Ryan Zeyuan Chen

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🌐 https://ryan-zeyuan-chen.github.io/ 🪪 Toronto, ON, Canada

Education

Toronto, ON, Canada Sep 2022 – Aug 2024	**M.A.Sc. in Mechanical Engineering**, University of Toronto Advisor: Prof. Andrew Goldenberg *Collaborative Specialization in Robotics*
Toronto, ON, Canada Sep 2017 – Apr 2022	**B.A.Sc. in Engineering Science**, University of Toronto Advisor: Prof. Jessica Burgner-Kahrs *Robotics Engineering Major, Artificial Intelligence Engineering Minor, Engineering Business Certificate*

Research Experience

Toronto, ON, Canada
Sep 2022 – Ongoing

Robotics Institute, University of Toronto | Graduate Student
Supervised by Prof. Andrew Goldenberg, Robotics and Automation Laboratory
- Exploring the development of a data-efficient and generalizable framework for learning robot kinematics, with an application to concentric tube continuum robots (CTCRs).
- Conducted a comprehensive literature review on learning-based robot kinematic modeling, identifying key challenges related to training data in the learning process.
- Developing a transfer learning framework designed to effectively address and mitigate the data-related obstacles in modeling robot kinematics.

Boston, MA, USA
May 2023 – Sep 2023

Brigham and Women's Hospital, Harvard Medical School | Research Intern
Supervised by Prof. Jayender Jagadeesan, Surgical Imaging and Mechatronics Laboratory
- Developed a novel dynamics model for tendon-driven continuum robots (TDCRs), addressing modeling disparities caused by hysteresis through the incorporation of static and sliding tendon frictions.
- Validated the accuracy of the dynamics model by rigorously comparing its predictions with the behavior of a physical TDCR prototype through static and dynamic experiments.
- Explored the integration of machine learning techniques to enhance the computational speed and convergence capabilities of the dynamics model.

Toronto, ON, Canada
May 2021 – Apr 2022

Robotics Institute, University of Toronto | Research Assistant
Supervised by Prof. Jessica Burgner-Kahrs, Continuum Robotics Laboratory
- Conducted an in-depth investigation into solving the forward and inverse kinematics of concentric tube continuum robots (CTCRs) utilizing machine learning.
- Comprehensively reviewed the existing physics-based and data-driven modeling approaches for CTCRs by analyzing relevant literature.
- Implemented a feed-forward neural network (FNN) model for learning the direct forward kinematics mapping between joint space and task space for CTCRs using PyTorch.
- Explored a novel hybrid approach that combines machine learning with differential inverse kinematics to compute the inverse kinematics of CTCRs.
- Rigorously tested and evaluated the performance of these approaches using data generated from both simulation and a physical CTCR prototype.

Toronto, ON, Canada
May 2019 – Apr 2020

Robotics Institute, University of Toronto | Research Assistant
Supervised by Prof. Xinyu Liu, Microfluidics and BioMEMS Laboratory
- Developed an antifreezing, ambient-stable and highly stretchable ionic skin with strong surface adhesion for wearable sensing and soft robotics applications.
- Conducted an extensive literature review to evaluate existing hydrogel-based ionic skin designs, gaining insights into current trends and challenges in the field.
- Executed the fabrication of the ionic skin, encompassing elastomer synthesis, material doping, and stretchable device integration.
- Performed comprehensive testing of the ionic skin's mechanical, electrical, antifreezing, and surface adhesion properties under various environmental conditions.
- Demonstrated the sensing capabilities of the hydrogel-based ionic skin, utilizing its piezoresistive properties to independently control the fingers of a robotic hand via Arduino.

Industry Experience

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<td>San Jose, CA, USA
Jun 2020 – May 2021</td>
<td>Wired and Wireless Group, Xilinx | SerDes Application Design Intern (Remote)
FPGA Software Development, SerDes System Engineering Team

Developed SDK test cases across different test suites to validate the functionality of APIs designed for the Kintex UltraScale+ FPGA using C++.
Verified developed software test cases on both virtual machines and physical hardware prototypes under various network communication protocols.
Regression tested developed software test cases in response to hardware upgrades to ensure performance consistency.

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Publications

2023

1. **Chen, R. Z.**, Shentu, C., Grassmann, R. M., Liang, N. & Burgner-Kahrs, J. Learning-Based Differential Inverse Kinematics for Concentric Tube Continuum Robots. *Manuscript in Preparation* (2023).

2. Pedrosa, F. C., **Chen, R. Z.**, Feizi, N., Arefinia, E., Jagadeesan, J. & Patel, R. V. Unveiling the Mechanics: Modeling and Validating Dynamic Frictional Forces in Tendon-Driven Intracardiac Echo Catheters. *Manuscript in Preparation* (2023).

2022

3. Grassmann, R. M., **Chen, R. Z.**, Liang, N. & Burgner-Kahrs, J. *A Dataset and Benchmark for Learning the Kinematics of Concentric Tube Continuum Robots* in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* (2022), 9550–9557.

2021

4. Ying, B., **Chen, R. Z.**, Zuo, R., Li, J. & Liu, X. An Anti-Freezing, Ambient-Stable and Highly Stretchable Ionic Skin with Strong Surface Adhesion for Wearable Sensing and Soft Robotics. *Advanced Functional Materials* **31,** 2104665 (2021).

Presentations

2023

National Center for Image-Guided Therapy (NCIGT) Summer Research Retreat, Brigham and Women's Hospital
Speaker at the Continuum Robotics session, "Robotic Assisted Intracardiac Echocardiography (ICE) Catheter."

Honors and Awards

2021

Faculty of Applied Science and Engineering Dean's Innovation Fellowship, University of Toronto
Awarded to undergraduate engineering students conducting research in the areas of "Smart Cities, Smart Health, and The Internet of Things."

2019

Undergraduate Student Research Award, Natural Sciences and Engineering Research Council of Canada (NSERC)
Awarded to undergraduate students pursuing research in the natural sciences and engineering, based on outstanding academic record and demonstrated research aptitude.

2017

Albert and Rose Jong Entrance Scholarship, University of Toronto
Presented for demonstrating leadership in the Chinese-Canadian community as a first-year student in the Electrical Engineering or Engineering Science program.

2017

Faculty of Applied Science and Engineering Admission Scholarship, University of Toronto
Awarded for outstanding academic achievement in the prerequisite courses as a first-year engineering student.

Technical Skills

Robotics Engineering: Robot Modeling, Machine Learning, Control Theory, Computer Vision, Human-Robot Interaction
Software Development: Python, C, C++, MATLAB, HTML
Tools and Packages: Git, NumPy, PyTorch, Scikit-learn, Pandas, Matplotlib, Seaborn, CMake

Extracurricular Activities

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<td>Toronto, ON, Canada
Jun 2023 – Ongoing</td>
<td>STEAMBOAT Future Education, Anchor Automation | Robotics Tutor

Developed a curriculum using the Arduino Starter Kit to introduce young learners to robotics.
Conducting weekly classes guiding students in building Arduino-based robotics projects, encompassing circuit design and software development, through both the Tinkercad simulation environment and physical hardware.

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