BIOGRAPHICAL SKETCH

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NAME: Nima Mesgarani

eRA COMMONS USER NAME (credential, e.g., agency login): nmesgarani

POSITION TITLE: Associate Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Sharif University of Technology, Iran	B.S.	05/99	Electrical Engineering
University of Maryland, College Park, MD	M.Sc., Ph.D.	05/08	Electrical and Computer Engineering
Johns Hopkins University	Postdoctoral	09/10	Center for Language and Speech Processing
University of California San Francisco	Postdoctoral	09/13	Neurosurgery Department

A. Personal Statement

My area of research, understanding the mechanisms underlying robust audio processing in the auditory system, requires both knowledge of audio signal processing as well as extensive experience in cortical neurophysiology. I supplemented my background in speech signal processing, acquired by undergraduate and graduate study in Electrical Engineering, with postdoctoral research at Center for Language and Speech Processing at Johns Hopkins University, and work experience at IBM Research and Applied Physics Laboratory. I started cortical neurophysiology as part of my Ph.D. research in Neural System Laboratory at University of Maryland. This effort resulted in several publications on neurophysiology of speech representation in mammalian auditory pathway and computational models inspired by these findings. Through further training under Dr. Edward Chang in the Neurosurgery Department of University of California San Francisco, I acquired the necessary training in psycholinguistics, and human invasive cortical neurophysiology. The interdisciplinary approach of my group at Columbia University aims to bridge the gap between audio signal processing and neurolinguistics by reverse engineering the signal processing in the brain, which in turns inspires novel computational algorithms to model and emulate human abilities, and new hypotheses that can be tested experimentally. For my research, I have received an NSF Early Career Award and a Pew Scholar Award in the Biomedical Sciences.

B. Positions and Honors

Positions and Employment

2007-2009 Consultant, Southwest Research Institute, TX
2010-2013 Consultant, BBN Technologies, Boston, MA
2013-2017 Assistant Professor, Department of Electrical Engineering, Columbia University, New York, NY
2017-present Associate Professor, Department of Electrical Engineering, Columbia University, New York, NY

Other Experience and Professional Memberships

1995- Member, Society for Neuroscience
1998- Member, Association for Research in Otolaryngology

1998- Member, IEEE

Honors

2005 Outstanding Systems Engineering Graduate Student Award, University of Maryland, MD
2007 Best Speaker Award, University of Maryland, MD
2009 Award for Academic Enhancement of Graduate Student, University of Maryland, MD
2015 Early career scholarship in Biomedical Sciences, The Pew Charitable Trust
2016 Early career award, National Science Foundation (NSF)
2018 Top 10 most significant and promising tech innovator of the year award for brain-controlled hearing aid, UNICEF, Paris
2018 Grant prize winner at NYC Media Lab competition for brain-controlled hearing aid, New York
2018 Young investigator Award, Advances and perspectives in auditory neuroscience community

C. Contributions to Science

1. **Neurophysiology of speech perception.** Using the latest advances in invasive and non-invasive human recording techniques, my group has uncovered fundamental characteristics of cortical speech processing in the human auditory cortex. This includes the representational properties of speech processing in primary and non-primary auditory areas, integration of spatial and spectrotemporal cues in this representation, and top-down modulation of the neural responses mediated by attention.

a. Khalighinejad, B., Herrero, J., Mehta A., **Mesgarani, N.**, (2019), Adaptive noise reduction in the human auditory cortex, *Nature Communication*
b. Patel, P., Long, L. K., Herrero, J. L., Mehta, A. D., & **Mesgarani, N.** (2018). Joint Representation of Spatial and Phonetic Features in the Human Core Auditory Cortex. *Cell reports*, *24*(8), 2051-2062.
c. Khalighinejad, B., Cruzatto da Silva, G., **Mesgarani, N**., (2017) Dynamic Encoding of Acoustic Features in Neural Responses to Continuous Speech, *Journal of Neuroscience*
d. **N. Mesgarani**, E. F. Chang, (2012) "Selective cortical representation of attended speaker in multi-talker speech perception", *Nature* 485, PMID: 22522927

2. **Neuro-inspired computational models of speech perception**. Our research in this area focuses on advancing and refining computational neural network models that are designed for speech processing. These models which are inspired by the properties of the biological neural networks are able to model and learn complex mappings that are necessary to solve difficult problems such as speech separation, speech enhancement, and speech recognition. In parallel, we aim to form a better understanding of the representation and transformation performed by these models so that we can identify their limitations and compare them accurately with their biological counterparts, thereby reducing the performance gap between biological and artificial computing.

a. Luo, Y., **Mesgarani, N.**, (2019), Conv-TasNet: Surpassing ideal time-frequency magnitude masking in real-time speech separation*, IEEE/ACM Transaction on Speech and Audio Signal Processing*
b. Luo, Y., Chen, Z. and **Mesgarani, N**., (2018), Speaker-independent Speech Separation with Deep Attractor Network. IEEE/ACM Transactions on Audio, Speech, and Language Processing
c. Nagamine, T. and **Mesgarani, N.**, (2017), Understanding the Representation and Computation of Multilayer Perceptron: A Case Study in Speech Recognition. In International Conference on Machine Learning (ICML) (pp. 2564-2573).
d. Nagamine, T., Chen, Z., **Mesgarani, N.**, (2016), Adaptation of neural networks constrained by prior statistics of node co-activations, In proceedings of the Sixteenth Annual Conference of the International Speech Communication Association, Interspeech

3. **Speech brain computer interfaces**. As we better understand how speech communication occurs in healthy brains, we are better able to devise experiments and therapeutic approaches to help those suffering from speech disorders. For example, individuals who suffer from hearing loss have great difficulty attending to one speaker in a group of many speakers. We have developed methods that integrate the latest advances in deep learning with neural signal processing to create brain-controlled auditory attention decoders, and to reconstruct intelligible speech from the neural activity in the brain of a listener.

a. Han, C., O'Sullivan, J., Lu, Y., Herrero, J., Mehta, A., **Mesgarani, N**., (2019), Speaker independent auditory attention decoding without access to clean sources, *Science Advances*
b. Akbari, H., Khalighinejad, B., Herrero, J., Mehta, A., **Mesgarani, N**., (2019), Reconstructing intelligible speech from the human auditory cortex, *Scientific Reports*, 350124
c. O'Sullivan, J., Chen, Z, Herrero, J., McKhann, M. G., Sheth, A. S., Mehta, A. D., **Mesgarani, N.,** (2017), Neural decoding of attentional selection in multi-talker environments without access to clean sources, *Journal of Neural Engineering*
d. Mesgarani, N., Cheung, C., Johnson, K., Chang,. E., (2014), Phonetic feature encoding in human superior temporal gyrus, *Science*, 343-6174

D. Research Support

Ongoing Research Support

IIS-1555079 Career Award (Mesgarani) 06/01/2016-05/31/2021
National Science Foundation
Biologically inspired neural network models for robust speech processing
The aim of this proposal is to analyze and transform the artificial neural network models to accurately reflect the computational and organizational principles of biological systems.

5R01DC014279-05 (Mesgarani) 03/01/2015-02/29/2020
NIH/NIDCD
Neurophysiology of robust speech perception in human superior temporal gyrus
The goal of this proposal is to understand the mechanisms underlying speech perception in challenging environments as a crucial step in determining how these processes deteriorate in various disorders of peripheral and central auditory pathways.

5R21MH114166-02 (Mehta) 07/01/2017-06/30/2020
NIH/NIMH (through Feinstein Institute for Medical Research)
Neurophysiology of Auditory Emotion Recognition in the Human Brain
The goal of this proposal is to study how the brain codes the emotional content of speech and how stimulating specific brain areas can potentially improve this process.
Role: Site PI

MIT 7000410874 (Smalt) 11/01/217-10/31/2019
Department of Air Force (through MIT)
A Brain Computer Interface for a New Approach to Hearing Aid Design
The goal of this project is to reduce the cognitive burden of isolating a single speaker in background noise, both for normal and hearing-impaired warfighters and civilians.
Role: Site PI

Completed Research Support

RISE Award (Mesgarani, Sheth) 01/01/2016-12/31/2017
Columbia University Research Initiatives in Science and Engineering
Neurobiology of Robust Speech Perception in Human Auditory Cortex.
The goal of this project is to enhance our understanding of the normal physiology of speech processing, and provide insight for developing therapeutic options for individuals with disorders of speech and language. Role: Co-PI