Josh Chartier, PhD

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Education

UC Berkeley and UC San Francisco   **Berkeley and San Francisco, CA**
Bioengineering, PhD, GPA: 3.83   *2014–2019*
Adviser: Edward Chang, MD, Major: Machine Learning, Minor: Neuroscience

Rice University   **Houston, TX**
Electrical Engineering, BS, GPA: 3.78   *2010–2014*

Relevant Experience

The University of California, San Francisco – The Chang Lab   **San Francisco, CA**
Postdoctoral Scholar; PhD Candidate, PI: Edward Chang, MD   *2015–Present*
Overview: Investigating the neural mechanisms underlying natural speech production and developing algorithms to decode speech from brain (electrocorticographic) signals.

○ Can we build a speech brain-computer interface (BCI) to restore communication to those who cannot speak? (Ongoing)
  - Leading a team to build a low-latency ($<$50 ms) closed-loop system with deep learning to synthesize speech decoded from neural activity in real-time.
  - Running a clinical trial with patients that have chronic neural implants to iteratively develop and evaluate our system.
○ Can we decode and synthesize speech from brain signals? (Published in Nature, 2019; Press Release)
  - Designed a LSTM-based recurrent neural network (RNN) in Tensorflow that explicitly leverages kinematic and sound representations encoded in human cortical activity to synthesize audible speech.
  - Listeners could readily identify and transcribe speech synthesized from cortical activity for the first time ever.
  - Findings advance the clinical viability of speech neuroprosthetic technology to restore spoken communication.
○ How is the sensorimotor cortex involved in speech production? (Published in Neuron, 2018 ; Press Release)
  - Collected and processed (Python Pandas) simultaneous time-series recordings of acoustic and neural (256 electrodes) data while each subject read several hundred sentences.
  - Developed trajectory encoding models with ridge regression in Python (NumPy, SciPy, and scikit-learn) that revealed distinct populations of neurons responsible for specific vocal tract movement patterns that are needed to produce fluent speech.
  - Analysis with hierarchical clustering, PCA, and mixed effects models paint a detailed view of how the sensorimotor cortex is involved in speech and present a new path for neural speech prosthetic development.

Google   **San Francisco, CA**
Software Engineering Intern, Daydream   *Spring 2019*
○ Researched and implemented methods that bring large-scale convolutional neural networks (CNN) for image applications to devices with limited compute and memory budgets.
○ Built out proof-of-concept models and training paradigms, and demonstrated up to 75% reduction in parameters while maintaining performance in a working product.

Relevant Projects

Integrated Vitals Monitoring from a Distance   **Houston, TX**
Senior Design – Rice Unversity   *2013-2014*
Overview: In a team of five, designed and built a non-invasive device for use with prematurely-born infants that contactlessly measures heart rate, respiratory rate, and temperature with $<$1% error rates.
○ Tracked user motion in real-time with a random forest algorithm anatomically segmenting infrared depth sensor data.
○ Extracted heart rate with FFT from hemoglobin dynamics gained by focusing an additional infrared camera at user's forehead.
○ Measured temperature and adjusted for humidity errors with a infrared thermometer and hygrometer on a custom PCB.
○ Targeted thermometer and infrared camera at user with Arduino-controlled servos with body segmentation feedback.

Computer Languages and Programs

Main: Python (NumPy, SciPy, Pandas, PyTorch, TensorFlow, scikit-learn)

Experienced: MATLAB

Less Experienced: C/C++, Java, R

Other: LaTeX, MS Office, Linux, Git, Asana, Illustrator

Other Experience

Rice University – Rice Realtime Neural Engineering Lab Houston, TX
Undergraduate Researcher, PI: Caleb Kemere, PhD *2012–2014*
- Spearheaded the lab's first *in vivo* rodent electrophysiology memory-maze experiment with Open-Ephys resulting in an experimental setup currently employed by the lab.

The University of California, San Francisco – The Sabes Lab San Francisco, CA
Visiting Researcher, PI: Philip Sabes, PhD *Summer 2013*
- Developed optogenetic tools for manipulating neural activity in non-human primates to study sensory integration.

Columbia University – Laboratory for Intelligent Imaging and Neural Computation New York, NY
Amgen Scholar, PI: Paul Sajda, PhD *Summer 2012*
- Designed and implemented a genetic algorithm in MATLAB to optimize parameters for logistic regression classification (improved accuracy 3.7% to 98%) of electroencephalography (EEG) data from perceptual binary decision tasks (Poster at CNS, 2013).

Baylor College of Medicine and Rice University – The Dabaghian Lab Houston, TX
Undergraduate Researcher, PI: Yuri Dabaghian, PhD *2011–2012*
- Related hippocampal local field potentials in CA1 and dentate gyrus (DG) to behavior in a fear-memory experiment with spectral and statistical methods in MATLAB to assess differences between MCEP2 mutated (Rett syndrome) and wild-type mice.

Publications

- Anumanchipalli G.*, **Chartier J.***, Chang E. (2019) Speech synthesis from neural decoding of spoken sentences. Nature, 568(7753), 493. Link
- **Chartier J.***, Anumanchipalli G.*, Johnson K., Chang E. (2018) Encoding of articulatory kinematic trajectories in human speech sensorimotor cortex. Neuron, 98(5), 1042-1054.e4. PDF

Selected Talks and Poster Presentations

- **Chartier J.** A brain-computer interface for speaking. *European Forum Alpach* (2019), Alpach, Austria. (Plenary talk)
- **Chartier J.** Café des Sciences/RedX lectures: Panel on brain implants. (2019), San Francisco, CA. (Invited Talk)
- Anumanchipalli G.*, **Chartier J.***, Chang E. Intelligible speech synthesis from neural decoding of spoken sentences. *Society for Neuroscience Annual Meeting* (2018), San Diego, CA. (Poster)
- **Chartier J.** Encoding of articulatory movements in speech sensorimotor cortex. *SfN satellite – Neural mechanisms of feeding and swallowing and their applications to neural rehabilitation* (2018), San Diego, CA. (Invited talk)
- **Chartier J.**, Encoding of articulatory movements in the sensorimotor cortex. *Brain Computer Interface Meeting* (2018), Pacific Grove, CA. (Invited talk)
- Anumanchipalli G.*, **Chartier J.***, Chang E. Synthesizing speech from the human sensorimotor cortex. *Cosyne* (2018), Denver, CO. (Poster)
- **Chartier J.**, Encoding of articulatory movements in the sensorimotor cortex. *Center for Neural Engineering and Prosthetics Retreat* (2017), Berkeley, CA. (Talk)
- **Chartier J.***, Anumanchipalli G.*, Johnson K., Chang E. Encoding of articulatory kinematic trajectories in human speech sensorimotor cortex. *Society for Neuroscience Annual Meeting* (2017), Washington, DC. (Poster)
- **Chartier J.***, Anumanchipalli G.*, Johnson K., Chang E. Encoding of articulatory kinematic trajectories in human speech sensorimotor cortex. *Society for the Neurobiology of Language Meeting* (2017), Baltimore, MD. (Poster)
- **Chartier J.***, Anumanchipalli G.*, Chang E. Articulatory gesture encoding in human sensorimotor cortex during continuous speech production. *Cosyne* (2017), Salt Lake City, UT. (Poster)
- Anumanchipalli G.*, **Chartier J.*** Gestural features in the behavior and brain, *Interspeech: 1st Workshop on Speech Engineering and Computational Neuroscience of Speech* (2016), San Francisco, CA. (Talk)

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*Equal contribution or co-presentation