Annesya Banerjee

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Research Interest: Auditory Perception, Hearing Prosthetics, Computational Cognitive Science

Education

2021 – 2027 **PhD Candidate, Harvard University**
Program in Speech and Hearing Bioscience and Technology (SHBT)
Thesis Advisor: Dr. Josh McDermott

2017 – 2021 **Bachelor of Engineering, Jadavpur University**
Department of Electronics and Tele-Communication Engineering (ETCE)

Research Experience

May, 2022 – Present **Graduate Research Assistant**, Dept. of Brain and Cognitive Sciences, MIT
Advisor: Dr. Josh McDermott
Project: Neural Network Modeling of Cochlear Implant Mediated Hearing

Jan., 2022 – May, 2022 **Rotation Student**, Massachusetts Eye and Ear, Harvard Medical School
Advisor: Dr. Heidi Nakajima
Project: Design and Validation of Middle Ear Microphones for Fully Implantable Cochlear Implants

Sept., 2021 – Dec., 2021 **Rotation Student**, Massachusetts Eye and Ear, Harvard Medical School
Advisor: Dr. Sunil Puria
Project: Developing Simulation Based Inference Models to Estimate Finite Element Model Parameters of the Middle Ear and Cochlea

May., 2019 – July., 2019 **Undergraduate Research Intern**, Indian Institute of Science (IISc)
Advisor: Dr. Prashanta K. Ghosh
Project:Development of Multichannel Sensor-Based Adventitious Lung Sound Localization System And Assessment Using 3-D Printed Thoracic Phantom

Jan., 2019 – July., 2021 **Undergraduate Research Assistant**, Jadavpur University
Advisor: Dr. P. Venkateswaran
Project: Design and Development of a Drone with Audition Capabilities for Sound Source Localization

Teaching Experience

Sept. 2022 – Dec. 2022 **MIT Brain and Cognitive Sciences**, Teaching Assistant
MIT HST .714 Introduction to Sound, Speech and Hearing
Instructors: Dr. Satrajit Ghosh, Dr. Heidi Nakajima, Dr. Sunil Puria

Technical Skills

Machine Learning	Tensorflow, PyTorch
General Coding	Python, MATLAB, C, LaTeX
Behavioral Research	Amazon Mechanical Turk, Prolific, PsychToolbox
Hardware Design	Microcontrollers (8051, Arduino), Raspberry Pi, Texas Instruments (TI), Digital Signal Processing (DSP) Kit, Analog Devices Analog-Digital-Converters (ADC)
Design Tools	Anaconda, Circuit Maker, Proteus, Xilinx Vivado Suite, COMSOL
Audio Analysis Tools	Audacity, PRAAT

Awards and Achievements

2021
- **Division of Medical Sciences Graduate Student Fellowship** Harvard University.
- **Best Student of the Year 2021 Gold Medal,** Jadavpur University.
- **Best Outgoing Female Student** (Runner Up), IEEE SAARC Countires
- **Dept. of ETCE Gold Medal**, Jadavpur University

2019
- **Supriya Kumar Basu Memorial Fellowship**, Jadavpur University
  Awarded to the Top Rank Holder across all Engineering departments.

2017
- **Jagadish Bose National Science Talent Search Senior Fellowship**
  Awarded to 30 students chosen Nationally through a highly competitive three-level examination to support their Undergraduate education.

Grants Awarded

2021-2022
- **5G-enabled Listener Drone: Integrating 5G with Acoustic Drone for Disaster Relief**
  Department of Telecommunications, Govt. of India
  Amount: INR 6,00,000

2020
- **Design of Portable Ventilators for COVID-19 Crisis**
  University of California, Berkely, USA
  Amount: USD 1,000

2019-2020
- **Listener Drone: Incorporating Audition Abilities in Drones and Potential Application for Search and Rescue Operations**
  WeRobotics, USA
  Amount: USD 15,000

Research Publications/Posters/Presentations

2023
- An Implantable Piezofilm Middle Ear Microphone: Performance in Human Cadaveric Temporal Bones. Zhang, J., Graf, L., **Banerjee, A.**, Yeiser, A., McHugh, C., Kymissis, J., Olson, E., Nakajima, H., Lang, J. Journal of the Association for Reasearch in Otolaryngology (JARO). [Submitted]
- Neural Network Models of Hearing Through a Cochlear Implant. **Banerjee, A.**, Saddler, M., McDermott, J. 46th Mid-Winter Meeting Association for Reasearch in Otolaryngology (ARO).

2022
- A Comparison of Implantable Microphones Constructed Around a Piezoelectric Polymer. Zhang, J.*, Yeiser, A.*, **Banerjee, A.***, Cary, B., Graf, L., McHugh, C., Kymissis, J., Olson, E., Nakajima, H., Lang, J. Mechanics of Hearing (MoH) Presentation. *equal contributions
- Implantable Piezoelectric-Polymer Microphones for the Middle Ear. Yeiser, A.*, **Banerjee, A.***, Zhang, J., Graf, L., McHugh, C., Song, Y., Kymissis, J., Olson, E., Nakajima, H., Lang, J. Symposium on Middle Ear Mechanics in Research and Otology (MEMRO) Presentation. *equal contributions
- Training a Machine-Learning Differential Diagnostic Tool for Conductive Hearing Loss Using Mechanistic Models. Motallebzadeh, H., Deistler, M., Schönleitner, F., **Banerjee, A.**, Macke, J., Puria, S. Symposium on Middle Ear Mechanics in Research and Otology (MEMRO) Presentation.
- A residual network-based deep learning model for the detection of COVID-19 using cough sounds. **Banerjee, A.** and Nilhani, A. Artificial Intelligence Strategies for Analyzing COVID-19 Pneumonia Lung Imaging, 1, p.6. **[Invited Paper]**

2021
- A novel sound source localization method using a global-best guided cuckoo search algorithm for drone based search and rescue operations. **Banerjee, A.**, Nilhani, A., Dhabal, S., Venkateswaran, P. In Unmanned Aerial Systems: Theoretical Foundation and Applications, pp. 377-417, Elsevier. DOI: https://doi.org/10.1016/B978-0-12-820276-0.00022-4

Patents

2022 **Annesya Banerjee**, Achal Nilhani. An intelligent cough and speech sensing visual monitoring device. Intellectual Property of India #399949

Invited Talks and Presentations

October, 2022 **SHBT End of Summer Talk, Harvard Medical School** - Plymouth, MA

October, 2020 **Dept. of Telecommunications, India** - India Mobile Congress (Virtual due to Covid)

May, 2020 **Overseas Volunteers for a Better India (OVBI) Foundation** - Virtual (due to Covid)

February, 2020 **Jyangra High School** - Kolkata, India

WeRobotics Unusual Solutions Final Pitch Event - Nairobi, Kenya

Outreach/Leadership Activities

Feb. 2023 – Present **Mentoring Co-Chair**, Harvard Graduate Women In Science and Engineering

Jan. 2023 – Present **Seminar Co-ordinator**, Science In The News (SITN)

Feb. 2023 – May. 2023 **Teaching Assistant**, Program of Ragon and IMES in Science and Medicine
Topic - Introduction to Neuroscience; Target level - High School students.

Oct. 2022 **Volunteer**, Cambridge Science Festival
Demonstrated and explained the science of auditory illusions to general public.

2020 – Present **Co-Founder**, JU UAV Innovators Lab
Non-profit educational organization to provide scientific (software and hardware resources) to students for open-source project development.

2018 – 2021 **Team Leader**, Team Jadavpur University
IEEE Signal Processing Cup 2019 (Rank: 13), IISc DiCOVA Challenge 2021 (Rank: 16), Microsoft Deep Noise Suppression Challenge 2021 (Rank: 14)

Mentor, Jadavpur University Science Club
Mentored 150+ freshmen, sophomores in Rudimentary Robotics, Circuit Design, etc.

Organizing Member, Annual Science Workshop, Jadavpur University
Hosts 100+ high school students annually for 2 days workshop on Experimental Physics, Chemistry, Basic Robotics.

Personal Projects

April'20 – June'21 **Viral Cough Cop Device**: An intelligent, **low-cost (under $135)** device for first-level screening and identification of potential COVID-19 suspects in public places. Project selected as one of the **Top 32 Global Finalists** of Microsoft and HCL organized Better Health Hackathon 2020

Feb'21 – April'21 **Moog-Emotion**: A personalized musical instrument to simulate human emotion through speech. Assistive device for healing mental stress, depression and other psychological disorders
Project selected for demonstration at **Guthman Musical Instrument Fair 2021** organized by Georgia Institute of Technology. Received **Best Hardware Project** and **Best Presentation Award** by Syracuse University.
Project blog at: https://devpost.com/software/moog-emotion

Personal Projects (continued)

Oct'20 – May'21 — **B.A.T. - Bio Acoustics Tracker**: Worked on the hardware development and algorithm development for a wireless, portable device based system for continuous monitoring and conservation of urban biodiversity using species (birds, insects, animals, etc.) specific call identification. First round of field study performed at A.J.C. Bose Indian Botanic Garden, Kolkata.
Project supported by **Texas Instruments** Innovation Lab at Jadavpur University.

Aug'20 – Oct'20 — **AuDiNoise: A deep learning based hybrid filtering approach for acoustic noise suppression.** : Developed Deep Learning + Adaptive Filtering based a hybrid algorithm for joint estimation and suppression of noises from audio signals during teleconferencing.

Aug'20 – Nov'20 — **Echo Debar: Real-Time Acoustic Echo Cancellation by Joint Implementation of Adaptive Filtering and Deep Learning**: Developed a novel acoustic echo cancellation algorithm that uses classical signal processing filters combined with multi-layer Deep learning model for real-time echo elimination in telecommunication devices.

March'20 – May'20 — **COVENTILATOR: Development of Low-Cost Ventilators for Patients during COVID-19 Pandemic**: Worked as the Technical Leader in a team of 6 members. Designed a **lowcost (<$300), easily deployable, medical grade** ventilator system for COVID-19 patients. Available at only 1/10th the cost of ICU ventilators. Served as the ***Leader*** of an *International* team of 6 members. Our design was selected as the **Winner Project** by University of California Berkeley CEND Hackathon 2020.