



Sandya Subramanian

Postdoctoral Scholar, Bioengineering

Bio

BIO

I'm a Stanford Data Science Postdoctoral Fellow and NINDS F32 Postdoctoral Fellow, and I work with Professor Todd Coleman in Bioengineering and Professor Sean Mackey in Pain Medicine. My research is on developing new technologies and methods to study the interactions between the brain, the autonomic nervous system, and the gut. Brain-gut interactions are poorly understood but involved in a number of disorders, such as functional gastrointestinal disorders, Parkinson's disease, diabetes, migraine, and eating disorders. The goal of my research is to improve our ability to monitor and quantify these physiologic processes.

I completed my B.S. in Biomedical Engineering and Applied Mathematics & Statistics from Johns Hopkins University in 2015 and spent the next year as a Churchill Scholar at the University of Cambridge getting an M.Phil. in clinical neurosciences (all my research was computational). I then did my Ph.D. at MIT in the Harvard-MIT Health Sciences and Technology program, advised by Professor Emery Brown. During my PhD, I developed and tested models and methods to track unconscious pain under anesthesia in the operating room. I grew up in Grand Rapids, Michigan.

HONORS AND AWARDS

- Schmidt Science Fellowship, Schmidt Science Fellows, Schmidt Futures, Rhodes Trust (2022-2024)
- Stanford Data Science Postdoctoral Fellowship, Stanford University (2021-2024)
- NIH NINDS F32 Postdoctoral Fellowship (Terminated early for Schmidt Science Fellowship), NIH NINDS (2021-2022)
- Collamore-Rogers Fellowship, MIT Office of Graduate Education (2020-2021)
- 3rd place, IEEE Engineering in Medicine and Biology Conference Student Paper Competition, IEEE Engineering in Medicine and Biology Society (2020)
- Sloan School of Management Healthcare Certificate, MIT Sloan School of Management (2020)
- Kauffman Teaching Certificate Program Graduate, MIT Teaching-Learning Lab (2019)
- Society for Neuroscience Trainee Professional Development Award, Society for Neuroscience (2017)
- MIT Presidential Fellow, MIT (2016)
- NSF Graduate Fellow, National Science Foundation (2015-2020)
- Churchill Scholar, The Winston Churchill Foundation (2015-2016)
- Goldwater Scholarship, Barry Goldwater Scholarship and Excellence in Education Foundation (2013)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, Reviewer, IEEE Engineering in Medicine and Biology Society (2017 - present)

PROFESSIONAL EDUCATION

- Doctor of Philosophy, Massachusetts Institute of Technology (2021)

- Master of Philosophy, University of Cambridge (2016)
- Bachelor of Science, Johns Hopkins University , Biomedical Engineering (2015)
- B.S., Johns Hopkins University , Biomedical Engineering, Applied Mathematics & Statistics (2015)
- M.Phil., University of Cambridge , Clinical Neurosciences (2016)
- Ph.D., Harvard-MIT Division of Health Sciences and Technology , Medical Engineering and Medical Physics (2021)

STANFORD ADVISORS

- Todd Coleman, Postdoctoral Faculty Sponsor

PATENTS

- Emery N Brown, Riccardo Barbieri, Sandya Subramanian. "United States Patent PCT/US2020/042031 Tracking Nociception Under Anesthesia Using a Multimodal Metric", Massachusetts Institute of Technology
- Sandya Subramanian, Riccardo Barbieri, Emery N Brown. "United States Surgical Cautery Artifact Removal from Electrodermal Activity Data", Massachusetts Institute of Technology
- Sandya Subramanian, Todd Coleman. "United States Automated classification of sleep and wake from single day triaxial accelerometer data", Stanford University
- Aaron Chang, Melinda Chen, Piyush Poddar, Rohil Malpani, Peter Malamas, Sandya Subramanian, Joon Eoh, Kevin George, Todd J. Cohen. "United States Patent 9,474,892 Method and System for Decreasing Transthoracic Impedance for Cardioversion and Defibrillation", Cardiac Inventions, Oct 25, 2016
- Piyush Poddar, Aaron Chang, Melinda Chen, Peter Malamas, Sandya Subramanian, Todd J. Cohen. "United States Patent 9,320,884 Method and System for Switching Shock Vectors and Decreasing Transthoracic Impedance for Cardioversion and Defibrillation", Cardiac Inventions, Apr 26, 2016
- Sridevi Vedula Sarma, Sandya Subramanian, Stephanie Hao. "United States Patent 9,277,873 Computational tool for pre-surgical evaluation of patients with medically refractory epilepsy", Johns Hopkins University, Mar 8, 2016

Research & Scholarship

RESEARCH INTERESTS

- Brain and Learning Sciences
- Data Sciences

CURRENT RESEARCH AND SCHOLARLY INTERESTS

I would like to focus on platform technology development for at-home monitoring of chronic disease, by studying gut-autonomic nervous system interactions. I am trained as an engineer and computational researcher, and I have experience developing computational algorithms from physiology, collecting data from patients in complex clinical scenarios, and collaborating with diverse clinical and regulatory teams. I am developing expertise in hardware-software interfacing and bioelectronics.

LAB AFFILIATIONS

- Todd Coleman, Neural Interactions Laboratory (9/1/2021)
- Sean Mackey, Systems Neuroscience and Pain Laboratory (9/1/2021)

Publications

PUBLICATIONS

- **An unsupervised automated paradigm for artifact removal from electrodermal activity in an uncontrolled clinical setting.** *Physiological measurement* Subramanian, S., Tseng, B., Barbieri, R., Brown, E. N. 2022
- **Tonic Electrodermal Activity is a Robust Marker of Psychological and Physiological Changes during Induction of Anesthesia.** *Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference* Tseng, B., Subramanian, S., Barbieri, R., Brown, E. N. 2022; 2022: 418-421

- **Automated classification of sleep and wake from single day triaxial accelerometer data.** *Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference*
Subramanian, S., Coleman, T. P.
2022; 2022: 3665-3668
- **How Machine Learning is Powering Neuroimaging to Improve Brain Health.** *Neuroinformatics*
Singh, N. M., Harrod, J. B., Subramanian, S., Robinson, M., Chang, K., Cetin-Karayumak, S., Dalca, A. V., Eickhoff, S., Fox, M., Franke, L., Golland, P., Haehn, D., Iglesias, et al
2022
- **A Model-Based Framework for Assessing the Physiologic Structure of Electrodermal Activity** *IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING*
Subramanian, S., Purdon, P. L., Barbieri, R., Brown, E. N.
2021; 68 (9): 2833-2845
- **Elementary integrate-and-fire process underlies pulse amplitudes in Electrodermal activity** *PLOS COMPUTATIONAL BIOLOGY*
Subramanian, S., Purdon, P. L., Barbieri, R., Brown, E. N.
2021; 17 (7): e1009099
- **Unsupervised Machine Learning Methods for Artifact Removal in Electrodermal Activity.** *Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference*
Subramanian, S., Tseng, B., Barbieri, R., Brown, E. N.
2021; 2021: 399-402
- **Quantitative assessment of the relationship between behavioral and autonomic dynamics during propofol-induced unconsciousness** *PLOS ONE*
Subramanian, S., Purdon, P. L., Barbieri, R., Brown, E. N.
2021; 16 (8): e0254053
- **Point process temporal structure characterizes electrodermal activity** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Subramanian, S., Barbieri, R., Brown, E. N.
2020; 117 (42): 26422-26428
- **Multimodal vs Unimodal Estimation of Sympathetic-Driven Arousal States**
Subramanian, S., Brown, E., Barbieri, R., IEEE
IEEE.2020
- **Analyzing Transitions in Anesthesia by Multimodal Characterization of Autonomic State**
Subramanian, S., Barbieri, R., Purdon, P. L., Brown, E. N., IEEE
IEEE.2020
- **Detecting Loss and Regain of Consciousness during Propofol Anesthesia using Multimodal Indices of Autonomic State**
Subramanian, S., Barbieri, R., Purdon, P. L., Brown, E. N., IEEE
IEEE.2020: 824-827
- **Risk-taking bias in human decision-making is encoded via a right-left brain push-pull system** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Sacre, P., Kerr, M. D., Subramanian, S., Fitzgerald, Z., Kahn, K., Johnson, M. A., Niebur, E., Eden, U. T., Gonzalez-Martinez, J. A., Gale, J. T., Sarma, S. V.
2019; 116 (4): 1404-1413
- **A Systematic Method for Preprocessing and Analyzing Electrodermal Activity**
Subramanian, S., Barbieri, R., Brown, E. N., IEEE
IEEE.2019: 6902-6905
- **Multitaper Infinite Hidden Markov Model for EEG**
Song, A. H., Chlon, L., Soulat, H., Tauber, J., Subramanian, S., Ba, D., Prerau, M. J., IEEE
IEEE.2019: 5803-5807
- **Arousal Detection in Obstructive Sleep Apnea Using Physiology-Driven Features**
Subramanian, S., Chamadia, S., Chakravarty, S., IEEE
IEEE.2018

- **A Point Process Characterization of Electrodermal Activity**

Subramanian, S., Barbieri, R., Brown, E. N., IEEE
IEEE.2018: 37-40

- **Using network analysis to localize the epileptogenic zone from invasive EEG recordings in intractable focal epilepsy** *NETWORK NEUROSCIENCE*

Li, A., Chennuri, B., Subramanian, S., Yaffe, R., Gliske, S., Stacey, W., Norton, R., Jordan, A., Zaghoul, K. A., Inati, S. K., Agrawal, S., Haagensen, J. J., Hopp, et al
2018; 2 (2): 218-240

- **The influences and neural correlates of past and present during gambling in humans** *SCIENTIFIC REPORTS*

Sacre, P., Subramanian, S., Kerr, M. D., Kahn, K., Johnson, M. A., Bulacio, J., Gonzalez-Martinez, J. A., Sarma, S. V., Gale, J. T.
2017; 7: 17111

- **Computing Network-based Features from Intracranial EEG Time Series Data: Application to Seizure Focus Localization**

Hao, S., Subramanian, S., Jordan, A., Santaniello, S., Yaffe, R., Jouny, C. C., Bergey, G. K., Anderson, W. S., Sarma, S. V., IEEE
IEEE.2014: 5812-5815