

Josh Chartier, PhD

San Francisco, CA

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Education

UC Berkeley and UC San Francisco

Bioengineering, PhD, GPA: 3.83

Berkeley and San Francisco, CA

2014–2019

Adviser: Edward Chang, MD, Major: Machine Learning, Minor: Neuroscience

Rice University

Electrical Engineering, BS, GPA: 3.78

Houston, TX

2010–2014

Experience

The Chang Lab – The University of California, San Francisco

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)
 - Building a closed-loop system with deep learning to synthesize speech decoded from neural activity in real-time.
 - Running a pilot study with patients that have chronic neural implants to iteratively develop and evaluate our device.
- Can we decode and synthesize speech from brain signals? (Published in [Nature](#), 2019; [Press Release](#))
 - Designed a LSTM-based recurrent neural network 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.
 - Decoder could synthesize speech even when a participant silently mimed sentences.
 - 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 recordings of acoustic and neural (256 electrodes) data while each subject read several hundred sentences.
 - Developed trajectory encoding models in Python (NumPy, SciPy, and sklearn) that revealed distinct populations of neurons responsible for specific vocal tract movement patterns that are needed to produce fluent speech.
 - Findings 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 neural networks to devices with limited compute and memory budgets.

Rice Realtime Neural Engineering Lab – Rice University

Houston, TX

Undergraduate Researcher, PI: Caleb Kemere, PhD

2012–2014

Overview: Spearheaded the first *in vivo* rodent electrophysiology memory-maze experiment with Open-Ephys in the lab resulting in an experimental setup currently employed by the lab.

- Developed pilot study to analyze role of the hippocampal-VTA loop in long-term memory encoding. Procedure: constructed experimental setup that is still in use, pretrained 5 rats on a memory-maze task, planned craniotomy with brain atlas, assisted in microdrive implantation surgery, lowered tetrodes into position over three weeks and recorded resulting neural activity daily.
- Constructed three 64-channel microdrives and accompanying PtIr tetrodes to be implanted in rats for electrophysiology experiments; the 40 hour process involved microscope work, soldering, gold plating, and impedance testing.

The Sabes Lab – The University of California, San Francisco

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.

Laboratory for Intelligent Imaging and Neural Computation – Columbia University

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 of electroencephalography (EEG) data from perceptual binary decision tasks (Poster at CNS, 2013).

The Dabaghian Lab – Baylor College of Medicine and Rice University

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.

Relevant Projects

Integrated Vitals Monitoring from a Distance

Houston, TX

Senior Design – Rice University

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.
- Captured respiratory rate by computing spectral information with the Fast Fourier Transform (FFT) from 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.
- Developed code in C++ to allow for real-time motion tracking and vitals collection from user and displayed vitals in a Qt GUI.
- 3D printed custom device casing designed in SolidWorks.

Computer Languages

Main: Python (NumPy, SciPy, Pandas, TensorFlow, sklearn)

Less Experienced: C/C++, Java

Experienced: MATLAB

Other: L^AT_EX, MS Office, Linux

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,

Awards and Achievements

2016: NSF GRFP Honorable Mention

2014: IEEE Eta Kappa Nu - Theta Ro Chapter Member

2013: Rice Engineering Alumni Junior Merit Award

2013: 3rd place in the Circuit Design Competition at the IEEE Region 5 Annual Meeting

*Equal contribution or co-presentation