LI DANNUO

Email: li_dannuo@u.nus.edu Mobile: +65 83474219

EDUCATION

National University of Singapore (NUS), Singapore **Aug 2022 - Aug 2024**
M.Eng. in Biomedical Engineering

- Research-based master student advised by Prof. Raye Yeow, Evolution Innovation Lab, Advanced Robotics Centre.
- Research on soft robotics, human-robot interaction and haptic feedback devices.

Southwest Jiao Tong University (SWJTU), China **Sep 2019 - Jun 2023**
B.Eng. in Biomedical Engineering

- Main Course: Fundamentals of Electric Circuit and Technologies, Advanced Language Program Design C++, Biomechanics, Bioelectronics and Biosensing, Basics of Mechanical Drawing CAD&Solidworks, Medical Equipment and Human Health.
- University Comprehensive Scholarship.

PUBLICATIONS (*: co-first author)

[1] Q. Xiong*, **D. Li***, X. Zhou, W. Xin, et.al., "Single-motor Ultraflexible Robotics (SMUFR) Humanoid Hand", *IEEE Transactions on Medical Robotics and Bionics*, 2024. (In press)
[2] **D. Li**, X. Zhou, Q. Xiong, C. H. Yeow, "A Multimodal Soft Gripper with Variable Stiffness and Variable Gripping Range Based on MASH Actuator", *Workshop in IEEE 7th International Conference on Soft Robotics (RoboSoft)*, 2024, arXiv preprint, arXiv:2408.05507.
[3] Q. Xiong, X. Zhou, **D. Li**, J. W. Ambrose, et.al., "An Amphibious Fully-Soft Centimeter-Scale Miniature Crawling Robot Powered by Electrohydraulic Fluid Kinetic Energy", *Advanced Science*, 2024, p. 2308033.

UNDER REVIEW

[4] **D. Li**, Q. Xiong, X, Zhou, C. H. Yeow, "A Novel Kinesthetic Haptic Feedback Device Driven by Soft Electrohydraulic Actuators", *Advanced Intelligent Systems*. (under review)
[5] Q. Xiong*, **D. Li***, X. Li*, L. Liu, et.al., "EA-SoGripper: Electroadhesion-Stiffening Self-Adaptive Soft Robotic Gripper", *IEEE Transactions on Mechatronics*. (major revision)
[6] Q. Xiong*, X. Zhou*, **D. Li***, G. Tan, D. Rus, et.al., "Electrohydraulic Jammed Variable Stiffness Robotic Link", *Soft Robotics*. (under review)

RESEARCH EXPERIENCE

Graduate Research Student **Dec 2022 - Aug 2024**
Evolution Innovation Lab, Advanced Robotics Centre, NUS
(Advisor: Prof Raye Yeow; Mentor: Dr. Quan Xiong)

A Novel Kinesthetic Haptic Feedback Device Driven by Soft Electrohydraulic Actuators.

- Developed a novel soft electrohydraulic actuator controlled and driven by high-frequency AC voltage. Built a kinesthetic haptic feedback device based on its stable output performance and rapid response speed.
- Achieved simultaneous and controlled output of stable kinesthetic and cutaneous feedback by superimposing sine waves of different frequencies onto the high-frequency AC square wave driving the actuator, without introducing any additional actuators.
- Developed a teleoperated robotic gripper system based on this kinesthetic haptic feedback device, enabling real-time teleoperated grasping with force feedback.
- **Contributions**: Designing and constructing hardware system for entire project, fabricating actuators, building teleoperated robot system, developing control algorithms, conducting all characterization experiment, and writing academic paper.

EA-SoGripper: Electroadhesion-Stiffening Self-Adaptive Soft Robotic Gripper.

- Developed a soft robotic gripper with capabilities in adapting to object shapes, adjusting grasping stiffness, and controlling grasping force with high accuracy based on electro-adhesion technology.
- The gripper based on flexible electro-adhesion structure realizes the adaptive increase of gripping effective area in the process of gripping objects of different shapes, which greatly enhances the robustness of gripping fragile objects.
- **Contributions**: Prototyping soft robot grippers, writing and debugging control algorithms for grasping objects, circuit design and construction of portable high-voltage output modules, experimental testing of adaptive grasping and writing academic paper.

Single-motor Ultraflexible Robotics (SMUFR) Humanoid Hand.

- Developed an ultra-flexible robotic humanoid hand driven by a single motor.
- Designed a pneumatic friction-based clutch mechanism and based on this, developed a one-to-more transmission system that transfers torque from a single motor to multiple tendon cables for humanoid hand actuation.
- Designed a rotational mechanism with a torsion spring return and pneumatic clutch locking structure to realize thumb rotation under tendon cable actuation.
- **Contributions**: The structural design and system construction of the humanoid hand and the single motor rotary clutch based on pneumatic actuator, built the circuit module for controlling the finger bending motion, integrated the whole set including the humanoid hand and the drive module into a wearable robot system and writing academic paper.

A Multimodal Soft Gripper with Variable Stiffness and Variable Gripping Range Based on MASH Actuator.

- Developed a multimodel soft gripper with variable stiffness and variable gripping range based on soft pneumatic actuator (SPA) and electro-adhesion technology.
- Achieved motion control and stiffness variation of the SPA by altering the activation state and voltage of the electro-adhesion clutches mounted on both sides.
- Under the coordinated control of the electro-adhesion clutches and pneumatic pressure input, the gripper gained the ability to vary its grasping range in the horizontal direction and independently grasp multiple overlapping objects in the vertical direction.
- **Contributions**: Designing and constructing hardware system for entire project, conducting all characterization experiment, and writing academic paper.

An Amphibious Fully-Soft Centimeter-Scale Miniature Crawling Robot Powered by Electrohydraulic Fluid Kinetic Energy.

- Developed a novel hydraulically amplified self-healing electrostatic (HASEL) actuator fabricated from BOPP film.
- Activated electrodes at different positions on the HASEL actuator with transient high voltage to induce fluid kinetic energy in various directions within the dielectric fluid bladder, enabling crawling movement.
- **Contributions**: The fabrication of MCR, experiments on electro-hydraulic fluid kinetic energy properties, and the design and fabrication of MCR multi-directional crawling control modules.

Electrohydraulic Jammed Variable Stiffness Robotic Link.

- Developed an electrohydraulic jammed variable stiffness robotic link (VSRL).
- Controlled stiffness variation by driving the dielectric fluid's aggregation within the bladder through electroadhesion, thereby achieving jammed.
- Realized VSRL’s bending self-sensing by measuring the change in current across a large resistor connected in series with the positive and negative electrodes of the VSRL.

- **Contributions**: The investigation of VSRL self-sensing characteristics and the development of a VSRL-based biplane UAV with complex terrain landing capability.

Graduate Research Student **Aug 2022 - Dec 2022**

Biomechanics Lab, Department of Biomedical Engineering, NUS
(Supervisor: A/Prof. Leo Hwa Liang)

- Engaged in research on topic of domain adaptive identification of malaria-infected blood cells based on deep neural networks. Built generative adversarial network (GAN) for training medical image dataset.

Undergraduate Student **Sep 2019 - Jun 2022**

Department of Biomedical Engineering, SWJTU

- Engaged in research on photothermal antibacterial nanoparticles with pH response.
- Collaborated scientific and creative projects on garbage classification under big data technology---helping to build an ecological city.

ACADEMIC PRESENTATIONS

- "A Multimodal Soft Gripper with Variable Stiffness and Variable Gripping Range Based on MASH Actuator", Poster in IEEE 7th International Conference on Soft Robotics (RoboSoft 2024). (Best poster award in the multimodal workshop)
- "A soft electrohydraulic actuator driven by high-frequency AC voltage capable of simultaneously delivering kinesthetic and cutaneous haptic feedback", Oral presentation in Biomedical Engineering Society 17th Scientific Meeting (BES17SM), 2024.
- "A tendon-driven single-motor system for prosthetic hands", Oral presentation in Biomedical Engineering Society 16th Scientific Meeting (BES16SM), 2023.

KEY SKILLS

Hardware Design: CAD, Solidworks, Altium Designer, Simply3D&Ultimaker Cura (3D Print).
Programming: C++, C#, Python (Pytorch, Tensorflow), MATLAB, LabView, Microcontrollers (e.g. Arduino).
Language: English and Mandarin (both spoken and written).