Sofia Luo

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Highlights of Qualifications

- Experienced research assistant with over **3 years of cross-disciplinary experience** in computer vision, robotics, human-computer interaction, and machine learning
- Passionate Robotics engineering student with three-year experience in computer programming and engineering design using divergent thinking, conflict management and creativity to enhance design projects
- Proven ability to communicate complex research through **peer-reviewed publications** at top-tier venues including **IEEE EMBS, ICCV, ACM CHI, UIST, and IEEE EMBC**
- Strong public speaking and communication ability obtained from presenting research result on UnERD research conference
- Strong team collaborator with a track record of delivering results in **multi-institutional, interdisciplinary** research teams
- Excellent time management and self-discipline, balancing concurrent research projects with publication timelines, app development, and dataset curation

Technical skills

- **Python (Pytorch, Tensorflow, PyQt, numpy, pandas, matplotlib), Git, C, Verilog, MATLAB, Assembly, Auto-CAD, MS Office**

Education

University of Toronto *Sep 2021 - June 2025 + PEY*
Bachelor of Applied Science in Engineering Science (Major in Robotics Engineering, Minor in Artificial Intelligence)

- Dean's Honour List (All Terms) - Academics: cGPA: 3.77/4.0
- Relevant Coursework: Mathmmatics For Robotics, Robot Modeling and Control, Computer Vision for Robotics, Computer Algorithms & Data Structure, Control Systems, Digital and Computer Systems, Mobile Robotics and Perception, Probability & Statistics

Publications

Conference Papers

- **Y. Luo**, A. Anwar, S. Ren, J. L. Coyle and E. Sejdić, "Towards Non-Invasive Swallowing Assessment: an AI-Powered Interface for Swallowing Kinematic Analysis using High-Resolution Cervical Auscultation," *IEEE Engineering in Medicine & Biology Conference (EMBC) 2024*. DOI: 10.1109/EMBC53108.2024.10781763
- **Y. Luo**, U. Z. A. U. Faiz, C. Rochman, F. Shkurti. "MPVision: An End-to-End Computer Vision Pipeline for Rapid Aquatic Microplastic Classification & Quantification." *ICCV Workshop on Computer Vision for Ecology 2025*. Paper
- B. Huang, S. Ren, **Y. Luo**, Q. Cheng, H. Cai, Y. Sang, M. Sousa, P H. D, D. Wigdor. "VibraForge: A Scalable Prototyping Toolkit For Creating Spatialized Vibrotactile Feedback Systems" *ACM CHI 2024*. https://arxiv.org/html/2409.17420v1
- **Y. Luo**, S. Ren, Z. Jiang, B. Huang, D. Wigdor. "TactileNet: Bringing Touch Closer in the Digital World." *ACM UIST 2024*. DOI: 10.1145/3672539.3686731

Journal Papers

- **Y. Luo**, A. Anwar, F. Khodami, J. L. Coyle and E. Sejdić. "Accelerometer Signal Encoding Using Deep Learning and Spectrograms for Swallowing Classification." *Submitted to IEEE EMBS*, 2025.

Research Experience

Research Assistant – Deep Learning–Based Signal Compression for Dysphagia Assessment (PyTorch) *May 2024–Present*
(iMED Lab, North York General Hospital, Dr. Ervin Sejdić)

- Developed and evaluated **autoencoder (AE)** and **variational autoencoder (VAE)** models using CNN and RNN architectures to compress HRCA signals (used for dysphagia detection) from 4×90×66 to a 512-dimensional latent space
- Maintained key diagnostic information post-compression, achieving **96.88% classification accuracy** on encoded data—exceeding the baseline 90% using raw input
- Applied **spectrogram transformations** to better capture frequency information; when paired with a CNN encoder, improved accu-

racy to **96.88%**, sensitivity to **99.76%**, and specificity to **90.77%**
- Explored architectural variations, including CNN encoder–RNN decoder combinations, to assess performance and robustness
- Demonstrated clinical feasibility by reducing computational requirements, enabling real-time, bedside abnormal swallow detection
- **Paper: First-author journal submission to IEEE EMBS**

Research Assistant – Vision-Based Microplastic Detection and Classification (Python, PyTorch, PyQt) *Sep 2023–Present*
(Robotic Vision Lab, Dr. Florian Shkurti; Rochman Lab, Dr. Chelsea Rochman)

- Collaborated on a large-scale, in-lake microplastic research initiative to analyze the fate, transport, and effects of microplastics in aquatic ecosystems using microscopy image data
- Developed an automated image analysis pipeline using **Segment Anything** and a two-stage **CNN classifier** to detect, classify, and measure microplastic particles in lake water samples
- Built a **PyQt application** enabling researchers to process microscopy images and export particle data to Excel in under **2 minutes**—reducing manual analysis time by over 95%
- Labeled a dataset of **20,000+ samples** to train plastic/non-plastic and multi-class plastic type classifiers with high accuracy
- Supporting ongoing large-scale field experiments on microplastics' fate and transport in freshwater ecosystems
- **Paper: First-author publication accepted at ICCV 2025 CV4E Workshop**

Research Assistant – VibraForge: Spatialized VR Haptic Feedback Toolkit (Python, PyQt) *Sep 2023–Present*
(Dynamic Graphics Project Lab, Dr.Daniel Wigdor

- Contributed to **VibraForge**, a scalable open-source toolkit for designing wearable haptic systems with up to 128 actuators for spatialized vibrotactile feedback
- Developed a **video editor–style GUI application** in PyQt, enabling intuitive design and real-time preview of complex haptic patterns
- Built and maintained the actuator SDK and supported toolkit integration for external collaborators, including **MIT CSAIL**
- Contributed to system architecture, software design, and deployment in diverse real-world scenarios including VR fitness, phoneme-based tactile displays, and drone teleoperation
- **Paper: Third author publication on the *VibraForge* at ACM CHI 2024**, Link: https://arxiv.org/html/2409.17420v1

Research Assistant – TactileNet: Remote Touch Interaction via Gesture Tracking (Python, OpenCV) *Jan 2024–Sep 2024*
(Dynamic Graphics Project Lab, Dr.Daniel Wigdor

- Designed a real-time gesture recognition system using an **end-to-end Ensemble Tuner (e2eET) Multi-Stream CNN**, optimizing semantic feature representation while minimizing computational overhead
- Developed the computer vision pipeline with **OpenCV** to enable precise hand motion capture and robust intent detection
- Leveraged **AI-accelerated Gen-M chips** for on-device video processing, reducing latency in gesture classification for seamless user interaction
- Engineered a low-latency video streaming framework to transmit motion data to remote actuators, enabling realistic **internet-based touch communication**
- **Paper: First-author publication accepted at ACM UIST 2024**, DOI:10.1145/3672539.3686731

Research Assistant – PC-GUI-based HRCA app for Dysphagia Assessment (Python, PyQT) *May 2023-Jan 2024*
(iMED Lab, North York General Hospital, Dr. Ervin Sejdić)

- Utilized the **PyQt5** framework to design a PC-GUI-based app tailored for non-invasive dysphagia assessments
- Achieved seamless real-time connectivity with HRCA devices, enabling uninterrupted recording of vibratory and acoustic signals
- Integrated state-of-the-art machine learning algorithms to provide in-depth swallow kinematics analysis
- Introduced an automated mechanism for swallow segmentation during real-time data streaming, complemented by intuitive manual control options for healthcare professionals
- Enhanced the app with features to interpret and visualize previously recorded data, offering actionable clinical insights
- **Paper: First-author publication accepted at IEEE EMBC 2024**; DOI: 10.1109/EMBC53108.2024.10781763

Research Assistant - Structural Insights into Cystinosis-causing Mutations *May 2022-Aug 2022*

(UofT Institute of Biomedical Engineering, Dr. Michael Garton's Lab)

- Tested and characterized **15** computationally predicted mutations for cystinosis disease to improve diagnostic strategies.
- Extracted and analyzed the experimental data, applied strong data analysis and management skills.
- Implemented high professional experiments under supervision, developed efficient knowledge-seeking skills.
- Performed **40+** progress presentations to supervisors, utilized strong problem-solving and communication skills.
- Completed a final experiment report and showcased experiment results through a podium presentation at Undergraduate Engineering Research Conference, and published abstract on STEM Fellowship Journal, utilizing strong public speaking skills.

Work Experience

Silicon Validation Intern – Alphawave Semi *May 2024–Aug 2025*
(Toronto, ON)

- Gained hands-on validation experience with high-speed interconnect protocols including **PCIe** and **UCIe**, contributing to both pre-silicon and post-silicon test development
- Performed lab-based signal integrity testing using **70G Tektronix Oscilloscope**, **DCA**, and **VNA**; executed compliance and characterization tests including TX compliance, return loss, ESD, interop, and die-to-die link, etc
- Develop and maintain **test automation** and **data post-processing** scripts to improve efficiency and accuracy of lab workflows
- Collaborated closely with design teams in debug meetings to troubleshoot silicon issues and improve design validation strategies
- Presented test results and performance findings to **VPs**, supporting key product decisions and cross-functional alignment
- Highly proficient in **Git** for version control, enabling effective collaboration and robust tracking across test

Projects

Smart Water Heating System for Sustainable Building Operations in Africa (CAD, Python) *Sep 2022-May 2023*
(Team Leader of a 6-person design team, Praxis III, Engineering Design Course)

- Utilized **CAD** & **3D printing** to develop an impeller-based Hall effect flowmeter, minimizing friction with enhanced spinning efficiency
- Implemented a robust **Arduino** Nano-based circuit with a Hall effect sensor, ensuring precise data acquisition and transfer capabilities
- Integrated Arduino Nano's Wi-Fi for IoT interfacing, enabling streamlined data upload to Adafruit IO for user-centric smart scheduling
- Communicated design concepts and advancements to stakeholders (UNEP), ensuring alignment with sustainability goals and user needs

ALU Construction Project (Verilog) *Dec 2022*

- Developed **Verilog** program that constructs an ALU that implements an FSM control path and a Datapath for given equations, including operations such as addition, multiplication, exponential function, etc
- Modified the control and Datapath to support different expanded ALUs and an increasing number of required registers
- Stimulated the program with ModelSim and tested the design on FPGA through instantiating a hex decoder

Research Team Leader- Medical Device for breathing detection (Python) *Sep 2022-May 2023*

- Led **10+** team members in building a wearable breathing detection device targeting clients' experience
- Constructed prototypes using Arduino, generated dynamic breathing-pattern images using **Python** data visualization
- Conducted weekly research, performed **20+** advisory meetings, and utilized strong multitasking and team-working skills

Message Encryption & **Data Security Monitoring Project (C)** *May 2022*

- Constructed a **C** program that reads from a text file to load string messages, and encrypts/decrypts messages into a QR code system
- Managed the received messages based on FIFO Queue structure
- Optimized the program by compressing QR codes from binary to hex, efficiently saving message historical memory by **60**%
- Measured the Levenshtein distance of two string messages using recursive & dynamic programming to identify data corruption

Semantic Similarity Programming Project (Python) *Dec 2021*

- Used **Python** dictionary structure to approximate the semantic similarity of any pair of words within the TOFEL database
- Measured the closeness of the meaning of words by computing the semantic descriptor vector of the word using the text
- Optimized the program by minimizing the run time complexity and acquiring a basic understanding of data structures

Awards

ESROP Scholarship Receiver *May 2023-Aug 2023, May 2022-Aug 2022*

- Received $7500 Scholarships from ESROP for summer research for two consecutive years

UnERD 2022 Certificate of Participation *Aug 2022*

- Participated and presented summer research project at UnERD conference (Undergraduate Engineering Research Day)