

Sejal Bhalla

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I am a PhD candidate (expected completion: Fall 2026) in Computer Science at the University of Toronto, specializing in multimodal wearable sensing systems that leverage signal processing and machine learning techniques for applications in health and HCI. My research spans speech, IMU, EEG, radar, and acoustic modalities, with a focus on turning raw biophysical signals into reliable real-time inference. I work across the full stack of a sensing problem, from hardware prototypes and signal characterization through algorithm design, evaluation and deployment, with a strong publication record and experience in building end-to-end pipelines that reduce the gap between user signals and actionable output.

EDUCATION

Ph.D., Computer Science

University of Toronto | Toronto, Canada

Advisors: Alex Mariakakis, Eyal de Lara

2021 – Present

Graduation: Fall 2026

B.Tech., Computer Science

IIIT Delhi | Delhi, India

Advisors: Aman Parnami, Jainendra Shukla

2017 – 2021

EXPERIENCE

Google

Research Intern | Waterloo, Canada / Seattle, USA

- Built end-to-end signal processing and representation learning pipelines for fine-grained microgesture recognition on commodity smartwatches from multimodal wearable data (IMU, audio, PPG), improving robustness across users and real-world conditions.
- Implemented and validated on-device inference under the compute and memory constraints of wearable hardware.

May 2024 – Jul 2024

Google

Research Intern | Waterloo, Canada / Seattle, USA

- Prototyped input systems for spatial computing, designing gesture vocabularies through elicitation studies and evaluating multiple sensing modalities to identify the optimal configuration for XR applications.
- Conducted data collection studies to construct a rich multimodal dataset and rigorously evaluated gesture sets to identify the most discriminative gestures across users.

Aug 2023 – Apr 2024

University of Toronto

Graduate Research Assistant | Toronto, Canada

Sep 2021 – Nov 2026

- Developed signal processing and machine learning pipelines for longitudinal wearable time-series data (speech, heart rate, physical activity), accounting for real-world noise and physiological confounders to extract robust digital biomarkers of COPD.
- Identified phonemes as physiologically meaningful units of speech, improving computational efficiency, prediction accuracy of health outcomes, and privacy.
- Developed SpeechDx, a benchmark exposing systematic generalization gaps in clinical speech AI across disease cohorts and recording conditions, and extended this work toward building a speech foundation model for health.
- Built an end-to-end system for blood pressure estimation from in-ear audio, enabling portable cardiovascular monitoring, and validated the approach against conventional signals such as ECG and PPG.

HCII, Carnegie Mellon University

Sep 2020 – Aug 2021

Visiting Student Researcher | Pittsburgh, USA

- Developed a heterogeneous domain adaptation framework to transfer activity recognition from wearable IMU to ambient, privacy-preserving mmWave radar.
- Designed viewpoint- and translation-invariant feature representations that enable robust performance with minimal labelled radar data, independent of sensor placement or orientation.

IBM Research

May 2020 – Jul 2020

Research Intern | Bengaluru, India

Built an NLP pipeline combining named entity recognition and graph-based relational modeling over unstructured text to automate business lead generation from open-source data.

IIIT Delhi

Dec 2018 – May 2021

Student Researcher | Delhi, India

- Designed ExpressEar, a novel sensing approach for privacy-preserving facial expression recognition using IMU-augmented earables, enabling applications in AR/VR, affective computing, and gestural input.
- Built AttentioNet, a deep learning system classifying attention and emotion states from EEG signals to monitor student attention and engagement in learning environments.

PEER-REVIEWED PUBLICATIONS

12. SpeechDx: A Multi-task Benchmark for Clinical Speech AI
Sejal Bhalla, Larry Kieu, Aina Merchant, Eyal de Lara, Alex Mariakakis.
Under review.
11. In-ear Acoustic Pulse Wave Analysis for Blood Pressure Estimation
Kenneth Christofferson, **Sejal Bhalla**, Michelle Lin, Joseph Cafazzo, Alex Mariakakis.
Under review.
10. Mudra: Enabling Microgesture Recognition on COTS Smartwatches
Sejal Bhalla, Benson Chou, Cady Xu, Karan Ahuja, Alex Mariakakis, Ishan Chatterjee.
ACM Graphics Interface (GI), 2026. To Appear.



9. Utilizing Speech as a Biosignal for Monitoring Respiratory Health and Beyond
Sejal Bhalla, Eyal de Lara, Alex Mariakakis.
*ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp), 2025. **Best Doctoral Colloquium Contribution.***
8. Association of Daily Lung Condition in COPD Patients with Wearable Speech and Physiological Data
Sejal Bhalla, Deshang Kong, Salaar Liaqat, Daniyal Liaqat, Robert Wu, Andrea Gershon, Eyal de Lara, Alex Mariakakis.
Nature Scientific Reports, 2025.
7. Phoneme-Aware Acoustic Analysis of Natural Speech for Lung Function Assessment
Sejal Bhalla, Tien Han, Andrea Gershon, Robert Wu, Eyal de Lara, Alex Mariakakis.
IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2025.
-  6. On the Production and Measurement of Cardiac Sounds in the Ear Canal
Kenneth Christofferson, **Sejal Bhalla**, Joseph Cafazzo, Alex Mariakakis.
*ACM UbiComp (EarComp), 2024. **Best Paper Award.***
5. PulmoListener: Continuous Acoustic Monitoring of Chronic Obstructive Pulmonary Disease in The Wild
Sejal Bhalla, Salaar Liaqat, Robert Wu, Andrea Gershon, Eyal de Lara, Alex Mariakakis.
ACM Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT), 2023.
4. AttentioNet: Monitoring Student Attention Type in Learning with EEG-Based Measurement System
Sejal Bhalla, Dhruv Verma, S.V. Sai Santosh, Saumya Yadav, Aman Parnami, Jainendra Shukla.
IEEE International Conference on Affective Computing and Intelligent Interaction (ACII), 2023.
3. IMU2Doppler: Cross-Modal Domain Adaptation for Radar-based Activity Recognition using IMU Data
Sejal Bhalla, Mayank Goel, Rushil Khurana.
ACM IMWUT, 2021.
2. ExpressEar: Sensing Fine-Grained Facial Expressions with Earables
Sejal Bhalla, Dhruv Verma, Dhruv Sahnani, Jainendra Shukla, Aman Parnami.
ACM IMWUT, 2021.
1. PAI-BPR: Personalized Outfit Recommendation Scheme with Attribute-wise Interpretability
Sejal Bhalla, Dikshant Sagar, Jatin Garg, Prarthana Kansal, Rajiv Ratn Shah, Yi Yu.
IEEE International Conference on Multimedia and Big Data (BigMM), 2020.

AWARDS & HONORS

Wolfond Scholarship in Wireless Information Technology (\$10,000 CAD)	2026, 2025
Best Doctoral Colloquium Contribution Award (ACM UbiComp/ISWC)	2025
Google PhD Fellowship Nominee (Nominated by University of Toronto)	2025
Data Sciences Institute Doctoral Fellowship (\$75,000 CAD across 3 years)	2025
University of Toronto Departmental Fellowship (\$1,355 CAD)	2023
Special Recognition for Outstanding Review, ACM IMWUT	2022
Alberta Machine Intelligence Institute AI Week Talent Bursary (\$1,500 CAD)	2022
University of Toronto Program-Level Fellowship (\$1,000 CAD / year)	2021 – 2025
GHCI Student Scholarship	2020
IBM Blue Scholar	2020

INVITED TALKS

Northwestern University CS, Decoding Ubiquitous Signals: Repurposing Speech as a Biosignal	2025
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Google Product & Engineering, Enabling Microgesture Recognition on COTS Smartwatches	2024
Google AR, Enabling Microgesture Recognition on COTS Smartwatches	2024
AGE-WELL & APPTA Policy Rounds, <u>Remote Patient Monitoring in the Wild</u>	2024

ACADEMIC SERVICE

Member of Technical Program Committee (TPC), ACM ISWC	2026
Lead Editor, <u>ACM XRDS Magazine</u> (Topic: Computing for Global Health)	2026
Feature Editor, <u>ACM XRDS Magazine</u>	2025 – Present
Reviewer, ACM CHI	2024
Reviewer, ACM IMWUT/ISWC	2022 – Present
Reviewer, IEEE BSN	2024 – Present
Reviewer, ACM ISS	2022
Student Volunteer, ACM UbiComp	2022, 2021
Student Volunteer, ACM IUI	2022

TEACHING EXPERIENCE

Teaching Assistant, University of Toronto Data Science II	2025, 2026
Teaching Assistant, University of Toronto Mobile and Digital Health	2025
Teaching Assistant, University of Toronto Topics in Ubiquitous Computing	2024, 2023
Teaching Assistant, University of Toronto Design of Interactive Media	2023
Teaching Assistant, University of Toronto Introduction to Computer Science	2022, 2021

VOLUNTEERING & OUTREACH

Mentor, UofT DCS Women Mentorship Event	2026, 2025
Mentor, <u>ML4H Mentorship Program</u>	2024
Mentor, <u>WISE Industry Mentorship Program</u>	2024 – Present
Mentor, <u>Toronto Graduate Application Assistance Program</u>	2023
Mentor, <u>Girls SySTEM Mentorship Program</u>	2023
Speaker and Panellist, <u>Pursue STEM Workshop</u>	2022

STUDENTS ADVISED

Aina Merchant, Undergraduate, Computer Science University of Toronto	2026 – Present
Larry Kieu, Undergraduate, Computer Science University of Toronto	2025 – Present
Maryam Taj, Undergraduate, Computer Science University of Toronto	2024 – Present
Zizheng Zhang, Ph.D., Computer Science University of Oxford	2024 – 2025
Benson Chou, Undergraduate, Computer Science University of Toronto	2024 – 2025
Tien Han, Undergraduate, Computer Science University of Toronto	2023 – 2024
Deshang Kong, Undergraduate, Computer Science (Currently Masters at HKUST) University of Toronto	2023 – 2024