

Chaitanya Ahuja

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Education

Carnegie Mellon University

Ph.D. in Language Technologies

Advisor: Louis-Philippe Morency

Pittsburgh

Aug 2015 – Present

Indian Institute of Technology, Kanpur

B.Tech. in Electrical Engineering, 9.5/10

Minor in Artificial Intelligence

Kanpur

Aug 2011 – May 2015

Research Areas

Pose generation, Multimodal Grounding, Multimodal Representation Learning, Speech Processing and Synthesis, Structured Prediction, Spatial Audio

Research Experience

Carnegie Mellon University, Prof. Louis-Philippe Morency

August 2015 – Present

Language2Pose: Natural Language Grounded Pose Forecasting

- Designed an algorithm to learn a joint embedding of natural language and 3D body pose.
- Trained a model with a curriculum based approach to generate animations from this joint embedding conditioned on natural language.
- Demonstrated empirically that using SmoothL1 as the loss function can help with the robustness of training and generalization over unseen data.

Lattice Recurrent Unit: Improving Convergence and Statistical Efficiency for Sequence Modeling

- Designed a recurrent unit (a.k.a. Lattice Recurrent Unit) which creates a distinct flow of information along time and depth dimensions allowing for **training of deeper models**
- Compared it and demonstrated **improvements on language modeling** as compared to SOTA recurrent units on metrics: accuracy, computational convergence, and statistical efficiency
- Demonstrated that decoupling information along depth and time shows significant improvement in all the aforementioned metrics

IIT Kanpur, Prof. Rajesh Hegde

Aug 2014 – May 2015

Final Year Project: *Source Separation using a Complex Matrix Factorization approach for Joint Modeling of Magnitude and Phase* [arXiv]

- Proposed a new algorithm to **jointly model magnitude and phase** while matrix factorization
- Reduced the Complex Matrix Factorization (CMF) problem to a simple Non-Negative Matrix Factorization (NMF) problem by simple transformations
- Justified the algorithm's effectiveness by comparing against state of the art source-separation methods
- Demonstrated that accurate phase reconstruction resolves unwanted artifacts in the reconstructed speech signal

IIT Kanpur, Prof. Vinay Nambodiri

Aug 2014 – May 2015

Final Year Project: *Visual Summarization of foreground object motion using boundary initialization of object tracking* [tech. report]

- Proposed an online system for creating **human-centric image summaries** of **surveillance videos** which is based on Kernel-based tracking for automated live synthesis of video synopsis of surveillance videos
- Initialized foreground objects based on locally varying blob-detection algorithm
- Clustered tracks based on time and space to prevent occlusion in the summary
- Video Summary was synthesized by placing objects, equally spaced in time, on the background

Selected Honors and Awards

- **Summer Undergraduate Research Grant for Excellence (SURGE)** 2013, IIT Kanpur
- One of the top 7 projects (out of 70) in **SURGE 2013**
- **Academic Excellence Award** for distinctive performance in terms 2011-12, 2012-13.
- **All India Rank 231 - Top 0.05%** (amongst 4,75,000 students) in IIT-JEE 2011.
- **All India Rank 124 - Top 0.05%** (amongst 10,00,000 students) in AIEEE 2011.

Publications

Published

- [P1] C. Ahuja, S. Ma, L.-P. Morency, and Y. Sheikh, "To react or not to react: End-to-end visual pose forecasting for personalized avatar during dyadic conversations," *ICMI*, 2019.
- [P2] C. Ahuja and L.-P. Morency, "Language2pose: Natural language grounded pose forecasting," *3DV*, 2019. [Online]. Available: <https://arxiv.org/pdf/1907.01108.pdf>.
- [P3] T. Baltrusaitis, C. Ahuja, and L.-P. Morency, "Multimodal machine learning: A survey and taxonomy," *TPAMI*, 2018. [Online]. Available: <https://arxiv.org/abs/1705.09406>.
- [P4] C. Ahuja and L.-P. Morency, "Lattice recurrent unit: Improving convergence and statistical efficiency for sequence modeling," *AAAI*, 2018. [Online]. Available: <https://arxiv.org/abs/1710.02254>.
- [P5] C. Ahuja and R. M. Hegde, "Fast modelling of pinna spectral notches from hrtfs using linear prediction residual cepstrum," in *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, IEEE, 2014, pp. 4458–4462. [Online]. Available: http://chahuja.com/files/icassp_chahuja_paper.pdf.
- [P6] A. Sohni, C. Ahuja, and R. M. Hegde, "Extraction of pinna spectral notches in the median plane of a virtual spherical microphone array," in *4th Joint Workshop on Hands-free Speech Communication and Microphone Arrays (HSCMA)*, IEEE, 2014, pp. 142–146. [Online]. Available: http://chahuja.com/files/hscma_chahuja_paper.pdf.

Tech. Reports

- [A1] C. Ahuja, K. Nathwani, and R. M. Hegde, "A complex matrix factorization approach to joint modeling of magnitude and phase for source separation," *ArXiv preprint arXiv:1411.6741*, 2014. [Online]. Available: <https://arxiv.org/abs/1411.6741>.

Teaching and Professional Activities

- **Reviewer** Icelandic Research Fund - External Grant Reviewer 2019
- **Reviewer** Empirical Methods in Natural Language Processing (EMNLP) 2019
- **Reviewer** Association for Computational Linguistics (ACL) 2019
- **Teaching Assistant** Structured Prediction for Language and Other Discrete Data (CMU 11-763) Spring 2018
- **Teaching Assistant** Advanced Multimodal Machine Learning (CMU 11-777) Spring 2017
- **Reviewer** International Conference on Learning Representations (ICLR) 2017
- **Reviewer** NIPS Workshop on Multimodal Machine Learning 2016

Internships

Facebook Reality Labs, Shugao Ma

Summer 2018

Human Communication Dynamics

- In a dyadic conversation setting, designed a model to generate upper body animations conditioned on the avatar's speech, pose history and interlocutor's speech and pose history.
- Used an attention based model to focus on interpersonal and intrapersonal dynamics as and when indicated by the stimuli to the model.
- Demonstrated the model's effectiveness in generating accurate and natural looking pose sequences via various objective and subjective metrics of evaluation.

Cornell University, Prof. Tsuhan Chen

Summer 2014

Prediction of Adjectives for given Nouns using Probability distribution of adjective-noun pairs and adjective-adjective similarity [tech. report]

- Designed a system to **predict adjectives** for a given noun based on an existing set of tags, which increased the vocabulary of the tags while maintaining the sanctity of the noun-adjective pair
- Incorporated a Sentence Corpus (British-National-Corpus) to improve the compatibility of adjective with respect to nouns based on a probability measure

- **Removed redundant data** from the sentence corpus using a hash table which increased accuracy as compared to the baseline

IIT Kanpur, Prof. Rajesh Hegde

Summer 2013

On-Line modeling of the Pinna for Computation of HRTF's in Rendering 3D Audio

- Explored relations between structure of a ear and Head Related Transfer Functions (HRTFs)
- Worked towards mimicking a ear with digital filters to synthesize **Spatial Audio**
- Developed methods to verify ear contours generated by spectral notches of HRTFs, hence mapping HRTFs to the anthropometry of the ear.

Selected Course Projects

Deep RL and control

Jan 2017 – May 2017

- *Segmentation Models for NLP tasks with RL* [\[tech. report\]](#)
Segmenting sentences into useful phrases for tasks like Machine Translation and Summarization

Statistical Machine Learning

Jan 2017 – May 2017

- *Topological Data Analysis* [\[tech. report\]](#) [\[presentation\]](#)
Analysing confidence intervals in cluster trees to facilitate pruning of low-confidence branches (or leaves)

Multimodal Machine Learning

Aug 2015 – May 2016

- *Video Captioning* [\[tech. report\]](#)
Generating descriptive captions for movie video segments.

Skills

- Languages: Bash, C, CSS, HTML, \LaTeX , Make, Python
- Frameworks: Numpy, Pandas, Pytorch, Scipy, Scikitlearn, Tensorflow, Theano
- OS: Linux, OSX

Graduate Coursework

- Deep Reinforcement Learning (CMU 10-703): R. Salakhutdinov, K. Fragkiadaki *Spring 2017*
- Statistical Machine Learning (CMU 10-702): L. Wasserman, R. Tibshirani *Spring 2017*
- Deep Learning (CMU 10-707): R. Salakhutdinov *Fall 2016*
- Intermediate Statistics (CMU 10-705): L. Wasserman *Fall 2016*
- Advanced Multimodal Machine Learning (CMU 11-777): L.-P. Morency *Spring 2016*
- Machine Learning (CMU 10-701): T. Mitchell *Spring 2016*
- Human Communication and Multimodal ML (CMU 11-776): L.-P. Morency *Fall 2015*
- Algorithms for NLP (CMU 10-702): C. Dyer *Fall 2015*