Sidharth

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CSE 302
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Summary

Incoming PhD Candidate in Computer Science at the University of Michigan (Fall 2025), advised by **Dr. Dhruv Jain**, with a focus on developing **acoustic algorithms for next-gen hearables**, including AI-driven hearing aids and real-time audio processing. Skilled in deploying **production-grade ML models** (Python, PyTorch, Triton) for low-latency edge computing and audio signal enhancement. Published in top-tier venues (**Interspeech, EMBC, AAAI**) on ML for healthcare and accessibility.

Education

University of Michigan, Ann Arbor *Incoming, Fall 2025*
Ph.D. Computer Science and Engineering
Research Focus: Audio AI, Accessibility
Advisor: Dr. Dhruv Jain

University of Washington, Seattle *2023 - present*
MS student in Electrical and Computer Engineering
GPA: 3.8/4.0
Advisors: Prof. Rajesh Rao & Prof. Jeffrey Herron

College of Engineering, Trivandrum *2019 - 2023*
B.Tech in Applied Electronics and Instrumentation Engineering with Minor in Mathematics
GPA: 9.35/10
Advisor: Prof. Jerrin Thomas Panachakel

Work Experience

BrainChip, Inc. *June 2024 - Present*
Research Scientist/ML Researcher Intern | PyTorch, Triton, Numpy, Librosa
Advisors: Dr. Yan Ru (Rudy) Pei & Dr. M. Anthony Lewis (CTO)
I contributed to the development of **TENNs**, a novel state-space model optimized for our Spiking Neural Network chip **Akida**, enabling efficient multimodal processing across audio, text, and vision. I developed **aTENNuate**, a real-time deep state-space speech enhancement model submitted to Interspeech 2025, and explored LoRA-based adaptation for optimizing these models. My work included refining LLM training for efficiency, designing a custom evaluation pipeline, and implementing a Triton-based GPU kernel for FFT convolution to enhance signal processing. Additionally, I developed model obfuscation techniques for secure edge inference and spearheaded a state-space-based speaker verification system for enterprise applications.

Neural Systems Lab, UW CSE *Sept. 2023 - present*
Graduate Student Researcher | PyTorch, Numpy, Pandas
Advisors: Prof. Rajesh P. N. Rao & Prof. Jeffrey Herron
In the Neural Systems Lab at the Paul G. Allen School of Computer Science & Engineering, I worked alongside esteemed researchers to analyze electrophysiological signals for potential pain biomarkers. By developing a custom pipeline for pain detection and classification, I identified brain regions associated with pain and created an electrode-pain-network to depict information flow in the brain. The paper has been accepted at AAAI 2025 Workshop on Health Intelligence.

LEAP lab, IISc *June 2022 - May 2023*
Research Intern in Audio and Speech Machine Learning group | PyTorch, Numpy, Kaldi, Librosa
Advisors: Prof. Sriram Ganapathy & Prof. Shikha Baghel
Developed speaker and language diarization systems for multilingual, multi-speaker environments with code-mixing, automating the annotation of 40 hours of conversational data. Collaborated with a team to preprocess audio, fine-tune speaker activity detection using x-vectors, and refine speaker boundaries with VB-HMM clustering. Achieved Diarization Error Rates (DER) of **28.04** for speaker diarization and **37.72** for language diarization on the DISPLACE dataset.

Publications

Preprints

* - equal contribution

1. **Real-time Speech Enhancement on Raw Signals with Deep State-space Modeling.**
   Yan Ru Pei, Ritik Shrivasthava, **Sidharth**
   arXiv:2409.03377, 2024 (Submitted to ISCA Interspeech, 2025).

2. **Decoding Pain: Statistical Identification of Biomarkers from Electrophysiological Signals.**
Sidharth*, Vishwas Sathish*, Shweta Bansal, Samantha Sun, Timmy Pham, Kurt Weaver, Rajesh Rao, Jeffrey Herron.
(AAAI 2025 Workshop on Health Intelligence, accepted), 2024.

Conference Publications

1. **The DISPLACE Challenge 2023 - DIarization of SPeaker and LAnguage in Conversational Environments.**
Shikha Baghel, Shreyas Ramoji, **Sidharth**, Ranjana H, Prachi Singh, Somil Jain, P. R. Chowdhuri, K. Kulkarni, S. Padhi, D. Vijayasenan, Sriram Ganapathy.
*(**ISCA Interspeech**), 2023*

2. **Emotion detection from EEG using transfer learning**.
Sidharth, Ashish Abraham Samuel, Ranjana H, Jerrin Thomas Panachakel, Sana Parveen K
*2023 45th Annual International Conference of the IEEE Engineering in Medicine & Biology Society **(EMBC)**, 2023* **(Oral Presentation)**.

3. **CSP- LSTM Based Emotion Recognition from EEG Signals**.
R.H, S. Parveen K, J. T. Panachakel, **Sidharth**, A. A. Samuel.
*2023 IEEE International Conference on Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering **(MetroXRAINE)**, 2023* **(Oral Presentation)**.

4. **EEG-based Emotion Classification - A Theoretical Perusal of Deep Learning Methods**.
S. Parveen, J. T. Panachakel, R. H., **Sidharth**, A. A. Samuel
*2023 2nd International Conference for Innovation in Technology **(INOCON)**, 2023 **(Oral Presentation)**.*

Selected Projects

1. **Conformer-Enhanced Acoustic Source Localization and Masked Channel Prediction in Noisy Environments**.
Sidharth.
Developed a self-supervised conformer-based model to predict and reconstruct masked microphone signals using a 4-microphone array in simulated room environments. Designed a complete data pipeline with room acoustics modeled via gpuRIR, achieving a validation MSE of 0.001.

2. **Decoding pain states from electrophysiological signals using statistical approaches**.
Sidharth.
This study aimed to identify brain regions associated with different stages of pain and distinguish between pain and no-pain states using ECoG data. Common Spatial Patterns applied to Power-In-Band values across six frequency bands improved class discriminability, followed by a Random Forest Classifier for binary pain state classification.

3. **Multi-label bird species classification from Field recordings using Mel Graph-GCN framework**.
Sidharth.
This project introduces the Mel Graph-GCN framework for bird call classification, addressing the challenge of overlapping bird vocalizations. By generating graphs from mel-spectrograms using a CNN and classifying them with a GCN, the approach achieves a macro F1-score of 0.85 on the Xeno-canto dataset, outperforming state-of-the-art models.

4. **Odessa: HMM based ASR**.
Sidharth.
This project presents a speaker-dependent ASR system using HMMs with single Gaussian states to recognize predefined phrases. Triggered by the wake-up phrase "Odessa," the system achieves 98.3% mean accuracy across 5-fold cross-validation.

Skills

Language: Python, Triton, C++, C, SQL, MATLAB, Verilog
Machine Learning Frameworks: PyTorch, PyTorch Lightning, Hydra, HuggingFace, Triton, OpenCV, NumPy, Kaldi, gpuRIR, Pyroomacoustics, OpenAI Gym
Tools and Technologies: Praat, Audacity, Git, SLURM, JIRA, Docker, Bash
Relevant Courseworks: Advanced Machine Learning, Deep Learning, Automatic Speech Recognition, Computer Vision, Digital Signal Processing, Data Structures and Algorithms, Computer Architecture and Embedded Systems

Awards and Honors

- **NSF AAI, ECE DEI and Weil Neurohub travel grant:** Awarded $2800 by the U.S National Science Foundation (NSF), Departments of ECE and CSE, University of Washington to present the research paper "Decoding Pain: Statistical Identification of Biomarkers from Electrophysiological Signals" at AAAI 2025 Workshop on Health Intelligence, Philadelphia, USA.
- **Travel grant:** Awarded $500 by College of Engineering Trivandrum to present the research paper "Emotion Detection from EEG using Transfer Learning" at a conference in Sydney.
- **Winter Research Fellowship:** Awarded $715 by Indian Institute of Science (IISc) to conduct research on speaker and language diarization in multilingual Indian languages.