MENOUA KESHISHIAN

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Education

Columbia University, Graduate School of Arts and Sciences — New York, NY
Doctor of Philosophy, Electrical Engineering — 2017 – Expected Dec. 2023
Master of Philosophy, GPA: 3.95 — 2017 – 2022
Master of Science, GPA: 4.13 — 2017 – 2019

Sharif University of Technology, School of Electrical Engineering — Tehran, Iran
Bachelor of Science, Electrical Engineering — 2012 – 2017
Minor, Computer Science

Research Experience

Columbia University, Department of Electrical Engineering — New York, NY
Graduate Research Assistant — 2017 – Present
Advisor: Nima Mesgarani, Ph.D.

Contributed to and led multiple research projects. A summary of some of the projects:

- *Interpretable models of stimulus-response mapping*: modeling the response of neurons in the auditory cortex to sound stimuli is traditionally done using linear spectro-temporal receptive fields (STRF) because of their interpretability. We leveraged the power of deep neural networks and a Jacobian-based model interpretation method to introduce the dynamic STRF (dSTRF). We used this method to discover new dynamics of the stimulus-response mapping in the auditory cortex.
- *Analyzing temporal context of stimulus-response mapping*: a fundamental characteristic of a time-series model is the temporal extent of the stimulus that it integrates to form its response. We used a method developed for studying temporal integration in biological systems to study a specific artificial system – automatic speech recognition. We discovered how the model changed its temporal integration window in different conditions.
- *A neural data processing toolbox*: we developed a python package for preprocessing and analyzing time-series neural data like electrocorticography, especially in response to auditory stimuli.
- *Linguistic components of speech processing*: in the speech processing pathway of the human brain, linguistic representations of the heard speech emerge in a hierarchy. We used manually extracted linguistic features of the speech stimulus and a ridge regression method to determine how different levels of linguistic information are coded in different brain regions. We then compared these results to the linguistic representation computed on an automatic speech recognition model, analyzing the similarities (and differences) of the brain and the artificial model.

Inst. for Research in Fundamental Sciences, Brain Engineering Center — Tehran, Iran
Research Assistant — 2017
Advisor: Reza Lashgari, Ph.D.

Analyzed local field potential (LFP) and single unit activity (SUA) recorded from the primary visual cortex of macaque monkeys as they were attending to a visual attention task, to determine the relationship between features extracted from simultaneously recorded LFP and SUA.

Awards and Achievements

Columbia University, Department of Electrical Engineering — New York, NY
MS Award of Excellence (awarded to fewer than 5% of the EE MS candidates) — 2020
MS Armstrong Memorial Award (awarded to one outstanding EE MS candidate) — 2019

Tehran, Iran
33rd place in Iran's National University Entrance Exam (top 0.01%) — 2012
Bronze medal in Iran's National Computer Olympiad — 2011

Publications

naplib-python: Neural Acoustic Data Processing and Analysis Tools in Python. Mischler, G, Raghavan, V, Keshishian, M, Mesgarani, N. *Software Impacts (2023)*

Joint, distributed and hierarchically organized encoding of linguistic features in the human auditory cortex. Keshishian M, Akkol S, Herrero J, Bickel S, Mehta AD, Mesgarani N. *Nature Human Behaviour (2023)*

Deep neural networks effectively model neural adaptation to changing background noise and suggest nonlinear noise filtering methods in auditory cortex. Mischler G, Keshishian M, Bickel S, Mehta AD, Mesgarani N. *NeuroImage (2023)*

Understanding Adaptive, Multiscale Temporal Integration In Deep Speech Recognition Systems. Keshishian M, Norman-Haignere S, Mesgarani N. *Advances in Neural Information Processing Systems 34 (2021)*

Estimating and interpreting nonlinear receptive field of sensory neural responses with deep neural network models. Keshishian M, Akbari H, Khalighinejad B, Herrero J, Mehta AD, Mesgarani N. *eLife (2020)*

Skills

Programming languages (years experience)
Python (10), Rust (2), MATLAB (10), Java (5), C++ (5)

ML frameworks
PyTorch, TensorFlow, Hugging Face Transformers, scikit-learn

Teaching Experience

Columbia University, Department of Electrical Engineering, *Teaching Assistant* — New York, NY
Quantum Computing and Communication, Dr. Alexei Ashikhmin — Fall 2021
Sparse & Low-dimensional Models for High-dimensional Data, Dr. John Wright — Spring 2021

Languages

English (Fluent), Armenian (Native), Persian (Native)