




# NATARAJAN BALAJI SHANKAR

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## Education

### University of California, Los Angeles (UCLA)

*Ph.D, Electrical and Computer Engineering (GPA: 4.00/4.00)*

**2024 - Present**

*Los Angeles, CA*

### University of California, Los Angeles (UCLA)

*M.S., Electrical and Computer Engineering (GPA: 3.97/4.00)*

**2021 - 2023**

*Los Angeles, CA*

### National Institute of Technology, Tiruchirappalli (NIT Trichy)

*B.Tech, Electronics and Communication Engineering (Minor: Computer Science) (GPA: 8.57/10.00)*

**2016 - 2020**

*Tiruchirappalli, India*

## Technical Skills

**Languages:** Python, C, C++, MATLAB

**Frameworks:** PyTorch, Tensorflow, Kaldi, LangChain, Huggingface, fairseq, NeMo, Espnet, NLTK

**Developer Tools:** Linux, PostgreSQL, Docker, Git

## Experience

### Speech Processing and Auditory Perception Laboratory

*Graduate Student Researcher*

**01/2022 - Present**

*Los Angeles, CA*

#### *Low Resource ASR for Child Speech*

- Introduced novel Speech-Only Adaptation (SOA) technique for unsupervised domain adaptation of speech foundation models to low resource domains utilizing only audio data, resulting in a 29% relative Word Error Rate reduction
- Proposed Perturbation Invariant Finetuning (PIF) loss to stabilize finetuning on augmented child speech, resulting in state-of-the-art results on the MyST dataset
- Designed a comprehensive benchmark to evaluate child ASR performance across various speech foundation models (Whisper, Wav2vec2.0, HuBERT, WavLM), while investigating finetuning strategies (data augmentation, parameter-efficient methods) and their impact based on model size

#### *Automated Scoring and Analysis of Children's Oral Language Assessments*

- Developed novel framework for automatically scoring children's oral narrative language abilities using linguistic features and BERT-based representations, achieving 98% classification accuracy of student scores on a portion of the Test of Narrative Language
- Evaluated the performance of open-source ASR systems (Whisper, HuBERT, Wav2Vec2) in transcribing African American English-speaking children's speech and used BERT to automatically grade oral responses with 95% accuracy
- Incorporated a pipeline for automated prediction of item difficulty and response time in educational assessments using NER, SRL, and linguistic features to prompt a Large Language Model, yielding results that surpassed the baseline on the BEA 2024 Shared Task and showcasing adaptability on Test of Narrative Language audio recordings

#### *Encoder Only Non-autoregressive ASR*

- Devised UniEnc-CASSNAT, a novel encoder-based non-autoregressive automatic speech recognition (NASR) model combining the strengths of CTC and Attention decoding, leveraging a single encoder for mask prediction and text decoding.
- Produced state-of-the-art results on Librispeech, MyST, and Aishell1 datasets with fewer model parameters than existing NASR models

#### *Question Answering from Long Context Audio*

- Created a novel dataset (CORAAAL QA) and framework for audio question-answering from long audio recordings of spontaneous speech, utilizing PLDA scoring of semantic embeddings to rank segment relevance for answering questions
- Employed large language models (ChatGPT, Llama 2) to generate additional training examples, enhancing framework performance through data augmentation

## *Predicting Dialect Density in African American English*

- Formulated novel framework for predicting dialect density in African American English (AAE) speakers integrating usage of HuBERT representations, prosody, grammar and speaker embedding based feature sets.
- Enhanced specificity in downstream tasks by predicting the level of dialect density rather than relying on a binary presence/absence approach, with a 40% accuracy improvement over baselines in adults and over 70% accuracy in children

## **KLA Corporation**

*Algorithms Intern*

**06/2022 - 09/2022**

*Milpitas, CA*

- Migrated backend for wafer inspection tool from Windows to Linux to facilitate multi GPU execution
- Created data transmission framework to enable client side wafer inspection tool GUI to communicate with Linux based remote backend
- Constructed a license generation system using Python and Flask to authenticate access requests for eligible clients for an internal tool

## **Academic and Research Contributions**

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- Served as a peer reviewer for the IEEE/ACM Transactions on Audio, Speech, and Language Processing
- Delivered an oral presentation on research findings related to "CORAAL QA: A Dataset and Framework for Open Domain Spontaneous Speech Question Answering from Long Audio Files" at the ICASSP 2024 conference.
- Successfully mentored a diverse team of Masters' (4) and undergraduate (3) students across various research projects, leading to successful thesis and project completions.
- Gained three years of teaching experience as a Graduate Teaching Assistant across a variety of courses

## **Publications**

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- **Shankar, N. B.**, Johnson, A., Chance, C., Veeramani, H., & Alwan, A. (2024). CORAAL QA: A Dataset and Framework for Open Domain Spontaneous Speech Question Answering from Long Audio Files. *ICASSP 2024 - IEEE International Conference on Acoustics, Speech, and Signal Processing*, 13371–13375.
- **Shankar, N. B.**, Fan, R., & Alwan, A. (2024). SOA: Reducing Domain Mismatch in SSL Pipeline by Speech Only Adaptation for Low Resource ASR. *2024 IEEE International Conference on Acoustics, Speech, and Signal Processing Workshops*, 560–564.
- **Shankar, N. B.**, Afshan, A., Johnson, A., Mahapatra, A., Martin, A., Ni, H., Won Park, H., Quintero Perez, M., Yeung, G., Bailey, A., Breazeal, C., & Alwan, A. (2024). The JIBO Kids Corpus: A speech dataset of child-robot interactions in a classroom environment. *The Journal of the Acoustical Society of America - Express Letters*
- Fan, R., **Shankar, N. B.**, & Alwan, A. (2024). Benchmarking Children's ASR with Supervised and Self-supervised Speech Foundation Models. *Proc. Interspeech*, 5173–5177.
- Fan, R., **Shankar, N. B.**, & Alwan, A. (2024). UniEnc-CASSNAT: An Encoder-only Non-autoregressive ASR for Speech SSL Models. *IEEE Signal Processing Letters*, 31, 711–715.
- Johnson, A., **Shankar, N. B.**, Ostendorf, M., & Alwan, A. (2024). An Exploratory Study on Dialect Density Estimation for Children and Adult's African American English. *The Journal of the Acoustical Society of America*, 155(4), 2836–2848.
- Veeramani, H., Thapa, S., **Shankar, N. B.**, & Alwan, A. (2024). Large Language Model-based Pipeline for Item Difficulty and Response Time Estimation for Educational Assessments. *Proceedings of the 19th Workshop on Innovative Use of NLP for Building Educational Applications (BEA)*, 561–566.
- Johnson, A., Veeramani, H., **Shankar, N. B.**, & Alwan, A. (2023). An Equitable Framework for Automatically Assessing Children's Oral Narrative Language Abilities. *Proc. Interspeech*, 4608–4612.
- Johnson, A., Chance, C., Stiemke, K., Veeramani, H., **Shankar, N. B.**, & Alwan, A. (2023). An Analysis of Large Language Models for African American English Speaking Children's Oral Language Assessment. *Journal of Black Excellence in Engineering, Science, and Technology*, 1.
- Veeramani, H., Johnson, A., **Shankar, N. B.**, & Alwan, A. (2023). Towards Automatically Assessing Children's Oral Picture Description Tasks. *Proc. 9th Workshop on Speech and Language Technology in Education (SLaTE)*, 119–120.
- Palanisamy, G., **Shankar, N. B.**, Palanisamy, P., & Gopi, V. P. (2020). A hybrid feature preservation technique based on luminosity and edge based contrast enhancement in color fundus images. *Biocybernetics and Biomedical Engineering*, 40(2), 752–763.