

EDUCATION

- **Indian Institute of Science, Bangalore** Aug 2016 - July 2023
Ph.D. System Science and Signal Processing, Electrical Engineering 9.0/10
 - **Thesis:** Investigating Neural Mechanisms of Word Learning and Speech Perception (Submitted on 31st July 2023)
 - **Main Courses:** Numerical Linear Algebra, Machine Learning for Signal Processing, Speech Information Processing, Data Analysis and Visualization
- **Indian Institute of Science, Bangalore** Aug 2013 - July 2015
M.E. System Science and Automation (now renamed as AI) 9.2/10
 - **Thesis:** The Riesz Vector Flow and Application to Medical Image Segmentation (Course-6.7/8; Thesis-8/8)
 - **Main Courses:** Linear Algebra, Stochastic Models, Optimization, Data Structures and Algorithms, Design and Analysis of Algorithms, Data Mining, Pattern Recognition and Neural Networks, Topics in Image Processing
- **College of Engineering, Trivandrum (University of Kerala)** Aug 2009 - June 2013
B.Tech. Electronics and Communication 9.0/10
 - **Main Courses:** Analog and Digital Electronics, Signals and Systems, Digital Signal Processing, Analog and Digital communication, Information theory and coding, Random Processes, Microcontrollers and Microprocessors, Computer Systems and Networks, C++ Programming

WORK EXPERIENCE

- **Mortimer B. Zuckerman Mind Brain and Behavior Institute, Columbia University** New York, USA
Short-term Research Scholar Sept 2019 - Feb 2020
 - **Contributions:** Collaborated with the research scientists at the institute and designed an experiment to study implicit language learning.
- **Indian Institute of Science** Bangalore, India
Teaching Assistant Aug 2018-Dec 2018 & Sep 2020 - Jan 2021
 - **Courses:** Machine Learning for Signal Processing, Advanced Deep Learning
- **Tata Research Development and Design Centre** Pune, India
R&D Systems Engineer Aug 2015 - July 2016
 - **Research Areas:** Image Processing, Machine Learning, and Crowdsourcing
 - **Contributions:** Developed machine learning-based solutions to score the crowd-sourced object segmentations.

SKILLS SUMMARY

- **Programming:** Python, C, C++, shell scripting, HTML, CSS
- **Tools:** PyTorch, TorchAudio, ScikitLearn, Git, \LaTeX , Keras

PROJECTS

- **Exploring the Role of Semantic Cue in Dichotic Speech Perception using a Deep Multi-Modal Network:**
 - Introduced a deep multi-modal architecture aligning speech and text features with EEG signals, demonstrating improved performance over individual modalities. This suggests that EEG signals capture both semantic and acoustic content.
 - Conducted comparisons between text features, including word2vec and BERT.
 - Proposed a Manhattan distance-based loss function for EEG response-stimulus match-mismatch task.
 - In dichotic speech listening, text data significantly outperformed audio, indicating EEG encodes higher-level semantic information over acoustic envelope data.
- **LSTM-Based Model for Speech-EEG Modeling with Word Boundary Integration:** [Interspeech\(2023\)](#)
 - Developed a deep neural network model for variable-length auditory stimulus and neural response processing.
 - Demonstrated the significance of word boundary information in sentence processing by relating EEG to speech input.

- Processed both speech and EEG signals using a network of convolutional layers and integrated word boundaries and inter-word context through a recurrent layer.
- Achieved a substantial improvement, with a 93% match-mismatch classification accuracy on speech-EEG data, surpassing previous results of 65-75%.
- **Deep Semantic Model for Cross-Lingual Transfer Learning:** [IEEE ASRU \(2019\)](#), [Interspeech \(2020\)](#).
 - Investigating the transfer learning efficiency of machines in acquiring foreign language vocabulary using minimal image supervision, inspired by human language learning.
 - Developed a deep audio-visual model with a proxy-based triplet loss.
 - Trained using a large dataset containing multi-modal speech and image inputs in English.
 - Demonstrated that the machine model achieved transfer learning performance for image retrieval comparable to human performance.
- **Decoding Language Discriminative Features In EEG Signals:** [BPEX journal by IOP \(2019\)](#).
 - Conducted EEG-based study, including experiment design and data collection, to investigate how the brain processes known and unknown word sounds during learning.
 - Analyzed EEG responses (noisy and small dataset size) to English, Japanese, and Hindi speech using an SVM-based classifier, revealing language discriminative patterns.
 - Identified improvements in Japanese pronunciation and pinpointed key brain regions related to language discrimination and learning.
 - Deployed an HMM-based speech recognition system for automatic pronunciation rating in the study.
- **Recognizing imagined speech using EEG:** MLSP course project (Dec 2016)
 - Implemented [a paper](#) exploring deep belief networks (DBNs) to classify phonological categories and a small number of words using EEG.
- **Deep RNNs for acoustic modeling:** Speech Processing course project (April 2017)
 - Implemented HMM-DNN and HMM-RNN hybrid systems for acoustic modeling inspired by [Hinton et. al paper](#).
- **Time Series Visualization with Horizon Graph:** Data Analysis and Visualization course project (April 2017)
 - HG is a space efficient charting technique for time series data.
 - Implemented using Python and Matplotlib, and evaluated performance with various time series datasets.

PUBLICATIONS

- **A. Soman** and S. Ganapathy, "Impact of Semantic Cues on Speech Perception During a Dichotic Listening Task," To be submitted to Journal of Neural Engineering.
- **A. Soman**, P. Ramachandran, and S. Ganapathy, "An EEG dataset exploring semantic learning with audio-visual input," To be submitted to Nature Scientific Data.
- **A. Soman**, V. Sinha and S. Ganapathy, "Enhancing the EEG Speech Match Mismatch Tasks With Word Boundaries," Interspeech (2023).
- **A. Soman**, P. Ramachandran, and S. Ganapathy, "ERP Evidences of Rapid Semantic Learning In Foreign Language Word Comprehension," Frontiers in Neuroscience, p.178, (2022).
- V. Krishnamohan, **A. Soman**, A. Gupta and S. Ganapathy, "Audiovisual Correspondence Learning in Humans And Machines," Proc. Interspeech (2020).
- K. Praveen, A. Gupta, **A. Soman**, and S. Ganapathy, "Second Language Transfer Learning in Humans and Machines Using Image Supervision," IEEE ASRU (2019).
- **A. Soman**, Madhavan C. R., K. Sarkar, and S. Ganapathy, "An EEG Study On The Brain Representations in Language Learning," IOP Journal on Biomedical Physics and Engineering Express, 5(2), p.25041, (2019).

HONORS AND AWARDS

- **Conference Travel Grant:** International Speech Communication Association (ISCA) travel grant for INTERSPEECH 2023, Dublin, Ireland.
- **Pratiksha Trust Fellowship:** for a student exchange program at Columbia University, USA, 2019.
- **Best Team Award:** for Best Project Proposal at the EMEA research workshop conducted by Broadcom Foundation at Imperial College, London, in Oct 2018.
- **University Gold Medal:** First Rank in BTech degree, ECE, University of Kerala (2009-2013 batch).
- **M Ajayan Memorial Award:** for Best outgoing ECE student in University of Kerala, 2013.