Karan Taneja

Research Interests: Computer Vision, Language and Speech Processing, and intersection thereof.

Education

- **Georgia Tech** — **Atlanta, US**
  Ph.D., Computer Science — *2021–*
  - Starting in January 2021
- **IIT Bombay** — **Mumbai, India**
  Dual Degree (B.Tech.+M.Tech.), Electrical Engineering — *2015–2020*
  - Grade: $9.63\ /10$, 3^{rd} among 78 students
  - Specialization: Signal Processing and Communication
  - Minor: Computer Science and Engineering $(9.40\ /10)$

Publications

- **A Bayesian Deep CNN Framework for Reconstructing k-t-Undersampled Resting-fMRI**
  Karan Taneja, Prachi H. Kulkarni, S. N. Merchant, Suyash P. Awate
  Under Review
- **Improving Low Resource Code-switched ASR using Augmented Code-switched TTS**
  Yash Sharma, Basil Abraham, Karan Taneja, Preethi Jyothi
  Interspeech 2020 (Virtual), 25-29 Oct. 2020, Shanghai, China
- **Exploiting Monolingual Speech Corpora for Code-mixed Speech Recognition**
  Karan Taneja, Satarupa Guha, Preethi Jyothi, Basil Abraham
  Interspeech 2019, 15-19 Sept. 2019, Graz, Austria

Achievements and Awards

- **Undergraduate Research Award (URA03)** — **IIT Bombay**
  Awarded to recognise exceptional work, in quality and extent, in the Dual Degree Project. — *2020*
- **Institute Academic Prize (IAP)** — **IIT Bombay**
  Awarded with IAP for ranking 1^{st} among 78 students in EE department for academic 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*

Research Projects and Internships

- **Fast R-fMRI k,t-undersampled Acquisition and Reconstruction Using a CNN Framework**
  Masters Thesis, IIT Bombay, Guide: Prof. Suyash Awate, Prof. Shabbir Merchant — *Jan 2019–Present*
  - Implemented a two-stage CNN framework model for R-fMRI reconstruction from under-sampled k,t-space acquisition to optimize for the structural similarity of the functional connectivity maps of the human brain.
  - Generalized the previously used GRAPPA scheme in the first stage to use a deep CNN network for the k-space filling and another network, in the second stage, for time upsampling and image enhancement.
  - Showed that our method outperforms previous methods that use dictionary priors and sparsity constraints.
  - Extended our framework to estimate uncertainty over the mean output to get more insight about the quality of functional connectivity maps and showed improved performance over previous training objectives.
- **Code-mixed Automatic Speech Recognition (CM-ASR) Using Monolingual Corpora**

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Research Intern, Microsoft IDC, Hyderabad, India, Guide: Prof. Preethi Jyothi *Oct 2018–Feb 2020*

- Proposed two linguistically motivated algorithms to create synthetic CM speech while preserving span length distributions and phone transition probability distributions at switch points.
- Investigated the effect of using synthetic CM speech to train acoustic models, used transcripts from the synthetic data to train language models and examined their effect on ASR performance in real Hindi-English CM speech.
- Showed improvements over naive linguistically-unmotivated methods using monolingual corpora for CM-ASR.
- Working on voice conversion for introducing speaker variability in utterances from CM text-to-speech systems.

- **Spherical CNNs for Human Detection Task in 360-degree Images**

Research Intern, Sony Semiconductor Solutions, Kanagawa, Japan *May 2018–Jul 2018*

- Extended the work on spherical CNNs to propose much lighter convolution operations on sphere S^2 and rotation group $SO(3)$ by factorization into depth-wise and point-wise spherical convolution.
- Enabled the use of deeper architectures such as ResNet, DenseNet and others which were previously infeasible with spherical CNNs and showed improved performance in human-detection on a Theta 360-degree image dataset.
- 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, Prof. Sunita Sarawagi *Jan 2018–May 2018*

- Proposed *Segmentation via Attention model* that maximizes joint conditional probability of output sequence of an attention model by introducing a latent segmentation for phoneme recognition on the TIMIT dataset.
- Devised an algorithm to marginalize over segmentations by interpreting attention probabilities over encoder states as conditional probabilities of segment boundaries and doing a one-step look-ahead for end-of-segment boundary.
- Enabled tractability by using a top-k beam over segmentation-lattice and implemented the model in TensorFlow.

- **Patient-motion Detection in MRI Scans Using Deep Neural Networks**

Research Intern, Philips Innovation Campus, Bangalore, India *May 2017–Jul 2017*

- Implemented a 3D CNN classifier and cascaded 2D CNN-RNN classifier where RNN takes in the features extracted by CNN over slices of MRI scans for detecting the level of patient motion detection.
- Implemented several feature-based classifiers that used wavelet analysis, spectral analysis, edge information and histogram of gradient information and performed feature selection for patient motion detection.
- Showed empirically that CNN-RNN model outperforms 3D-CNN model which outperforms feature-based classifiers.

Academic Service

- **Reviewing**: ICPR 2020
- **Teaching Assistant**

Introduction to Machine Learning (CS 419)	Prof. Sunita Sarawagi	Autumn 2018, 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, IIT Bombay

- **Bootcamps**

Coding Bootcamp for Interview Preparation	Undergraduate Academic Council	Autumn 2018
Web Development and Programming Camp	Camp K–12, Mumbai	Summer 2016

Coursework

Machine Learning	Machine Learning, Advanced Machine Learning, Reinforcement Learning, Speech Processing, Speech Recognition, Image Processing, Advanced Image Processing, Medical Imaging
Signal Processing	Digital Signal Processing, Analytical Signal Processing, Estimation & Identification, Probability & Random Processes, Markov Chains & Queuing Systems, Data Analysis
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 (HTML5, CSS3, JS)
Packages	SciPy Stack, PyTorch, TensorFlow, OpenCV, OpenGL, Django
Other tools	Bash Script, Vim, Jekyll, LaTeX, Eagle, Ngspice, Quartus, SolidWorks

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