Vinu Sankar Sadasivan

Junior Research Fellow
Computer Science & Engineering (CSE)
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Education

Indian Institute of Technology, Gandhinagar (IIT Gandhinagar) *Jul '16 – Jul '20*
B. Tech in CSE [**Director's Silver Medalist**]

Publications

A Simple Approach To Define Curricula For Training Neural Networks
VS Sadasivan, A Dasgupta
Under review, *2021*.

Shallow RNN: Accurate Time-series Classification on Resource Constrained Device
D Dennis, DAE Acar, V Mandikal, **VS Sadasivan**, V Saligrama, HV Simhadri, and P Jain
In *Advances in Neural Information Processing Systems (NeurIPS), 2019*. [PDF]

High Accuracy Patch-Level Classification of Wireless Capsule Endoscopy Images Using a Convolutional Neural Network
VS Sadasivan, and CS Seelamantula
In *IEEE* 16^{th} *International Symposium on Biomedical Imaging (IEEE ISBI), 2019*. [PDF]

Adaptive Exponential Generalized Functional Link Network for Nonlinear Active Noise Control
VS Sadasivan, SS Bhattacherjee, V Patel, and NV George
Manuscript in preparation.

FPGA-Based Area, Power, and Latency Optimized Approximate Multipliers For Neural Networks
VS Sadasivan, CK Jha, and J Mekie
Manuscript in preparation.

Research Experiences

IIT Gandhinagar, India *Aug '20 – Present*
Junior Research Fellow in CSE
Advisor: Prof. Anirban Dasgupta

California Institute of Technology, Pasadena *May – Jul '19*
Summer Undergraduate Research Fellow in Astrophysics and Astronomy Department
Advisor: Dr. Ashish Mahabal

Microsoft Research India, Bangalore *Jan – Apr '19*
Research Intern in Machine Learning and Optimization Group
Advisors: Dr. Harsha Vardhan Simhadri & Dr. Prateek Jain

Indian Institute of Science (IISc), Bangalore *May – Jul '17, Dec '17, Feb '18, May – Jul '18*
Research Intern at Spectrum Lab for Signal Processing
Advisor: Prof. Chandra Sekhar Seelamantula

Supervised Research Projects

On optimizing deep learning *Aug '20 – Present*
Advisor: Prof. Anirban Dasgupta, IIT Gandhinagar [Under review]

We studied coreset construction methods for efficient pruning of neural networks. We also explored using coreset theory for accelerating gradient descent. Our work on understanding curriculum learning and its benefits on gradient descent proposes two novel curriculum learning frameworks.

Design of a Recursive Single Layer Neural Networks *Aug – Dec '19*
Advisor: Prof. Nithin V. George, IIT Gandhinagar [Manuscript in preparation]

A low-computational recursive functional link network with adaptive exponential terms and cross-terms enabled is proposed for enhanced performance in terms of error for nonlinear active noise cancellation. Our proposed model has an improvement of over 1 dB mean squared error against state-of-the-art models.

Classification of Light Curves Using Recurrent Neural Networks *May – Jul '19*
Advisor: Dr. Ashish Mahabal, Caltech [Special mention for poster at Undergraduate Research Conclave '19]

Telescopes from CRTS and ZTF facilities observe millions of objects in the night sky. Classifying these objects into various classes could help us learn and characterize them easily. RNN based algorithms are employed with preprocessing techniques and attention mechanisms to tackle the challenge of temporal irregularity and sparsity in the big data for multi-class classification of time-series light curves. Our model achieves over 99% accuracy, similar to the state-of-the-art CNN model, with impressive 380× model parameter reduction for classification of long period variables against other objects.

Online Speech Keyword Spotting For Resource Constrained Edge Devices *Jan – Apr '19*
Advisor: Dr. Harsha Vardhan Simhadri & Dr. Prateek Jain, Microsoft Research

A RNN based algorithm is designed to enable real-time keyword spotting in speech data. The model is made memory efficient for deploying in edge devices such as Arduino Uno. The uncompressed online model uses as less as 200 KB memory and performs better than the baseline offline vanilla RNN with ∼2.5% higher F_1 score.

Online Transduction of Phonemes to Alphabets in Speech Data With Shallow RNNs *Jan – Apr '19*
Advisor: Dr. Harsha Vardhan Simhadri & Dr. Prateek Jain, Microsoft Research [Published at *NeurIPS '19*]

Attention based encoder-decoder RNN is designed to transduce phonemes to English alphabets with less delay. RNNs are infused with shallow recurrence by breaking them into *bricks* for parallelization or computation reuse for streaming data. Phoneme transduction with shallow RNN takes 12× lesser time than the baseline architecture without increment in phoneme error rate.

Approximate Integer Multipliers on FPGA for Resource Constrained Neural Networks *Aug – Dec '18*
Advisor: Prof. Joycee Mekie, IIT Gandhinagar [Manuscript in preparation]

Neural networks can be approximated and implemented on FPGA with lesser energy, time, and memory consumption using approximate multipliers with only a low dip in accuracy. We exploit FPGA to occupy ∼38% lesser area, consume ∼30% lesser power, and have ∼28% lesser delay with an accuracy drop as low as ∼1.8% for classification tasks with perceptron network using our 8×8 approximate multiplier units compared to using accurate multilpier units.

Pixel-Wise Segmentation of Malign Pixels of Endoscopy Images with Few-Shot Learning *May – Jul '18*
Advisor: Prof. Chandra Sekhar Seelamantula, IISc Bangalore

The challenge in deploying learning for biomedical tasks is the unavailability of sufficient number of labelled data. Few-shot learning approaches are employed to match the performance of deep state-of-the-art architectures using as low as 5 labelled data points for training.

Patch-Wise Classification of Endoscopy Images for Abnormality Detection *Dec '17 & Feb '18*
Advisor: Prof. Chandra Sekhar Seelamantula, IISc Bangalore [Published at *IEEE ISBI '19*]

Wireless capsule endoscopy is performed to diagnose abnormalities in the gastrointestinal tract. We developed a CNN based algorithm that classifies patches in an endosocopy images to be benign or malign with ∼15% higher accuracy (AUROC score of 98.65%) than the state-of-the-art. Intel Movidius neural stick is used to accelerate the task on RPi enabling it to run real-time. The challenge of sufficient availability of labelled data is tackled with data augmentation.

Epoch Based Time and Pitch Scaling of Speech Signals *May – Jul '17*

Advisor: Prof. Chandra Sekhar Seelamantula, IISc Bangalore [Certified as Outstanding intern]

Learnt and implemented a novel algorithm, developed at the Spectrum Lab to extract glottal closure instants from speech signals, with GUI. The linear-time algorithm extracts epochs from the speech signal and helps in performing time-scaling for speech signals.

Awards And Honors

- Received *Cash Award for CS Publication* from IIT Gandhinagar, 2020.
- Received the *Director's Silver Medal* in CSE while graduating from IIT Gandhinagar in 2020.
- *Special mention* for Best Poster Award in Undergraduate Research Conclave '19 at IIT Gandhinagar for my research work at Caltech.
- Caltech's *Summer Undergraduate Research Fellowship* '19 Awardee, received a fellowship amount of $6,350$ USD.
- In Dean's list 4 times for excellent academic performance at IIT Gandhinagar.
- Received A^+ grade, the highest grade given for exceptional performance, in Introduction to Digital and Analog Electronics, and Electrical Lab courses in a class of ~ 180 students at IIT Gandhinagar.
- Awarded *KVPY fellowship* by the Government of India in 2016 for excellent performance in basic science – all India rank of 85 among $\sim 100,000$ candidates.
- Kerala *state topper* in Regional Mathematics Olympiad 2014 conducted by National Higher Board for Mathematics.
- Awarded *NTSE scholarship* – the most prestigious scholarship in India by the Government of India in 2012 for high school students.

Positions Of Responsibility & Extra-curricular

- Published the first ever musical video cover from IIT Gandhinagar as the main vocalist and lead actor [URL].
- *Peer-Assisted Learning Mentor* for the Academic Year '18 –' 19 – mentored and helped freshmen students who found it difficult to cope up with their academic work load.
- *Leader* and the *main vocalist* of music band at IIT Gandhinagar in '18.
- Hobbies include singing, playing ukulele, ultimate frisbee, badminton, and football.
- Active member of Sargam (music club) in my junior and sophomore years.
- Active member of Metis (coding club) in my freshman year.