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

Department of Neurology
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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

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, 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

Anjana Ganesh, Women in Neuroscience undergraduate intern at UT	06/22 to present
Rohan Shah, CSEM undergraduate student at UT	01/22 to 05/22
Ashley Chong, CSEM undergraduate student at UT	09/21 to 12/21
Alisha Ragatz, Moncrief Summer Internship student at UT	06/21 to present
Juan Paez, CSEM undergraduate student at UT	09/20 to 12/20
Nitya Rao, Medical Student Growth Year at Dell Medical School	09/19 to 03/21
Daniel Paydarfar, Summer internship at Dell Medical School Current Position: Undergraduate at University of North Carolina – Chapel Hill	06/19 to 08/21
Diego Gracia-Olano, Electrical and Computer Engineering Graduate Student at UT	09/18 to present
Aydin Zahedivash, Medical student Growth Year at Dell Medical School	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 Current Position: Software Engineer at Harris Corporation	06/14 to 08/14
Arman Paydarfar, Summer internship at UMass Medical School Current Position: Graduate student at Columbia University	06/13 to 08/13

Residents and Fellows

Sara Hackett, Hardware Engineer	06/19 to 01/21
Varun Sridhar, Clayton Research Fellow	08/18 to 12/21

Grants

Current

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

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 provides to quickly screen their patients for mild cognitive impairment by analyzing speech patterns.
Total Costs: $345,325   Role: Co-Principal Investigator (1.2 CM)

Coleman Fung Foundation (PI: Paydarfar)   09/21 to 08/24
Human Cortical Network Plasticity Induced by Multimodal Gaming Technologies

The goal of this project is to map the brain of adolescents before and after epilepsy surgery in order to examine how novel brain-machine interfaces and embodied learning technologies can help the brain rewire itself before surgery, move key functions away from the surgeon's target and recover more quickly afterward.

Total Costs: $2,500,000   Role: Co-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

NIH (PI: Chang)
Early Detection of Delirium in Older Adults using Continuous Physiological Signals
Develop tools to detect delirium both in the hospital and at home using wearable devices.

Total Costs: $$2,973,378   Role: Principal Investigator (4.8 CM)

Other Active Research Activities and Clinical and Quality Improvements 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

Peer-reviewed publications

Paydarfar, Daniel, David Paydarfar, Peter Mucha, Joshua Chang. "Optimizing emergency care of ischemic stroke patients using a mathematical model of infarct growth and transport times." Stroke (2021).

Rao, Nitya, Joshua Chang, and David Paydarfar. "Evaluating disparity in emergency medical transport of suspected stroke patients in the setting of racial variation in geospatial distributions." Annals of Emergency Medicine (2021).

Chang, Joshua and David Paydarfar. "Falling off a limit cycle using phase-agnostic stimuli: Applications to clinical oscillopathies." Chaos (2021).

Chang, Joshua, Varun Sridhar and David Paydarfar. "Falling off a limit cycle using phase-agnostic stimuli: Definitions and conceptual framework." Chaos 30. 12 (2020): 123113

Ngu, Anne H., Vangelis Metsis, Shaun Coyne, Brian Chung, Rachel Pai, and Joshua Chang. "Personalized Fall Detection System." In *2020 IEEE International Conference on Pervasive Computing and Communications Workshops (PerCom Workshops)*, pp. 1-7. IEEE, 2020.

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

Chang, Joshua, and David Paydarfar. "Optimizing stimulus waveforms for electroceuticals." Biological cybernetics 113.1-2 (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 (2018).

Öktem, Elif Kubat, et al. "Mutant SOD1 protein increases Nav1. 3 channel excitability." Journal of Biological Physics (2016): 1-20.

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

Frendl, Daniel M., Joshua T. Chang, Galen S. Wagner, Eric L. Eisenstein. "Wireless transmission of a prehospital electrocardiogram can be cost effective for patients with ST-elevation myocardial infarction." Circulation 122 (2010): 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.

Invited Presentations, Posters & Abstracts

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, "Neuromodulatory Control: Personalizing electrical stimulation for medical therapeutics." Workshop on Dynamical Diseases and mHealth, Mathematical Biological Institute, Montreal, Canada, 2019

Chang, Joshua and David Paydarfar, "Finding optimal stimulus waveforms with intelligent algorithms." 41st International Conference of Engineering in Medicine and Biology Society, Berlin, Germany, 2019

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?" 7th International IEEE/EMBS Conference on Neural Engineering in Montpelier, France   2015

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

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

Regional

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

Community Service

Women in Neuroscience, Speaker and Mentor	2019 to present
NSF Smart and Connected Health Workshop, Organizer	03/18