

**Joshua Chang, M.D., Ph.D.**

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Dell Medical School, The University of Texas at Austin  
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**Education**

Ph.D., (Quantitative Health Sciences), University of Massachusetts, Worcester, MA 05/11 to 06/17  
Thesis Title: Flipping Biological Switches: Solving for Optimal Control  
Advisor: Dr. David Paydarfar

M.D., University of Massachusetts Medical School, Worcester, MA 08/09 to 06/17

M.Eng., Electrical Engineering and Computer Science, MIT, Cambridge, MA 05/06 to 06/07

B.S., Electrical Engineering and Computer Science, MIT, Cambridge, MA 08/03 to 06/07

**Academic and Leadership Appointments**

Assistant Professor, Affiliate 02/19 to present  
Oden Institute for Computational Engineering and Sciences, The University of Texas at Austin

Assistant Professor 12/17 to present  
Department of Population Health, Dell Medical School, The University of Texas at Austin

Assistant Professor 05/17 to present  
Department of Neurology, Dell Medical School, The University of Texas at Austin

**Educational Activities**

**Classroom Teaching Activities**

Mathematical Physiology, Co-Instructor, 15 undergraduate / graduate students  
Lectures: Computational Neuroscience (10 lectures) 01/22 to 05/22

Mathematical Physiology, Co-Instructor, 6 graduate students  
Lectures: Computational Neuroscience (7 lectures) 01/21 to 05/21

Neuroscience Studies Foundation / Women in Neuroscience, Lecturer, 8 undergraduate students  
Session Titles: Improving Stroke Care in Travis County using Data, Research Proposal: Detecting and Addressing Disordered Swallowing and Speech 07/20

Technology and Health Care, Lecturer and Course Organizer, 15 medical students,  
Session Titles: AI and Medicine; Implications and Challenges of AI and Medicine 11/19

Integrating Technology and Health Care, Guest Lecturer, 15 medical students,  
Session Title: AI, Machine Learning and Medicine 10/18

Digital Signal Processing, Guest Lecturer, Worcester Polytechnic Institute, 8 graduate students,  
Lectures: Introduction to MATLAB, Hilbert-Hwang Transforms 09/12

## Advising and Mentoring

### Students

Maria Favela, CSEM undergraduate CSEM Scientific Computing Project Supervisor	01/23 to present
Sophia Epstein, Oden Institute graduate PhD Co-mentor	08/22 to present
Aidan O'Keefe, CSEM undergraduate Research Project Supervisor	08/22 to 12/22
Anjana Ganesh, Women in Neuroscience intern Women in Neuroscience Research Supervisor	06/22 to present
Rohan Shah, CSEM undergraduate CSEM Scientific Computing Project Supervisor	01/22 to 05/22
Allison Torsey, Oden Institute graduate PhD Co-mentor, Thesis Committee	09/21 to present
Ashley Chong, CSEM undergraduate CSEM Scientific Computing Project Supervisor	09/21 to 12/21
Alisha Ragatz, Moncrief Summer Internship Moncrief Summer Internship Supervisor	06/21 to 09/22
Juan Paez, CSEM undergraduate student at UT CSEM Scientific Computing Project Supervisor	09/20 to 21/20
Nitya Rao, Medical Student Growth Year at Dell Medical School Research supervisor	09/19 to 03/21
Daniel Paydarfar, Summer internship at Dell Medical School Research supervisor	06/19 to 08/21
Aydin Zahedivash, Medical student Growth Year at Dell Medical School Research supervisor	05/18 to 05/20
Zaineb Marediya, Dell Medical School's HLA program	02/18 to 06/18
Jonathan Wong, Dell Medical School's HLA program	02/18 to 06/18
Alan Gee, Electrical and Computer Engineering Graduate Student at UT	05/17 to 08/21
Anagha Indic, Summer internship at UMass Medical School Research supervisor	06/14 to 08/14
Arman Paydarfar, Summer internship at UMass Medical School Research supervisor	06/13 to 08/13

### Grants

#### Current

NIH, 1R61AG069780-01, PI: Hilsabeck <b>Cognitive Screening Made Easy for Primary Care Provider</b> Develop tools for primary care provides to quickly screen their patients for mild cognitive impairment by analyzing speech patterns. Total Costs: \$484,171	09/20 to 08/25 Role: Investigator (0.6 CM)
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NSF: 2123749 (PI: Ngu)

10/21 to 9/25

**Personalized Watch-based Fall Risk Analysis and Detection with Cross Modal Learning**

Develop tools for primary care providers to quickly screen their patients for mild cognitive impairment by analyzing speech patterns.

Total Costs: \$345,325

Role: Co-Principal Investigator (1.2 CM)

Clayton Foundation for Research (PI: Paydarfar)

01/17 to 12/22

**Electroceutical Science and Medicine**

The major goal of this project is to catalyze the development of an entirely new class of medical devices for optimizing neural stimuli, by constructing intelligent waveforms tailored specifically to a patient's pathophysiology.

Total Costs: \$1,900,000

Role: Co-Principal Investigator (9 CM)

**Pending**

NSF Smart and Connected Health (PI: Jia)

01/17 to 12/22

**SCH: A biomechanics-guided wireless ultrasound e-tattoo with an application specific integrated circuit for ambulatory blood pressure monitoring**

The major goal of this project is to develop a wireless ultrasound e-tattoo for continuous non-invasive ambulatory blood pressure monitoring.

Total Costs: \$1,200,000

Role: Co-Investigator (0.5 CM, Yr 3,4)

NIH (PI: Chang)

07/23 to 06/28

**Early Detection of Delirium in Older Adults using Continuous Physiological Signals**

The major goals of this project are to better understand the genesis of and recovery from delirium through the lens of physiological signals. By tracking traditional signals (e.g., heart rate, respiratory rate, oxygenation levels) through in-hospital monitors and wearable devices longitudinally, we hope to gain a better understanding of delirium as well as identify signatures for earlier automated detection.

Total Costs: \$3,684,625

Role: Principal Investigator (4.8 CM)

**Other Active Research Activities and Clinical and Quality Improvement Projects**

Developing a framework to optimize stroke response times in Travis County

05/18 to present

**Technology Development**

**Patents**

Paydarfar, Daniel, David Paydarfar, Peter Mucha, Joshua Chang. "System and method for calculating transport routes." US. Provisional Application No. 63/182,140. April 30, 2021.

Paydarfar, David, Joshua Chang, Sara Hackett, Varun Sridhar. "Apparatus and methods for phase-agnostic stimuli." US. Provisional Application No. 63/114,636. November 17, 2020.

Paydarfar, David, and Joshua Chang. "Application of the extrema distortion method to optimize control signals." U.S. Patent No. 10,506,983. 17 Dec. 2019.

**Publications (List chronologically either newest to oldest or oldest to newest)**

**Peer-reviewed publications**

Paydarfar, Daniel A., et al. "Optimizing emergency stroke transport strategies using physiological models." *Stroke* 52.12 (2021): 4010-4020.

Rao, Nitya, Joshua Chang, and David Paydarfar. "Characterizing the performance of emergency medical transport time metrics in a residentially segregated community." *The American Journal of Emergency Medicine* 50 (2021): 111-119.

Chang, Joshua, and David Paydarfar. "Falling off a limit cycle using phase-agnostic stimuli: Applications to clinical oscillopathies." *Chaos: An Interdisciplinary Journal of Nonlinear Science* 31.2 (2021): 023134.

Chang, Joshua, Varun Sridhar, and David Paydarfar. "Falling off a limit cycle using phase-agnostic stimuli: Definitions and conceptual framework." *Chaos: An Interdisciplinary Journal of Nonlinear Science* 30.12 (2020): 123113.

Ngu, Anne H., et al. "Personalized fall detection system." *2020 IEEE International Conference on Pervasive Computing and Communications Workshops (PerCom Workshops)*. IEEE, 2020.

Chang, Joshua, and David Paydarfar. "Optimizing stimulus waveforms for electroceuticals." *Biological Cybernetics* 113.1 (2019): 191-199.

Chang, Joshua, and David Paydarfar. "Optimizing stimulus waveforms for suppressing epileptic activity reveals a counterbalancing mechanism." *2018 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*. IEEE, 2018.

Gee, Alan H., et al. "Bayesian online changepoint detection of physiological transitions." *2018 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*. IEEE, 2018.

Chang, Joshua, and David Paydarfar. "Evolution of extrema features reveals optimal stimuli for biological state transitions." *Scientific reports* 8.1 (2018): 1-13.

Kubat Öktem, Elif, et al. "Mutant SOD1 protein increases Nav1.3 channel excitability." *Journal of biological physics* 42.3 (2016): 351-370.

Chang, Joshua, and David Paydarfar. "Optimal stimulus waveforms for eliciting a spike: How close is the spike-triggered average?." *2015 7th International IEEE/EMBS Conference on Neural Engineering (NER)*. IEEE, 2015.

Chang, Joshua, and David Paydarfar. "Switching neuronal state: optimal stimuli revealed using a stochastically-seeded gradient algorithm." *Journal of computational neuroscience* 37.3 (2014): 569-582.

Kim, Sun-Young, et al. "Comparative evaluation of the potential impact of rotavirus versus HPV vaccination in GAVI-eligible countries: a preliminary analysis focused on the relative disease burden." *BMC infectious diseases* 11.1 (2011): 1-17.

Frendl, Daniel M., et al. "Wireless Transmission of a Prehospital Electrocardiogram Can be Cost Effective for Patients with ST-Elevation Myocardial Infarction." (2010): A12786-A12786.

Jiang, Leaf A., Eric A. Dauler, and Joshua T. Chang. "Photon-number-resolving detector with 10 bits of resolution." *Physical Review A* 75.6 (2007): 062325.

## Books & Chapters

Chang, Joshua and David Paydarfar. "Methods for optimizing stimulus waveforms for electroceutical control." *Encyclopedia of Computational Neuroscience* (2020).

## Editorial Responsibilities

Cochrane Protocol Review

10/22

Frontiers Digital Health, Review Editor

08/22 to present

International Journal of Stroke, Reviewer

05/22 to 06/22

**Invited Presentations (For all entries, indicate *speaker*)****International**

**Chang, Joshua**, David Paydarfar, and John Milton, "Multistable neuromorphic computing: Controlling attractor switches using waveforms." IEEE IEDM, San Francisco, CA, USA 12/22

**Chang, Joshua**, "Neuromodulatory Control: Personalizing electrical stimulation for medical therapeutics." Workshop on Dynamical Diseases and mHealth, Mathematical Biological Institute, Montreal, Canada 11/19

**Chang, Joshua** and David Paydarfar, "Finding optimal stimulus waveforms with intelligent algorithms." 41st International Conference of Engineering in Medicine and Biology Society, Berlin, Germany, 7/19

**National**

**Chang, Joshua**, "AI and the Future of Medicine.", MIT's Faculty Forum Online 2018

**Chang, Joshua**, "Evolution of extrema features reveals optimal stimuli for biological state transitions," Mathematical Biosciences Institute Workshop on Control and Modulation of Neuronal and Motor Systems 2017

**Chang, Joshua** and David Paydarfar, "Flipping Biological Switches: Solving for Optimal Control." Society for Industrial and Applied Mathematics Life Sciences Conference 2016

**Local**

**Chang, Joshua**, "The Electrified Brain: A Conversation about how to use electricity to treat neurological disorders." UT Brainstorms, The University of Texas at Austin. 05/22

**Chang, Joshua**, "Improving Stroke Care Decision Making." Neurology Grand Rounds, Dell Seton Medical Center 2019

**Chang, Joshua**, "How the Brain Works: Design and Optimality." Neuromorphic Computing, The University of Texas at Austin 2019

**Chang, Joshua**, "Artificial Intelligence and Medicine." Amazon Alexa & Artificial Intelligence course with Hello World Computer science for 3rd – 12th grade student 2018

**Chang, Joshua**, "Machine Learning and Medicine." Houston Engineering Center Machine Learning at The University of Texas at Tyler, Houston, TX 2018

**Chang, Joshua**, "Personalizing Electrical Stimulation for Medical Therapy." IEEE Corona Chapter at The University of Texas at Tyler, Tyler, TX 2018

**Chang, Joshua**, "Personalizing Electrical Stimulation for Medical Therapy." NSF Smart and Connected Health Workshop, Austin, TX 2018

**Accepted Oral and Poster Presentations (For all entries, indicate *speaker* / *presenter*)****International**

**Paydarfar, Daniel**, David Paydarfar, Peter Mucha, Joshua Chang. "Stochastic Methods Can Resolve the Dilemma of Emergency Stroke Transport." International Stroke Conference 2020

**Chang, Joshua** and David Paydarfar, "Optimizing stimulus waveforms for suppressing epileptic activity reveals a counterbalancing mechanism." 40th International Conference of Engineering in Medicine and Biology Society, Honolulu, HI, 2018

**Chang, Joshua** and David Paydarfar, “Optimal stimulus waveforms for eliciting a spike: How close is the spike-triggered average?” 7<sup>th</sup> International IEEE/EMBS Conference on Neural Engineering in Montpellier, France 2015

**National**

**Chang, Joshua** and David Paydarfar, “Optimizing stimulus waveforms for controlling the behavior of a neuron: Shaping stochastic signals with a gradient algorithm.” Society for Neuroscience Conference in San Diego, CA 2016

**Community Service**

Women in Neuroscience, Faculty Council, Speaker, Mentor 05/19 to present

NSF Smart and Connected Health Workshop, Organizer 03/18