

Facebook Research  
Redmond, WA - 98052

Phone: +1 (412) 245-0913  
Email: [anuragkr@ieee.org](mailto:anuragkr@ieee.org)  
Web: [anuragkr90.github.io](http://anuragkr90.github.io)

## ANURAG KUMAR

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### Current Position

**Research Scientist** at [Facebook Research](#)

### Research Interests

Artificial Intelligence, Machine Learning, Audio and Speech Signal Processing,  
Multimodal Learning

### Education

**Ph.D and M.S, Carnegie Mellon University** Aug. 2013 - Sep. 2018  
Language Technologies Institute, School of Computer Science  
Dissertation: *Acoustic Intelligence in Machines*  
Advisor: Prof. Bhiksha Raj

**Bachelors, Indian Institute of Technology Kanpur** 2008 - 2013  
BTech - MTech Integrated Dual Degree in Electrical Engineering

### Research Experiences

**Research Scientist** at [Facebook Research](#) Dec 2018 - present

**Graduate Research Assistant** at Carnegie Mellon University Aug. 2013 - Sep 2018  
*Machine Learning and Signal Processing Group*  
Advisor: Prof. Bhiksha Raj  
Dissertation Research: Acoustic Intelligence in Machines

**Research Intern** at [Facebook Research](#) May 2017 - Aug. 2017  
*Applied Machine Learning Group.*  
Advisor: [Christian Fuegen](#) and Maksim Khadkevich  
Research Topic: Large Scale Video Understanding Using Audio Content Analysis

**Research Intern** at [Microsoft Research](#) July 2015 - Oct. 2015  
*Multimedia, Interaction, and Communication Group.*  
Advisor: [Dinei Florencio](#)  
Research Topic: Speech Enhancement using Deep Learning

**Undergrad. Researcher** at Indian Institute of Technology Kanpur 2012 - Jun 2013  
*Multimodal Information Processing Systems (MiPS) Lab*  
Advisor: Prof. Rajesh Hegde  
Research Topic: Audio Event Recognition and Detection

**Visiting Undergraduate Researcher** at Carnegie Mellon May 2011 - July 2011  
*Machine Learning and Signal Processing Group*  
Advisor: Prof. Bhiksha Raj and Prof. Richard Stern  
Research Topic: Audio Events, Source Separation, Music Information

Publications *Peer Reviewed (Reverse Chronological Order)*

1. A Sequential Self Teaching Approach for Improving Generalization in Sound Event Recognition.  
**Anurag Kumar**, Vamsi Krishna Ithapu  
37<sup>th</sup> International Conference on Machine Learning (ICML), , 2020
2. Large Scale Audiovisual Learning of Sounds with Weakly Labeled Data.  
Haytham Fayek\*, **Anurag Kumar**\* ( \* Equal Contribution )  
29<sup>th</sup> International Joint Conference on Artificial Intelligence (IJCAI), 2020
3. SeCoST:: Sequential Co-Supervision for Large Scale Weakly Labeled Audio Event Detection.  
**Anurag Kumar**, Vamsi Krishna Ithapu  
45<sup>th</sup> IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), 2020
4. Learning Sound Events from Webly Labeled Data  
**Anurag Kumar** , Ankit Shah , Alexander Hauptmann and Bhiksha Raj  
28<sup>th</sup> International Joint Conference on Artificial Intelligence (IJCAI), 2019
5. Classifier Risk Estimation under Limited Labeling Resources  
**Anurag Kumar**, Bhiksha Raj  
22<sup>nd</sup> Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD), 2018
6. Knowledge Transfer From Weakly Labeled Audio Using Convolutional Neural Network For Sound Events and Scenes  
**Anurag Kumar**, Maksim Khadkevich and Christian Fügen  
43<sup>rd</sup> IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), 2018
7. Content Based Representations Of Audio Using Siamese Neural Networks  
Pranay Manocha, Rohan Badlani, **Anurag Kumar**, Ankit Shah, Benjamin Elizalde and Bhiksha Raj  
43<sup>rd</sup> IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), 2018
8. Framework For Evaluation Of Sound Event Detection In Web Videos  
Rohan Badlani, Ankit Shah, Benjamin Elizalde, **Anurag Kumar** and Bhiksha Raj  
43<sup>rd</sup> IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), 2018
9. Deep CNN Framework for Audio Event Recognition using Weakly Labeled Web Data  
**Anurag Kumar**, Bhiksha Raj  
Neural Information Processing Systems (NIPS) Workshop on Machine Learning for Audio, 2017

10. [NELS - Never Ending Learning of Sounds](#)  
Benjamin Elizalde\*, Rohan Badlani\*, Ankit Shah\*, **Anurag Kumar\***, Bhiksha Raj\*  
Neural Information Processing Systems (**NIPS**) Workshop on Machine Learning for Audio, 2017 (\* Equal Contribution)
11. Discovering Sound Concepts and Acoustic Relations In Text  
**Anurag Kumar**, Bhiksha Raj, Ndapandula Nakashole  
IEEE International Conf. on Acoustics, Speech, and Signal Processing (**ICASSP**), 2017
12. Audio Event and Scene Recognition: A Unified Approach using Strongly and Weakly Labeled Data  
**Anurag Kumar**, Bhiksha Raj  
International Joint Conference on Neural Networks (**IJCNN**), 2017
13. Audio Content based Geotagging in Multimedia  
**Anurag Kumar**, Benjamin Elizalde, Bhiksha Raj  
**Interspeech**, 2017
14. An Approach for Self-Training Audio Event Detectors Using Web Data  
Ankit Shah\*, Rohan Badlani\*, **Anurag Kumar\***, Benjamin Elizalde\* and Bhiksha Raj  
25<sup>th</sup> European Signal Processing Conference (**EUSIPCO**), 2017 (\* Equal Contribution)
15. Audio Event Detection using Weakly Labeled Data  
**Anurag Kumar**, Bhiksha Raj  
24<sup>th</sup> ACM International Conference on Multimedia (**ACM Multimedia**), 2016
16. Weakly Supervised Scalable Audio Content Analysis  
**Anurag Kumar**, Bhiksha Raj  
IEEE International Conference on Multimedia and Expo (**ICME**), 2016
17. Speech Enhancement In Multiple-Noise Conditions using Deep Neural Networks  
**Anurag Kumar**, Dinei Florencio  
**Interspeech**, 2016
18. Experiments on the DCASE Challenge 2016: Acoustic Scene Classification and Sound Event Detection in Real Life Recording  
Benjamin Elizalde\*, **Anurag Kumar\***, Ankit Shah, Rohan Badlani, Emmanuel Vincent and Bhiksha Raj (\* Equal Contribution)  
Workshop on Detection & Classification of Acoustic Scenes and Events (**DCASE**), 2016
19. A Novel Ranking Method For Multiple Classifier Systems  
**Anurag Kumar**, Bhiksha Raj  
IEEE International Conf. on Acoustics, Speech and Signal Processing (**ICASSP**), 2015
20. Detecting Sound Objects In Audio Recordings  
**Anurag Kumar**, Rita Singh, Bhiksha Raj  
22<sup>nd</sup> European Signal Processing Conference (**EUSIPCO**), 2014
21. Monaural Speaker Segregation Using Group Delay Spectral Matrix Factorization  
Karan Nathwani, **Anurag Kumar** and Rajesh Hegde  
20<sup>th</sup> National Conference on Communications (**NCC**), 2014 [**Nominated for Best Paper Award**]

22. Event Detection in Short Duration Audio Using Gaussian Mixture Model and Random Forest Classifier  
**Anurag Kumar**, Rajesh Hegde, Rita Singh and Bhiksha Raj  
21<sup>st</sup> European Signal Processing Conference (**EUSIPCO**), 2013
23. Audio event detection from acoustic unit occurrence patterns  
**Anurag Kumar**, Pranay Dighe, Rita Singh, Sourish Chaudhuri and Bhiksha Raj  
IEEE International Conf. on Acoustics, Speech and Signal Processing (**ICASSP**), 2012

*Non Peer Reviewed: Preprints, Posters and Tech Reports*

6. A Closer Look at Weak Label Learning for Audio Events - Ankit Shah\*, **Anurag Kumar**\*, Alex Hauptmann and Bhiksha Raj (\*Equal Contribution)  
Under review for IEEE Transactions on Multimedia, preprint available on arXiv
5. Large Scale Audio Event Classification using Weak Labels - **Anurag Kumar**, B. Raj  
Poster at Speech and Audio in the Northeast (**SANE**) Workshop, 2017
4. Unsupervised Fusion Weight Learning in Multiple Classifier Systems - **Anurag Kumar**, Bhiksha Raj, , 2015  
An unsupervised method of combining multiple classifiers directly on test data
3. Features and Kernels for Audio Event Recognition - **Anurag Kumar**, Bhiksha Raj  
Comparison of features and SVM kernels for Audio Events, 2016
2. Informedia@ Trecvid 2014: Multimedia Event Detection and Recounting  
CMU Aladdin MED Team, TRECVID Tech Report, 2014
1. Speech Emotion Recognition by AdaBoost Algorithm and Feature Selection for Support Vector Machines - Anurag Kumar, Parul Agarwal, Pranay Dighe, Bhiksha Raj, K Prahallad  
CMU-IIIT IPTSE Winter School, 2010

**Awards  
& Honors**

- Finalist **Qualcomm Innovation Fellowship**, 2017
- **Research Fellowship** at Carnegie Mellon University (2013-2018)
- **Gandhian Young Technological Innovation Awards**, 2017  
National Level Award in India for Scientific Innovation  
Mentored and Advised Incoming CMU Graduate Students on Acoustic Intelligence
- **IEEE Signal Processing Society Travel Grant** for ICASSP 2015
- **Best Paper Award** Nomination at National Conference on Communication (NCC), 2014
- **EURASIP Travel Grant** for European Signal Processing Conference, 2013
- **Samsung Innovations Awards 2012**  
For developing Audio Based Event and Context Recognition System
- **Best Speech Technology** project at Carnegie Mellon University Winter School-2010 held at IIIT Hyderabad, India

- **Accepted for fellowship** from Consultancy Development Center  
Department of Science and Industrial Research, Govt. of India, 2010
- Among Top **0.1%** in IIT Joint Entrance Examination-2008  
Taken by more than 0.5 million students

#### Technical Skills

- Programming Languages: Python, MATLAB, C
- Deep Learning Toolkits: PyTorch, Theano, Lasagne
- Tools and Software Packages: MATLAB, Octave, CVX
- Operating Systems: Linux, Windows

#### Professional Activities

- **Reviewer (Journals)**
  - IEEE Transactions on Audio Speech and Language Processing (TASLP)
  - IEEE Transactions on Signal Processing (TSP)
  - IEEE Transactions on Multimedia (TMM)
  - Neural Networks
  - IEEE Signal Processing Letters (SPL)
  - IEEE Transactions on Emerging Topics in Computational Intelligence (TETCI)
- **Reviewer (Conferences)**
  - International Conference on Machine Learning (ICML)
  - Neural Information Processing Systems ( Neurips )
  - AAAI Conference on Artificial Intelligence ( AAAI )
  - IEEE International Conference on Audio, Speech, and Signal Processing (ICASSP)
  - IEEE International Conference on Multimedia and Expo ( ICME )
  - IEEE Global Conference on Signal and Information Processing (GlobalSIP)
  - Human Computer Interaction: CHI
- **Memberships** - IEEE Member, IEEE Signal Processing Society Member, ACM Member, ISCA Member

#### Teaching Experiences

- Carnegie Mellon University
- Teaching Assistant - Machine Learning and Signal Processing, Fall 2017

- Teaching Assistant - Machine Learning and Signal Processing, Fall 2016

#### Indian Institute of Technology Kanpur

- Teaching Assistant - Control System Laboratory, Fall-2012
- Teaching Assistant - Analog and Digital Circuit Design Lab., Spring 2013

#### Mentorship

##### Interns Advised/Co-Advised

- Raymond Xia, PhD Student CMU
- Panagiotis Tzirakis, PhD Student at Imperial College London
- Sohel Patel, PhD Student at Missouri University of Science and Technology

##### Undergraduate and Masters Students Mentored

- Ankit Shah, MS student at LTI, CMU.
- Rohan Badlani, Undergraduate student at BITS, Pilani.
- Pranay Manocha, Undergraduate student at IIT Guwahati.