Karan Taneja

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Research Interests: Signal Processing, Machine Learning, Speech Recognition, Computer Vision, Natural Language Processing and Understanding, Human-Computer Interaction.

Education

- **Indian Institute of Technology (IIT) Bombay** — **Mumbai, India**
  Dual Degree (B.Tech. + M.Tech.), Electrical Engineering — *2015–2020*
  - GPA (CPI): 9.51 /10, (3^{rd} among 78 students)
  - Specialization: Signal Processing and Communications
  - Minor: Computer Science and Engineering

Publications

- **Exploiting Monolingual Speech Corpora for Code-mixed Speech Recognition**
  Karan Taneja, Satarupa Guha, Preethi Jyothi, Basil Abraham
  Proceedings of Interspeech 2019, 15-19 September 2019, Graz, Austria
- **A Deep CNN Framework to Reconstruct k-t-Undersampled Resting-fMRI**
  Karan Taneja, Prachi H. Kulkarni, S. N. Merchant, Suyash P. Awate
  Submitted to IEEE International Symposium on Biomedical Imaging (ISBI) 2020
- **Uncertainty Estimation in Deep CNN Frameworks for Undersampled Resting-fMRI Reconstruction**
  Karan Taneja, Prachi H. Kulkarni, S. N. Merchant, Suyash P. Awate
  In preparation, Journal of IEEE Transactions on Image Processing

Achievements and Awards

- **Institute Academic Prize (IAP)** — **IIT Bombay**
  Awarded with IAP for ranking 1^{st} among 78 students in EE department for year 2018-19 — *2018-2019*
- **Exceptional Performance Grade (AP)** — **IIT Bombay**
  AP grade in 3 courses: Image Processing, Control Systems, Computer Programming and Utilization — *2015-2020*
- **International Speech Communication Association (ISCA) Travel Grant** — **ISCA–Interspeech'19**
  Awarded with ISCA Travel Grant for attending Interspeech 2019, Graz, Austria. — *2019*
- **Kishore Vaigyanik Protsahan Yojana (KVPY) Fellow** — **Government of India**
  Awarded with KVPY fellowship, ranked 437 among 100 thousand candidates nationwide — *2014*
- **National Talent Search Scheme (NTSS) Fellow** — **Government of India**
  Awarded with NTSE fellowship, in top 1000 students among 300 thousand candidates nationwide — *2013*

Internships and Research Projects

- **Code-mixed Hindi-English Automatic Speech Recognition (ASR) Using Monolingual Corpora**
  Research Associate, Microsoft IDC, Hyderabad, India, Guide: Prof. Preethi Jyothi — *Oct 2018–Present*
  - Working on code-mixed speech recognition using monolingual data. Currently exploring text-to-speech and voice-conversion systems for synthetic code-mixed speech generation which can be used for training ASR systems.
  - Published a paper titled *Exploiting Monolingual Speech Corpora for Code-mixed Speech Recognition* which was accepted at Interspeech 2019, Graz, Austria.

- **Fast R-fMRI k,t-undersampled Acquisition and Reconstruction Using Deep-NN Priors**
  Master of Technology Project, IIT Bombay, Guide: Prof. Suyash Awate — *Jan 2019–Present*
  - Implemented a multi-stage CNN-based model for multi-coil R-fMRI reconstruction from under-sampled k,t-space acquisition which aims at preserving the default-mode network, for lowering the acquisition time.
  - Exploring the use of different architectures under severe noise conditions that is characteristic of fMRI signals while preserving the performance and aiming for a reduction in reconstruction/computation time.

- **Spherical CNNs for Human Detection Task in 360-degree Images**
  Research Intern, Sony Semiconductor Solutions, Kanagawa, Japan — *May 2018–Jul 2018*

- Worked on Spherical CNNs for human-detection in 360-degree images captured using an omnidirectional camera.
- Published an internal technical report titled *Spherical CNNs for Human Detection Task in 360-degree Images*.

- **Attention-based and Segmental Models for Speech Recognition**
  R&D Project, IIT Bombay, Guide: Prof. Preethi Jyothi *Jan 2018–May 2018*
  - Proposed and implemented *Segmentation via Attention model* that maximizes joint probability of output sequence of an attention model by introducing a latent segmentation like *Segement to Segment Neural Transduction* model.
  - Used a top-k beam for making the computation more tractable and efficient and implemented it in TensorFlow.

- **Patient-motion Detection in MRI Scans Using Deep Neural Networks**
  Research Intern, Philips Innovation Campus, Bangalore, India *May 2017–Jul 2017*
  - Worked on patient-motion detection in MRI using light-weight fully-convolutional neural networks.
  - Implemented a proof-of-concept 2D-CNN and RNN cascade model for 3D-image classification.

- **Vector Representation of Words Using Neural Networks**
  Center for Indian Language Technology, IIT Bombay *Dec 2016–Jan 2017*
  - Implemented Continuous Bag of Words model to develop Word2Vec for English language and experimented with network architecture, training algorithms and related parameters.
  - Worked on neural network models using TensorFlow on a corpus with approximately 1.7 billion words.

Selected Course Projects

- **Semantic Image Inpainting with Deep Generative Models**
  Medical Image Computing, Spring 2018-19
  - Implemented a Generative Adversarial Model (GAN) based technique for image inpainting with backpropagation-to-input and Poisson blending in PyTorch, inspired from a paper with same title by Yeh et al., in CVPR 2017.
  - Extended to Variational Auto-encoder (VAE) based model and evaluated performance differences quantitatively.
- **Compressed Sensing and Dictionary Learning to Alleviate Spatial-Temporal Resolution Trade-off in Videos**
  Recent Topics in Analytical Signal Processing, Spring 2018-19
  - Implemented a method for video reconstruction using coded sampling, K-SVD algorithm for dictionary learning and Orthogonal Matching Pursuit (OMP) algorithm for sparse reconstruction.
  - Experimented with variations in sampling schemes, dictionary parameters, etc. to optimize performance.
- **Experiments with Differentiable Neural Computer (DNC)**
  Advanced Machine Learning, Spring 2018-19
  - Experimented with DNC on top-k sorting, shortest-path in graph and connectedness in graph tasks.
  - Evaluated performance of DNC with different parameter settings and tasks to gain insights about its capacity.
- **Isolated Words Speech Recognition System**
  Speech Processing, Autumn 2018-19
  - Obtained features for the utterances using Mel frequency cepstral coefficients (MFCCs) from scratch.
  - Implemented vector quantization (VQ) codebook, clustering, and dynamic time warping (DTW).
- **The MusicBox – Modelling, Rendering, and Animation**
  Computer Graphics, Autumn 2018-19
  - Modelled music box with two humanoid characters in a realistic room with lighting and texture.
  - Rendered animation of dancing characters with camera movement on user-specified Bezier curve.
- **Adaptive Echo Cancellation (AEC)**
  Digital Signal Processing, Spring 2017-18
  - Implemented Least Mean Square (LMS), Normalized LMS and Recursive Least Square algorithms for AEC.
  - Comparatively analyzed computation cost, convergence time and stability of the algorithms.
- **Voice Conversion using GANs**
  Automatic Speech Recognition, Autumn 2017-18
  - Participated in the Voice Conversion Challenge 2018 in both parallel and non-parallel corpus track.
  - Implemented a GAN model conditioned on sentence embeddings and achieved a mean opinion score (MOS) of 3.8.
- **Pipelined Processor Design**
  Microprocessors, Autumn 2017-18
  - Designed a 6-staged pipelined processor in VHDL for a given instruction set architecture.
  - Implemented 15 instructions with advanced ones like load multiple, store multiple, jump and link.
  - Optimized the architecture for hazard mitigating techniques such as data forwarding and stalling.
- **Mini Function Generator**
  Microprocessors Lab, Autumn 2017-18

- Developed a circuit for generation of sine, square and triangular waveforms using DDS chip.
- Implemented frequency, amplitude and offset control based on user input and analog front-end.
- Involved UART and SPI communication protocols and VHDL coding of 8051 micro-controller.

- **Music Genre Detection using Machine Learning**
  Foundations of Machine Learning, Spring 2016-17
  - Used Music Information Retrieval (MIR) toolbox for feature extraction from audio files of five genres and compared the performance of several machine learning algorithms and achieved 78% accuracy on GTZan dataset.
  - Visualized extracted data from music files using t-Distributed Stochastic Neighbour Embedding (t-SNE).

Teaching

- **Teaching Assistant**
  - **Introduction to Machine Learning** *(CS 419)*, Prof. Sunita Sarawagi, Autumn 2018-19, IIT Bombay
  - **Data Analysis and Interpretation** *(EE 223)*, Prof. Shabbir Merchant, Summer 2019, IIT Bombay
  - **Data Analysis and Interpretation** *(EE 223)*, Prof. Prasanna Chaporkar, Autumn 2019-20, IIT Bombay
- **Bootcamps**
  - **Coding Bootcamp for Interview Preparation**, Undergraduate Academic Council, Autumn 2018-19, IIT Bombay
  - **Web Development and Programming – Summer Camp**, Summer 2016, Camp K12 - Mumbai

Relevant Coursework

- **Machine Learning and Applications:** Machine Learning, Advanced Machine Learning, Intelligent and Learning Agents, Speech Processing, Automatic Speech Recognition, Medical Image Computing, Image Processing
- **Signal Processing and Applications:** Digital Signal Processing, Analytical Signal Processing, Estimation and Identification, Probability and Random Processes, Signals and Systems, Data Analysis and Interpretation
- **Computer Science and Mathematics:** Computer Graphics, Data Structures and Algorithms, Matrix Computations, Control Systems, Optimization, Game Theory and Applications, Computer Networks, Operating Systems, Microprocessors, Discrete Structures, Error Correcting Codes, Random Graphs

Technical Aptitude

- **Programming:** Python, C/C++, Java, MATLAB/Octave, VHDL, Web development
- **Packages:** SciPy stack, PyTorch, TensorFlow, OpenCV, OpenGL
- **Other tools:** Bash, LaTeX, Eagle, Ngspice, Quartus, SolidWorks

Extra-curricular Activities

- Attended, volunteered and presented a paper at Interspeech 2019, Graz, Autria organized by ISCA and TU Graz.
- Attended Symposium on Recent Advances in Speech Prosody Research, 2018 at IIT Bombay.
- Attended Deep Learning Workshop by NVIDIA Deep Learning Institute in Winter 2016.
- Attended National Science (Vijyoshi) Science Camp 2014, organized by IISc Bangalore and IISER Kolkata.
- Won *Honorable Mention Prize* in an essay competition organized by Vigilance Department (IIT Bombay) during Vigilance Awareness Week 2015 on moral values and responsibilities.
- Awarded with Technical Color Prize, Hostel 2, IIT Bombay for notable contribution in inter-hostel competitions.
- Volunteered for social initiatives under National Service Scheme at IIT Bombay, like health camps, cloth collection drive, assisting construction workers and awareness initiatives.
- Mentored three first-year undergraduate students in the *Summer of Science* study-project organized by Math and Physics Club, IIT Bombay on introductory topics in Machine Learning and Artificial Intelligence.
- Speaker for *Reflections Session* by Web and Coding Club, IIT Bombay to share my research experience at IITB.

References

Prof. Preethi Jyothi
Indian Institute of Technology Bombay
E-mail | Webpage

Prof. Suyash Awate
Indian Institute of Technology Bombay
E-mail | Webpage