), Data Science(A-), Evolutionary Computation(A-)

Sun Yat-sen University (SYSU), *School of Aeronautics and Astronautics* — *Shenzhen, Guangdong, China*
BE in Theoretical and Applied Mechanics, **GPA**: 3.4/4.0 — *Sep 2018 - Jul 2022*

- **Main Courses**: Linear Algebra (90), Fortran (94), Elasticity (91), Fluid Mechanics (90), Rocket Dynamics (89)
- SYSU 2022 Outstanding Undergraduate Thesis (7/140)
- National First Prize: IAF-CSA Space University CubeSat Challenge

PAPER & PATENT

Rapid grasping of fabric using bionic soft grippers with elastic instability, *Z Xiong,* ***Z Guo****, L Yuan, Y Su, Y Liu, H Lipson - arXiv:2301.09688* ***(IROS 2023, Accepted)*** [pdf]

A deployable cable-net antenna for satellite, *G Xun,* ***Z Guo****, L Long, J Jiang, Z Wu - CN202120252012.9* [link]

RESEARCH EXPERIENCE

Creative Machines Lab, *Columbia University* — *New York, NY, US*
Research Assistant, Mentored by Prof. Hod Lipson — Oct 2022 – Present

- Researched on bi-stable structures that can be used as end-effectors and actuators for robots, especially a soft gripper for picking up 2D objects and a robot fish for underwater navigation
- Designed a soft gripper based on a novel bi-stable structure using SolidWorks after studying several pertinent papers, achieving a 2.7 times wider span and 10.9 times faster closure speed compared to traditional designs
- Developed a robotic arm platform using Arduino and implemented an control system to conduct gripping experiments
- Innovated and developed a robot fish using a bi-stable carbon fiber structure, constructed a mathematical model using numerical methods to describe its motion and verified that this bi-stable actuator is more energy-efficient compared to traditional bionic robot fish tails

Tensegrity Robots Lab, *Sun Yat-sen University* — *Shenzhen, Guangdong, China*
Research Assistant, Mentored by Prof. Zhigang Wu — Dec 2021 - Jun 2022

- Worked on a cable-driven robotic arm for in-space docking and object capturing with an attribute to avoid rigid collisions, independently designed the mechanical structure of the cable-driven robotic arm and fabricated it using 3D printing
- Developed the kinematic model of the tensegrity robot arm and developed a forward kinematics simulator in MATLAB, used Newton's method to perform numerical integration to solve complex partial differential equations and obtain the solution from drive space to joint space.
- Established the static equilibrium equation and analyzed the stiffness of the robotic arm by calculating the relationship between the force applied at the end effector and the deformation of the whole arm
- Developed a control system using *Arduino* and performed multiple control-driven experiments, achieving accuracy greater than 98%

SYSU UAV Association, *Sun Yat-sen University* — *Shenzhen, Guangdong, China*
Project Leader, Mentored by Prof. Jianing Wu, Funded by school with *150,000RMB* — Dec 2021 - Jun 2022

- Supervised a team in the design and fabrication of the solar-powered, fixed-wing drone, coordinated teams to design the structure, aerodynamics, and solar-power systems of the drone
- Conducted research on papers and patents pertaining to solar aircraft and solar cell technologies, informing the design and construction process of the drone, and utilized *AutoCAD*, *SolidWorks*, *Xflr 5*, and ANSYS for drone design, with manufacturing processes including 3D printing, laser cutting and soldering
- Successfully developed a solar-powered, fixed-wing drone with a wingspan of 4.7 meters

Advanced Spacecraft Lab, *Sun Yat-sen University* *Shenzhen, Guangdong, China*

Research Assistant, Mentored by Prof. Zhigang Wu Jul 2020 - Oct 2021

- Designed the deployment mechanism and built a 3D model of the antenna using *SolidWorks*
- Performed Finite Element Analysis (FEA) using ANSYS, calculated and corrected the error of the cable-net

PROJECTS [Website]

Bipedal Robot, *Columbia University* Jan 2023 - May 2023

- Conceptualized and built a bipedal robot from scratch, integrating a control system using a Raspberry Pi and IMU.
- Utilized the *MuJoCo* for gait simulation, employing hill climber and reinforcement learning algorithms for training, successfully implemented the "sim-to-real" transfer, achieving a walking speed of 11.43 cm/s.

Robot Learning, *Columbia University* Jan 2023 - May 2023

- Collected state data from a robot arm and constructed a neural network to train the forward model
- Used *PyTorch* for reinforcement learning with DQN and PPO for MPC control of the robot arm

Evolutionary Algorithm, *Columbia University* Sep 2022 - Dec 2022

- Developed a mass-spring physics simulator in *C++* to create a physics environment for a soft quadruped robot model
- Utilized evolutionary algorithms within the simulator to progressively train and optimize the robot's gait motion

Rocket Trajectory Simulation, *Sun Yat-sen University* Nov 2020 - Jan 2021

- Utilized numerical algorithms in MATLAB to solve a rocket's trajectory, created a detailed description of flight state
- Wrote a calculation report of 50+ pages to evaluate an accuracy of less than 10 meters

WORKING EXPERIENCE

Columbia University *New York, NY, US*

Course Assistant- MECS4510 Evolutionary Computation, Prof. Hod Lipson Sep 2023 - Dec 2023

- Graded students' assignments and exams, answered students' questions online about the evolutionary algorithm, python, C++, Git and etc.

SZ DJI Technology Co., Ltd. (DJI) *Shenzhen, Guangdong, China*

Education Content Developer Feb 2022 - Jul 2022

- Created comprehensive STEAM educational resources including Robotics, *Scratch*, *Python*, PID control for students
- Trained 1000+ robot teachers and implemented multiple assessments to validate their capabilities

ROWING COMPETITIONS

- *Championship*: 2020 China Rowing Masters Competition “Zhejiang Yongli Cup”-Men’s Eight Oct 2020
- *2nd Place*: 2019 China Land Rowing Tournament-Men’s One-minute Dash Dec 2019
- *4th Place*: 2019 China Land Rowing Tournament-Team Relay Dec 2019
- *2nd Place*: 2019 Guangdong “Rowing at SYSU”, College Student Division-Men’s One-minute May 2019
- *4th Place*: 2019 Chinese and Foreign Famous Collegiate Rowing Regatta- Men’s Eight Apr 2019

SKILLS

- **Programming**: *Python*, *C++*, MATLAB, *Fortran*
- **Design and Simulation**: *MuJoCo, Pybullet, SolidWorks*, *AutoCAD*, ANSYS, *Proteus* 8, *Mathcad*, *Xflr* 5
- **Others**: *Raspberry Pi, Arduino, Ubuntu, PyTorch, Numpy, Pandas, Keras, ROS, Git, LaTeX, OriginLab, PS, PR*