

Jerry Cao

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EDUCATION

University of Washington, Seattle, WA 2022 – present

- Ph.D. in Computer Science
- Advised by Shwetak Patel and Jennifer Mankoff

University of Washington, Seattle, WA 2018 – 2022

- B.S. in Computer Science and Applied Mathematics
- Interdisciplinary Honors Program

RESEARCH EXPERIENCE

Adverse Symptoms Prediction using a Wearable Device Jan 2020 – May 2022

Faculty Advisors: Dr. Jennifer Mankoff and Dr. Shwetak Patel

Goal: Analyze markers in the photoplethysmograms (PPGs) collected using a custom-built device to predict the onset of adverse symptoms for Postural Orthostatic Tachycardia Syndrome (POTS)

- Leading two other members in developing a novel sensing device for predicting adverse symptoms of POTS from design to user testing
- Developed an Arduino prototype informed by prior literature to collect PPG and accelerometer data in a wearable form factor
- Applied signal processing techniques to extract features of interest from a noisy signal
- Presented at Undergraduate Research Leaders Lightning Talks [T4] and UW DUB REU Mini Symposium [T2]

Developable Prostheses: Elastic Metamaterials as a Low-Cost Custom Prostheses Sep 2021 – Aug 2021

Faculty advisor: Dr. Alexandra Ion

Goal: Building upon the work of [Developable Metamaterials](#) (CHI '21) to create a novel low-cost prosthesis formed from strips of sheet material that are smoothly pleated to create different sized ruffles. The shape of these ruffles defines the local elasticity throughout the prosthesis.

- Integrated flex sensors and IMUs through the prosthesis
- Developing script to output the state of the prosthesis (e.g. force distribution, acceleration, etc.) according to the sensor data
- Presented at the HCII REU Poster Session [T1]

NIH Print Exchange – COVID-19 Response Analysis Jun 2020 – Mar 2021

Faculty Advisors: Dr. Jennifer Mankoff

Goal: Perform qualitative coding for 500+ entries in the NIH Print Exchange uploaded as part of the COVID-19 Response effort to discover patterns in the fabrication community

- Webscrapped the NIH Print Exchange site to generate a dataset of face masks, face shields, and tension release bands along with their important keywords
- Performed graph analysis on the network of model submissions to identify remixing behavior
- Identified patterns within submissions (e.g. what info is correlated with including sanitization documentation)
- Work is published to TOCHI [P3]

Multi-Channel Facial Photoplethysmography Apr 2019 – Mar 2020

Faculty advisor: Dr. Shwetak Patel

Goal: Develop a system to record synchronized pulse waveforms at multiple locations on the face in an intraoperative environment using different optical wavelengths.

- Set-up optical sensors to get a pulse waveform to use to calculate pulse transit time
- Developed firmware on an MSP430 to control and synchronize sampling across devices and sensors
- Worked alongside a clinical collaborator from University of Washington Medicine to refine the device and prepare it for a user study in an intraoperative environment
- Presented at UW Undergraduate Research Symposium, May 2020 [T3]
- Published manuscript to EMBC 2020 as 2nd author [P2]

Customizable Tactile Maps for the Visually Impaired

Dec 2018 – Mar 2020

Faculty Advisor: Dr. Jennifer Mankoff

Goal: Use linear optimization on a set of user preferences to generate a 3D printed tactile map that is optimized for their needs. This abstracts away the design process and allows users to focus on their personal preferences rather than what to physically put onto the map.

- Designed logic to automatically generate 3D renditions of roads and sidewalks to fit on a 3D-printable tactile map from queried OpenStreetMap data
- Helped to design a user study to test how tactile maps affect mental spatial models
- Presented at UW Undergraduate Research Symposium, May 2019 [T5]
- 2 papers accepted to CHI [P1] [P4]

Utilizing Chemically Induced Dimerization to Detect CBD

Feb 2019 – Nov 2019

Faculty Advisors: Dr. Liangcai Gu and Dr. Herbert Sauro

Goal: Combine a standard luciferase assay with chemically induced dimerization (CID) to create a biosensor for CBD to measure the quantity of a chosen molecule.

- Combined a standard luciferase assay with chemically induced dimerization (CID) to create a biosensor for CBD to measure the quantity of a chosen molecule.
- Conducted site-directed mutagenesis to alter the binding affinity of the protein
- Collected and purified the protein using a nickel-resin based purification protocol
- Ran biolayer interferometry assays on our protein to test binding affinity of our altered protein
- Project won a Silver Award and is archived on the iGEM wiki - <https://2019.igem.org/Team:Washington>

PUBLICATIONS

Peer Reviewed Publications

[P1] Megan Hofmann, Kelly Mack, Jessica Birchfield, **Jerry Cao**, Autumn G Hughes, Shriya Kurpad, Kathryn J Lum, Emily Warnock, Anat Caspi, Scott E Hudson, and Jennifer Mankoff. Maptimizer: Using Optimization to Tailor Tactile Maps to User's Needs. 2022. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems.

[P2] Parker S. Ruth, **Jerry Cao**, Millicent Li, Jacob E. Sunshine, Edward J. Wang, and Shwetak N. Patel. Multi-Channel Facial Photoplethysmography Sensing. In 42nd Annual International Conference of the IEEE Engineering in Medicine Biology Society (EMBC), pages 4179–4182, July 2020

[P3] Kelly Mack, Megan Hofmann, Udaya Lakshmi, **Jerry Cao**, Nayha Auradkar, Rosa Arriaga, Scott Hudson, and Jen Mankoff. 2023. Rapid Convergence: The Outcomes of Making PPE During a Healthcare Crisis. ACM Trans. Comput.-Hum. Interact. 30, 1, Article 4 (February 2023), 25 pages. <https://doi.org/10.1145/3542923>

[P4] Megan Hofmann, Nayha Auradkar, Jessica Birchfield, **Jerry Cao**, Autumn G Hughes, Shriya Kurpad, Kathryn J Lum, Kelly Mack, Anisha Nilakantan, Emily Warnock, Jennifer Mankoff, and Scott E Hudson. OPTIMUM: Supporting Domain-Specific Generative Design with Metaheuristic Methods. 2023. In Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems.

TALKS

[T1] **Embedding Sensors in a Novel Prosthesis Created from Elastic Metamaterials**, August 2021
CMU HCII REU Poster Session, Pittsburgh, PA

[T2] **Adverse Symptoms Prediction using a Wearable Device**, Sep 2020
UW DUB REU Symposium, Seattle, WA

[T3] **Developing a Non-Invasive, Continuous Blood Pressure Monitor with Pulse Transit Time**, May 2020
Undergraduate Research Symposium, Seattle, WA

[T4] **Adverse Symptoms Prediction using a Wearable Device**, Mar 2020
Undergraduate Research Leaders Lightning Talks, Seattle, WA

[T5] **Customizable Tactile Maps for the Visually Impaired**, May 2019
Undergraduate Research Symposium, Seattle, WA

LEADERSHIP

WOOF3D (Digital Fabrication club at UW)

- Project Manager Jun 2019 – Jun 2022
 - Oversee and mentor 7 undergraduate team leads who are each leading a project with 5-7 other members.
 - Some projects include (1) creating an automatic zen-garden, (2) customizing slicing STLs to allow for nonplanar 3D-printing, and (3) fabricating a high-end tool-changing from scratch
- Team Lead Jan 2018 – Jan 2020
 - Led a team of 5 undergraduates to design an ultrasoundable 3D-printed kidney model in collaboration with the UW Center for Industrial and Medical Ultrasound. Have not succeeded, but members have graduated.
 - Modified an existing FDM printer to extrude viscous materials
 - Wrote an accepted proposal for two advanced 3D-printers (\$14,000) to UW's Student Technology Fund
 - Tested the ultrasound properties and printability of ballistics gel, silicone, gelatin, chocolate, and agar

Project IF (Indoor Farming club at UW)

- Advisor Sep 2021 – Jun 2022
 - Oversee the officer team and facilitate communication with the stakeholders of the organization
- Club President Oct 2018 – Sep 2021
 - Handle logistics with UW administrators about funding (raised over \$30k), registration, space acquisition, and selling produce
 - Advise and support independent student projects within the club, which includes (1) continuously monitoring EC/pH of the nutrient solution and (2) adapting FDM printers to automate growing microgreens
 - Set up biweekly presentations discussing topics related to indoor farming

Washington iGEM (Synthetic biology club at UW)

- Operations Manager Feb 2019 – Dec 2019
 - Facilitate communication across eight subteams (wetlab, simulations, design, fundraising, outreach, web development, human practices, and collaborations) consisting of over 50 members total to ensure there is sufficient progress to meet our competition criteria
 - Worked closely with fundraising to raise over \$16,000 to support competition and wetlab expenses

WORK / VOLUNTEER EXPERIENCE

Co-instructor for CSE 590U – Ubiquitous Computing Graduate Research Seminar Sep 2021 – present

- Organizing and facilitating discussion about the latest published research in the field of ubiquitous computing

CSE Research Stakeholder Council – Undergraduate Representative Oct 2021 – Jun 2022

- Working with department staff on improving the research experience in CSE department

Undergraduate Research Leader Oct 2019 – Jun 2022

- Helping undergraduates get involved with research by presenting university resources and talking about personal research in different classrooms and events

CoMotion Labs Student Associate at Fluke Hall Oct 2018 – Oct 2019

- Worked at the front desk to support ~20 biotech startups by handling guest reception, inventory, and mail

Enrichment Tutor for Math and English at Best in Class Education Oct 2018 – Jan 2019

- Tutored groups of up to eight K-10th grade students in 50-minute sessions
- Edited the curriculum (used in over 50 branches around the US) before they were deployed for use

HONORS AND AWARDS

NSF Graduate Research Fellowship	2022
CRA Outstanding Undergraduate Researcher Award - Honorable Mention	2021
Mary Gates Research Scholarship (\$5000)	2021
UW Paul G. Allen School of Computer Science CRA Nominee (4 per year)	2020
UW Barry Goldwater Scholarship Nominee (5 per year)	2020
Levinson Emerging Scholars Award (\$8000)	2020
Mary Gates Leadership Scholarship (\$5000)	2019
Annual Dean's List	2018 – 2020
Mary Gates Honors Scholarship (full tuition for 2 years)	2018 – 2020

Mac Willems IB Student of the Year
Northshore Healthcare Scholarship (\$2500)

2018
2018

COURSEWORK

CSE 332 – Data Structures and Parallelism
CSE 333 – Systems Programming (C/C++)
CSE 444 – Database Internals
CSE 351 – Hardware/Software Interface
CSE 442 – Data Visualization
CSE 446 – Machine Learning
CSE 473 – Introduction to AI
CSE 556 – Computational Fabrication
AMATH 481 – Scientific Computing
AMATH 353 – Partial Differential Equations and Waves
AMATH 401 – Vector Calculus and Complex Variables
AMATH 403 – Methods for Partial Differential Equations
AMATH 481 – Scientific Computing
AMATH 482 – Computational Methods for Data Analysis
AMATH 483 – High-Performance Scientific Computing

Last Updated: March 17, 2023