Sidharth

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Summary

Current PhD student in Computer Science department at the University of Michigan, Ann Arbor, 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 audio processing and computational neuroscience

Education

University of Michigan, Ann Arbor *2025 - 2030*
Ph.D. Computer Science and Engineering
Research Focus: Audio AI, Accessibility
Advisor: Dr. Dhruv Jain

University of Washington, Seattle *2023 - 2025*
MS student in Electrical and Computer Engineering
Advisors: Dr. Rajesh Rao & Dr. Jeffrey Herron

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

Industry Research Experience

Skyworks Solutions, Inc. *May 2025 - Aug. 2025*
Research Intern | PyTorch, Tensorflow, Numpy, Librosa
Advisors: Dr. Meysam Asgari

1. Pioneered a dual-microphone enhancement framework integrating internal and external ear microphone signals to improve intelligibility and mitigate speech drop in low-SNR conditions.
2. Designed a low-parameter, streamable U-Net-based architecture with a cross-attention mechanism to fuse two-channel feature representations for real-time deployment.
3. Collected and curated a real-world evaluation dataset using a dummy-head HAT recording system for robust, ecologically valid testing.
4. Introduced SpeechDROPBERT, a novel SpeechBERT-based evaluation metric for quantifying speech-drop effects.
5. Achieved DNSMOS OVRL 2.45 on the curated test set vs. 2.3 in a beamformer + speech enhancement baseline, and SpeechDROPBERT 0.88 vs. 0.60 baseline, demonstrating substantial perceptual and robustness gains.

BrainChip, Inc. *June 2024 - March 2025*
Research Intern | PyTorch, Triton, Numpy, Librosa
Advisors: Dr. Yan Ru (Rudy) Pei & Dr. M. Anthony Lewis (CTO)

1. Designed **aTENNuate**, a real-time deep state-space speech enhancement model (Interspeech 2025) achieving PESQ 3.27 on VB-DMD with 0.84M parameters, 0.33G MACs, and 46.5 ms latency, and retaining strong performance under quantized and down-sampled inputs.
2. Explored LoRA-based adaptation for deployment-specific optimization of state-space speech enhancement models.
3. Implemented a Triton-optimized GPU FFT convolution kernel to accelerate core signal processing operations.
4. Developed model obfuscation techniques for secure edge deployment of speech enhancement models.

Academic Experience

Neural Systems Lab, UW CSE *Sept. 2023 - May 2025*
Graduate Student Researcher | PyTorch, Numpy, Pandas
Advisors: Prof. Rajesh P. N. Rao & Prof. Jeffrey Herron

1. Analyzed electrophysiological signals to investigate subject-specific pain biomarkers, leveraging magnitude-squared coherence and power-in-band spectral features.
2. Developed a custom random forest classification pipeline to discriminate high- vs. low-pain states, achieving subject-specific optimization.
3. Identified and localized pain-relevant brain regions, constructing subject-specific electrode–pain networks to model cortical information flow.
4. Work presented at the 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

1. Developed speaker and language diarization systems for multilingual, multi-speaker, code-mixed environments, automating annotation of 40 hours of conversational audio.
2. Preprocessed audio, fine-tuned speaker activity detection with x-vectors, and refined boundaries using VB-HMM clustering.
3. Achieved DER 28.04 for speaker diarization and DER 37.72 for language diarization on the DISPLACE dataset.

Publications

Conference Publications

1. **Real-time Speech Enhancement on Raw Signals with Deep State-space Modeling.**
Yan Ru Pei, Ritik Shrivasthava, **Sidharth**
*arXiv:2409.03377, 2024 (**ISCA Interspeech**), 2025, **(Oral Presentation)**.*
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 Workshop on Health Intelligence**), 2025, **(Poster Presentation)**.*
3. **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, **(Oral Presentation)***
4. **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)**.
5. **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)**.
6. **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. **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, C, MATLAB
Machine Learning Frameworks: PyTorch, TensorFlow, PyTorch Lightning, Hydra, HuggingFace, Triton, OpenCV, NumPy, Kaldi, gpuRIR, Pyroomacoustics, Triton
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

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.

Service and Outreach

- Reviewer, ACL Student Research Workshop (SRW) 2025
- Member, ECE MS Admissions Committee (2025), University of Washington: Contributing to the selection process for incoming MS students
- Founded *MATHLETES CET*, the official math club of College of Engineering, Trivandrum, India.