Chaitanya Ahuja

CONTACT INFORMATION

Senior Undergraduate,
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Indian Institute of Technology, Kanpur
India

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RESEARCH INTERESTS

Machine Learning, Machine Listening, Speech Processing, Natural Language Processing, Computer Vision

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EDUCATION

Indian Institute of Technology, Kanpur   **2011-Present**
B.Tech in **Electrical Engineering**
Minor in **Artificial Intelligence** (Computer Science and Engineering)

- *Cumulative Performance Index* (CPI) - **9.6*** *(out of 10)* - Till 6th semester

All India Senior School Certificate Examination, CBSE India   **2011**

- *Scored* cumulative **94.4 %** in Senior Secondary School

All India Secondary School Examination, CBSE India   **2011**

- *Scored* cumulative **94 %** in High School

SCHOLASTIC ACHIEVEMENTS

- Awarded **Summer Undergraduate Research Grant for Excellence** (SURGE) 2013, granted by *Dean, Resource Planning and Generation, IIT Kanpur*
- *Conferred* **"One of the best Projects Award"** *(top 7 out of 70)* **in SURGE 2013**
- Received **Academic Excellence Award** for distinctive performance in terms 2011-12, 2012-13.
- Secured **All India Rank 231 - Top 0.05%** (amongst 4,75,000 students) in IIT-JEE 2011.
- Secured **All India Rank 124 - Top 0.05%** (amongst 10,00,000 students) in AIEEE 2011.
- Received CBSE-Certificate of Merit **(Top 0.1% in India)** in AISSCE 2011 **Math Examination**.
- Selected in the Regional Level **CBSE-Group Mathematics Olympiad** 2011.

PUBLICATIONS

- **Chaitanya Ahuja**, Karan Nathwani, and Rajesh M. Hegde, *A Complex Matrix factorization approach to joint modeling of magnitude and phase for source separation*, Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), IEEE, Brisbane, Australia, 2015 (**Submitted**) - **[arXiv] [Demo] [GitHub]**
- **Chaitanya Ahuja**, and Rajesh M. Hegde, *Fast modelling of Pinna Spectral Notches from HRTFs using Linear Prediction Residual Cepstrum*, Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), IEEE, Florence, Italy, 2014 - **[Paper] [Poster]**
- Ankit Sohani, **Chaitanya Ahuja**, and Rajesh M. Hegde, *Extraction of Pinna Spectral Notches in the Median Plane of a Virtual Spherical Microphone Array*, 4th Joint Workshop on Hands-free Speech Communication and Microphone Arrays (HSCMA 2014) Nancy, France - **[Paper] [Poster]**

INTERNSHIP

- **Cornell University**
  Prediction of Adjectives for given Nouns using Probability distribution of adjective-noun pairs and adjective-adjective similarity. [Report]
  Mentor : Dr. Tsuhan Chen   (May 2014- July 2014)
  - 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.
  - Designed a storage system to **remove redundant data** from the sentence corpus which increased accuracy as compared to the baseline.

RESEARCH EXPERIENCE

- **Final Year Project - Visual Summarization of Foreground Object Motion using Boundary Initialization of Object Tracking [Report]**
  Mentors : Dr. Vinay P. Namboodiri and Dr. K.S. Venkatesh   (Aug 2014-Present)
  - Proposed an online system based on Kernel-based tracking for automated live synthesis of video synopsis of surveillance videos.
  - Initialization of foreground objects based on locally varying blob-detection algorithm.
  - Clustering 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.

- **Source Separation using a Complex Matrix Factorization approach for Joint Modeling of Magnitude and Phase**
  Mentor- Prof. Rajesh Hegde, IIT Kanpur (August 2014 - Present)

  – 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

  – Order of computation of the proposed CMF remains the same as that of standard NMF

  – Algorithm's effectiveness was confirmed by comparison against state of the art separation methods.

  – Accurate phase reconstruction resolves unwanted artifacts in the reconstructed speech signal, which has been aptly done so in this work

  – Work done has been submitted to ICASSP 2015

- **On-Line modeling of the Pinna for Computation of HRTFs in Rendering 3D Audio**
  Mentor- Prof. Rajesh Hegde, IIT Kanpur (July 2013 - Present)

  – Preliminary **testing of spatial audio** to recognize issues that needed improvement.

  – Understanding the structure of the ear and working towards mimicking its functioning through digital filters

  – Relating the **anthropometry of the ear to HRTFs** in general and developing methods to verify contours generated by spectral notches (significant feature in HRTFs).

  – Currently working on application of closely-packed-multi-array systems in spatial audio analysis.

  – Involved in setting up of a **Spatial-Audio Lab**, which is crucial for finding newer methods of HRTF measurement

  – Work done has been published in ICASSP 2014 and HSCMA 2014.

SELECTED PROJECTS

- **Source Separation using Negative-Tensor-Factorization**
  Term Paper, Prof. Rajesh Hegde, IIT Kanpur (Jan-April 2014)
  Modeled speech signals as tensors for an unsupervised monaural source separation algorithm. Based on the algorithm proposed by Barker et. al. which provides a technique for Non-Negative Tensor Factorization (NTF). Performed oracle clustering to estimate the Signal to Distortion Ratio (SDR) to quantify the effectiveness of the algorithm. **[Report] [Presentation]**

- **XOR based Edge Detection**
  Term Paper, Mentor: Dr. Sumana Gupta (Aug-Nov 2014)
  Implemented an edge detection tool based on the ideas and algorithms proposed in a work by Diaconu et. al. Compared to the conventional Sobel, Prewitt and Canny edge detectors. Used comparisions based on visual quality of the edge images obtained. Objective measures MSE and PSNR were also calculated to demostrate the effectiveness of the algorithm. **[Report][GitHub]**

- **Development of Concept of Transitivity in Pre-Operational Stage Children**
  Course Project, Mentor: Dr. Amitabha Mukherjee (Aug-Nov 2014)
  Understanding development of concepts is a complex phenomenon. Hence, we focused on learning of concepts in the age group of 4-7 years. Modifying the existing Piaget Theory Experiments, we incorporated 'quick-learning' aspects and tested them on a group of elementary school students in campus.**[Report][Poster][Video]**

- **2D Mesh Generation** in **12th Indo-European Winter Academy**
  Mentor- Prof. G. Greiner (Dec 2013)
  Studied the traditional 2D-Meshing techniques. Explored Delaunay Traingulation and Voronoi Tesselation and node insertion in existing meshes in detail. This is crucial of enhancing the existing Mesh-Structure of a given 2D image.**[Presentation]**

- **Cellular Network Optimization**
  Summer Project, Prof. A.R. Harish, IIT Kanpur (May-June 2012)
  Designed an automated system for collecting cellular signal data (signal strength & power spectral density) using a portable workstation, Spectrum Analyzer and GPS. Conducted Drive Tests around IIT Kanpur campus to conduct statistical analysis on data collected for the same frequency, but on different dates and times.

RELEVANT COURSES	**Statistical ML**: Mathematics in Machine Learning, Probability and Statistics, Machine Learning Techniques[#], Machine Learning in Computer Vision[#], Statistical & AI Techniques in Data Mining[#]

RELEVANT COURSES

Statistical ML: Mathematics in Machine Learning, Probability and Statistics, Machine Learning Techniques[#], Machine Learning in Computer Vision[#], Statistical & AI Techniques in Data Mining[#]

AI:Artificial Intelligence Programming[#], Introduction to Cognitive Science[*], Image Processing[*]

Mathematics: Linear Algebra, Real Analysis, Complex Analysis, Differential Equations, Partial Differential Equations, Single and Multi-Variate Calculus

Signal Processing and Communications: Signal Systems and Networks, Digital Signal Processing, Principles of Communications, Digital Signal Processing, Information Theory[*]

Algorithms: Data Structures and Algorithms, Fundamentals of Computing

Electrical Engineering: Microelectronics(Analog Circuits), Digital Electronics, Control System Analysis, Power Systems

[*] - 7th Semester, [#] - 8th Semester

TECHNICAL SKILLS

- **Programming Languages** - C, C++, Python, Verilog, SQL
- **Other Tools** - MATLAB, GNU Octave, AutoCAD, LaTeX
- **Development Platforms** - dsPIC, Atmel AVR

POSITIONS OF RESPONSIBILITY

- **DUGC Student Nominee (2014-15)** - Member of the DUGC committee as a student representative. Act as a medium between students and faculty for putting up and resolving grievances related to academic issues.
- **VOX Populi - Editor (2014-15)** - Responsible for writing on pressing issues in the campus to raise awareness amongst my fellow residents and fight for change through the power of words.
- **Academic Mentor(2012-13) & Senior Academic Mentor (2013-14), Counselling Service** - Provided academic assistance, along with taking extra-lectures for students struggling with academics.
- **Student Guide, Counselling Service (2012-13)** - Helping freshers in their transition from school to college life along with emotional assistance.

EXTRA-CURRICULAR/VOLUNTEER

- Created and Managed *"Freshmen Forum"* : website for peer interaction of Freshmen before coming to campus. Remains closed most of the year, but comes in handy during orientation.
- As a part of Electronics-Club, participated and won many events in Teckriti '11,'12, and '13 (Inter-College Technical Festival) including FPGA Design (**First position**), Annotrix-Circuit Design (**First Postition**), Embedded-Design of products using Micro-controllers (**Fifth position**).
- Underwent rigorous *Aquatics and Water-Polo* training in Summer Camp 2012 at IIT Kanpur.
- Part of the high-school orchestra, as a *flutist*, in numerous cultural events.
- Taught middle and high school students Math and Sciences as a *Community Service Initiative* "Reaching Out" at the *Mother's International School (2010)*.

REFERENCES

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