Bhavya Vasudeva

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Education

Bachelor of Technology — IIT Roorkee
Major: Electronics and Communication Engineering, CGPA: 9.362/10, Rank: 3/84 — 2016-2020

Interests

Machine Learning, Computer Vision, ML for Health, Explainable AI, Adversarial Robustness

Publications

1. **B. Vasudeva***, P. Deora*, S. Bhattacharya, U. Pal, S. Chanda. LoOp: Looking for Optimal Hard Negative Embeddings for Deep Metric Learning, **under review**.
2. **B. Vasudeva***, P. Deora*, S. Bhattacharya, P. M. Pradhan. Compressive Sensing MRI Reconstruction using Complex-Valued Generative Adversarial Network (Co-VeGAN), **under review** in *IEEE Transactions on Computational Imaging*.
3. P. Deora*, **B. Vasudeva***, S. Bhattacharya, P. M. Pradhan. Structure Preserving Compressive Sensing MRI Reconstruction using Generative Adversarial Networks, in *IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*, pp. 2211-2219, 2020. (peer-reviewed, h5-index: 73)
4. **B. Vasudeva**, P. Deora, P. M. Pradhan, S. Dasgupta. Efficient Implementation of LMS Adaptive Filter based FECG Extraction on an FPGA, *IET Healthcare Technology Letters*, pp. 125-131, vol. 7, no. 5, 2020. (peer-reviewed)

(*equal contribution)

Research Experience

Visiting Researcher — ISI Kolkata
Advisors: Prof. Saumik Bhattacharya & Prof. Umapada Pal — June'20 - Ongoing

- **Finding Optimal Hard Negatives for Deep Metric Learning** — Preprint
  - Proposed to find the minimum distance between two pairs of embeddings from different classes, to find hard negatives for each tuple in a batch.
  - Solved the optimization problem using Karush-Kuhn-Tucker (KKT) conditions.
  - Upto 7.2% increase in Recall@1 value (retrieval) and 5.8% increase in F_1 score (clustering) over previous best method, when combined with representative metric learning losses.
- **Learned ISP for RAW to RGB conversion** — Code | Paper
  - Proposed a two-stage model for local and global enhancement, inspired by traditional ISPs.
  - Proposed an exposure fusion based loss, using a weighted map of saturation, exposure, contrast.
  - Ranked 4^{th} in mean opinion score in the challenge organized by AIM workshop, ECCV 2020.

Undergraduate Researcher — IIT Roorkee (Bachelor Thesis)
Advisors: Prof. Saumik Bhattacharya & Prof. P. M. Pradhan — June'19 - July'20

- **Complex-Valued GAN for CS-MRI Reconstruction** — Preprint | Slides
  - Proposed a novel complex-valued GAN for reconstructing both magnitude and phase content of compressive sensing (CS) undersampled MRI data.
  - Proposed a learnable and phase-sensitive activation function for the complex domain, a dense U-net based generator and a Gaussian weighted wavelet-based loss.
  - Uses significantly fewer ($\sim 77\times$) parameters than real-valued approaches, obtains 5.4% and 15.7% increase in PSNR for 30% undersampled real-valued and complex-valued images, respectively.
- **Structure Preserving CS-MRI Reconstruction using GANs** — Code | Paper
  - Incorporated RRDBs in a U-net based generator, with patch-based discriminator, SSIM based loss, to improve structural reconstruction.
  - Used noisy images for augmentation to train the GAN model and make it robust to noise.
  - Obtains 8.2% increase in PSNR for 30% undersampled data.

Undergraduate Intern — Northwestern University
Advisor: Prof. Yuan Yang — May'19 - July'19

- **Quantifying Various Types of Phase Coupling** — Report | Slides
  - Proposed multi-phase locking value (mPLV), a generalized metric to quantify phase coupling.
  - Validated mPLV using synthetic coupled white Gaussian signals, and coupled Rössler oscillators.

UNDERGRADUATE RESEARCHER — IIT Roorkee
Advisors: Prof. P. M. Pradhan & Prof. S. Dasgupta — May'18 - Nov'18

- **FPGA Implementation of FHR Monitoring System** — Paper
  - Preprocessed ECG signals, extracted fetal ECG using least means square algorithm based adaptive filter (LMS-AF), estimated fetal heart rate (FHR) with a novel variant of Pan & Tomkins algorithm.
  - Implemented the system on FPGA with series and parallel architectures of LMS-AF for lower hardware utilization, and lower latency, power consumption, respectively.
  - Fetal R peaks detected with a sensitivity of 95.74% to 100% and a specificity of 100%.

Other Projects

- **Zero-Shot Action Recognition in Videos** — ISI Kolkata | July'20-Aug'20
  - Implemented an end-to-end model, without a pre-trained feature extractor, to directly map videos to the embedding space.
  - Incorporated proxy anchor loss, with class embeddings as proxies.
- **Low-light Image Enhancement** Code | Report — IIT Roorkee | Spring'19
  - Low-light input composed of desired scene and illumination map, as per retinex theory.
  - Estimated the illumination map by solving an optimization problem using alternating direction method of multipliers (ADMM).
  - Implemented post-processing methods, compared with histogram equalization based methods.
- **FECG Extraction using BSS based Techniques** — IIT Roorkee | Autumn'18
  - Preprocessed abdominal ECG signals, applied FastICA algorithm to separate sources.
  - Obtained the fetal ECG from one of the sources, using PCA for denoising.
- **Grid Solving Line Follower** — IIT Roorkee | Autumn'17
  - Implemented a line following bot using Arduino and Raspberry Pi.
  - Programmed it to traverse through a complex grid, avoiding some of the nodes detected during a dry run, using Dijkstra's algorithm, as well as perform color detection and logo identification.

Skills

Programming Languages	Python, C, C++
Libraries & Tools	Keras, MXNet, PyTorch, TensorFlow, Matlab, Git, LaTeX

Awards and Achievements

2020 **Singhal's Tech. for Society Award** for best bachelor thesis at institute level
2020 **Viney K. and Sunita Jain Award** for academic excellence by IIT Roorkee
2020 Finalist of **INAE Innovative Student Projects Award**, a national level award for bachelor thesis
2020 **3AI Pinnacle Student of the Year Award** for bachelor thesis
2019 **S. N. Bose Scholars Program**, among the 50 students selected across the country
2017 Third position, **International Robotics Challenge** at Techfest'17, IIT Bombay
2016 IIT JEE Advanced **All India Rank 978**, 99.5 percentile
2016 IIT JEE Mains **All India Rank 336** among 1.2 million candidates
2015 **Kishore Vaigyanik Protsahan Yojana**, awarded fellowship in Science stream by IISc Bangalore
2014 **National Talent Search Examination**, awarded scholarship by the Government of India

Relevant Courses

CS	**ECE**	**Math**
Fund. of Object Oriented Prog.	Signals & Systems	Mathematics-I (Matrix Algebra & Vector Calculus)
Data Structures	Digital Image Processing	Mathematical Methods (Solving ODEs & PDEs)
Deep Learning	Digital Signal Processing	Probability & Statistics

Online Courses

Intro. to CS and Prog. in Python (MIT OCW 6.0001) — Linear Algebra (MIT OCW 18.06)
Intro. to Compressive Sensing (Prof. Duarte's notes) — Sparse Approximation (Prof. Romberg's notes)
CNNs for Visual Recognition (Stanford Uni., CS231n) — Machine Learning (Stanford Uni., Coursera)
AI for Medical Diagnosis (Stanford Uni., Coursera)