# Gabriel Schamberg

**gabes@mit.edu**

## Education

**PhD Electrical Engineering** August 2019
*Electrical and Computer Engineering Department, University of California, San Diego (UCSD)*

**MS Electrical Engineering** June 2016
*Electrical and Computer Engineering Department, UCSD*

**BS Computer Engineering** June 2012
*Computer Science and Engineering Department, UCSD*

## Research

**Postdoctoral Fellow** October 2019 – Present
*Picower Institute for Learning and Memory, Neuroscience Statistics Research, MIT*

- built statistical state-space models for tracking a subject's level of unconsciousness from human electroencephalogram recordings
- developed a reinforcement learning paradigm for automatic titration of anesthetic drugs during anesthesia

**Graduate Student Researcher** December 2014 – August 2019
*Neural Interaction Lab, UCSD*

- proposed novel approaches for measuring and estimating causal influence using information theory
- created a novel framework for estimating latent time series with non-Markov priors

**Undergraduate Student Researcher** January 2012 – June 2012
*San Diego Supercomputer Center, UCSD*

- assisted in data collection for design of the "10×10 processor" by running performance benchmarks on an array of different GPUs

## Teaching

**Co-Instructor, Statistics for Neuroscience Research (9.073)** Spring 2021 *(In preparation)*
*Brain and Cognitive Science Department, MIT*

- **Details:** graduate-level; 3 hrs/week; 13 weeks
- **Roles:** preparing/delivering lectures (50%); creating HW
- **Topics:** random variables; estimation; statistical testing; spectral analysis; state-space modeling

**Co-Instructor, Topics in Neural Signal Processing (9.272)** Spring 2020
*Brain and Cognitive Science Department, MIT*

- **Details:** 19 students (12 enrolled/7 listeners); graduate-level seminar series; 3 hrs/week; 13 weeks
- **Roles:** inviting/organizing guest lectures; advising final projects
- **Topics:** statistical modeling; physiologic control; neural imaging; Granger causality

**Instructor, Fundamentals of Engineering Applications (ENG 10)** Summer 2018
*Jacobs School of Engineering, UCSD*

- **Details:** 30 students; undergraduate-level; 6 hrs/week; 5 weeks
- **Roles:** developing curriculum; preparing/delivering lectures; creating labs; advising projects
- **Topics:** engineering math fundamentals; Python programming; Arduino-based project; 3D printing

**Instructor, Introduction to Engineering III (ENG 3)** Spring 2016
*Jacobs School of Engineering, UCSD*

- **Details:** 7 students; undergraduate-level, 2 hrs/week; 10 weeks

- **Roles:** developing curriculum; preparing/delivering lectures; creating HW/labs/quizzes
- **Topics:** engineering design process; design challenges; Arduino programming

**Instructor, Introduction to Engineering II (ENG 2)** Winter 2015
*Jacobs School of Engineering, UCSD*

- **Details:** 18 students; undergraduate-level, 2 hrs/week; 10 weeks
- **Roles:** developing curriculum; preparing/delivering lectures; creating HW/labs/quizzes
- **Topics:** mathematical programming with Python; multivariable calculus; differential equations

**Instructor, Introduction to Engineering I (ENG 1)** Fall 2015
*Jacobs School of Engineering, UCSD*

- **Details:** 31 students; undergraduate-level, 2 hrs/week; 10 weeks
- **Roles:** developing curriculum; preparing/delivering lectures; creating HW/labs/quizzes
- **Topics:** mathematical programming with Python; trigonometry; calculus

## Industry Experience

**Analytics Research Intern** June 2017 – September 2017
*CoreLogic*

- built a convolutional neural network for identifying homes with solar panels from satellite images
- conducted detailed performance analyses and visualizations of mortgage fraud detection model

**Software Developer** May 2014 – July 2014
*Ziva Corporation*

- wrote automated start-up and failure check routines for software defined radios

**Software Developer** October 2012 – April 2014
*NKI Engineering*

- developed software for testing conformance of encryption routers
- designed a software defined radio system for simultaneously monitoring and recording multiple channels with a single receiver

**Software Developer (Part-time)** June 2011 – December 2011
*Teradata*

- created automated tests for database management software

## Publications

**In Review**

- J. H. Abel*, M. A. Badgeley*, B. Meschede-Krasa, **G. Schamberg**, I. C. Garwood, K. Lecamwasam, S. Chakravarty, D. W. Zhou, M. Keating, P. L. Purdon, and E. N. Brown, "Machine Learning of EEG Spectra Classifies Unconscious States During Propofol-Induced Anesthesia."
- A. Shanker, J. H. Abel, P. Mathur, E. Work, **G. Schamberg**, A. Sharkey, R. Bose, V. Rangasamy, V. Senthilnathan, E. N. Brown, and B. Subramaniam, "Perioperative Multimodal General Anesthesia Focusing on Specific CNS Targets in Patients Undergoing Cardiac Surgeries: The PATHFINDER Study."

**Journal Publications**

- **G. Schamberg**, W. Chapman, S. Xie, and T. P. Coleman, "Direct and Indirect Effects: An Information Theoretic Approach," *Entropy*, Volume 22, Issue 8, August 2020
- **G. Schamberg** and T. P. Coleman, "Measuring Sample Path Causal Influences with Relative Entropy," *IEEE Transactions on Information Theory*, Volume 66, Issue 5, October 2019
- A. Allegra, A. Gharibans, **G. Schamberg**, D. Kunkel, and T. P. Coleman, "Bayesian Inverse Methods for Spatiotemporal Characterization of Gastric Electrical Activity from Cutaneous Multi-Electrode Recording," *PLoS One*, Volume 14, Issue 10, October 2019

- **G. Schamberg**, D. Ba, and T. P. Coleman, "A Modularized Efficient Framework for Non-Markov Time Series Estimation," *IEEE Transactions on Signal Processing*, Volume 66, Issue 12, June 2018.

**Conference Proceedings**

- **G. Schamberg***, S. Chakravarty*, T. Baum, and E. N. Brown, "Inferring neural dynamics during burst-suppression using a neurophysiology-inspired switching state-space model," *IEEE Asilomar Conference on Signals, Systems, and Computers*, November 2020 (To appear).
- W. De Faria, **G. Schamberg**, and E. N. Brown, "Classifying EEG of Propofol-Induced Unconsciousness in the Presence of Burst Suppression," *IEEE MIT Undergraduate Research Technology Conference*, October 2020.
- **G. Schamberg***, M. A. Badgeley*, and E. N. Brown, "Controlling Level of Unconsciousness by Titrating Propofol with Deep Reinforcement Learning," *International Conference on Artificial Intelligence in Medicine*, August 2020 **(Best Paper Award)**.
- **G. Schamberg** and T. P. Coleman, "On the Bias of Directed Information Estimators," *IEEE International Symposium on Information Theory*, July 2019.
- **G. Schamberg** and T. P. Coleman, "Quantifying Context-Dependent Causal Influences," *NeurIPS Workshop on Causal Learning*, December 2018.
- **G. Schamberg** and T. P. Coleman, "A Sample Path Measure of Causal Influence," *IEEE International Symposium on Information Theory*, June 2018.
- **G. Schamberg**, M. Wagner, D. Ba, and T. P. Coleman, "Efficient Low-Rank Spectrotemporal Decomposition using ADMM," *IEEE Statistical Signal Processing Workshop*, June 2016.

**Thesis**

- "Information Theoretic Measures and Estimators of Specific Causal Influences," *University of California, San Diego*, August 2019.

## Invited Talks

| | |
|---|---|
| Royal College of Anaesthetists Winter Symposium | December 2020 |
| Information, Signals, and Systems Seminar, *Harvard* | March 2019 |
| Neuroscience Statistics Research Laboratory Seminar, *MIT* | March 2019 |
| CRISP Lab Seminar, *Harvard* | March 2017 |

## Conference Talks

| | |
|---|---|
| IEEE Asilomar Conference on Signals, Systems, and Computers | November 2020 |
| International Conference on Artificial Intelligence in Medicine | August 2020 |
| IEEE International Symposium on Information Theory | July 2019 |
| Information Theory and Applications Workshop | February 2019 |
| IEEE International Symposium on Information Theory | July 2018 |

## Grants and Awards

**Picower Postdoctoral Fellowship** October 2019 – Present

*Picower Institute for Learning and Memory*

- **Summary:** research proposal based award to support pursuit of an independent research agenda
- **Project:** developing control signals for closed loop anesthesia delivery systems

**Innovative Research Grant Award** July 2018

*Kavli Institute for Brain & Mind*

- **Summary:** $50,000 awarded for proposed innovative research studying brain organization (with four co-investigators)
- **Project:** rhythmic coordination – a mechanism for efficient processing of information from multiple sources

**Honorable Mention, Graduate Research Fellowship Program** April 2015
*National Science Foundation*

- **Summary:** awarded to top ∼30% of applicants
- **Project:** statistical phase estimation for quantifying neural mechanisms underlying cognition

**Jacobs Fellowship** September 2014 – September 2017
*Jacobs School of Engineering, UCSD*

- **Summary:** three years of fully funded graduate studies awarded to top applicants among all engineering PhD programs

**Gordon Scholar** September 2009
*Gordon Center for Engineering Leadership, UCSD*

- **Summary:** a program aimed to train engineering students to be leaders through symposiums, workshops, challenge projects, and additional required coursework

## Academic Involvement

| | |
|---|---|
| Guest Editor, *Entropy* Special Issue on "Information Flow in Neural Systems" | November 2020 |
| Reviewer, *IEEE Transactions on Neural Networks and Learning Systems* | October 2020 |
| Reviewer, *IEEE Transactions on Signal Processing* | January, March 2020 |
| Reviewer, *IEEE International Symposium on Information Theory* | February 2020 |
| Reviewer, *IEEE Transactions on Information Theory* | December 2019 |
| Reviewer, *Knowledge Based Systems* | December 2018, June 2019 |
| Session Co-Chair, *Information Theory and Applications Workshop* | February 2017 |