

Zachary Danziger

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PROFESSIONAL APPOINTMENTS

Associate Professor of Biomedical Engineering, Florida International University Applied Neural Interfaces Lab (https://anil.fiu.edu), Principal Investigator	≥2022
Assistant Professor of Biomedical Engineering, Florida International University	2016-22

EDUCATION

Postdoctoral Fellow, Duke University Advisor: Warren M. Grill • Neurourology; electrophysiology (mouse, rat, cat); pre-clinical SCI (human)	2016
Neuroinformatics Certification, Marine Biological Laboratory, Woods Hole	2012
Ph.D. in Biomedical Engineering, Northwestern University Advisor: Ferdinando A. Mussa-Ivaldi • Motor learning (human); human-machine interface design	2011
B.S. in Biomedical Engineering, <i>Cum Laude</i> , University of Michigan Ann Arbor Concentration in Philosophy (Moral and Political), University of Michigan Ann Arbor	2005

RESEARCH FUNDING

NIH NIDDK R01DK133605 [\$3.03M], PI: ZC Danziger . <i>A New Hybrid Modeling Framework Combining Biophysics and Deep Learning to Predict and Optimize Peripheral Neuromodulation Outcomes in Lower Urinary Tract Disease</i> . We develop a new computational framework to predict functional, organ level responses of the lower urinary tract (LUT) to electrical stimulation of its peripheral nerves, greatly increasing the pace of therapeutic discovery. We achieve this by merging biophysical models of LUT organs with artificial neural networks through training and validation on <i>in vivo</i> experiment data.	2022-27
NSF M3X CMMI 2128465 [\$480k], PI: ZC Danziger . <i>Non-Invasive Models of Human Brain-Computer-Interface Control of Robots</i> . The project develops a preliminary theory of how to design human-machine collaborative systems by manipulating how human input is translated into commands for physical robots and the speed at which the translation algorithm adapts to the user's behavior. As a specific use case, we apply these ideas to brain-computer interfaces, using human-in-the-loop models embedded in our experiment design, to optimize co-adaptive system performance.	2021-25
NSF SMA 2124953 & 2124907 [\$390k], lead faculty consultant role , PI: A Brightman. <i>Collaborative Research: Standard: Exploring the Variation in Understanding and Experiences with Ethical Engineering Research among Faculty in Biomedical Engineering</i> .	2021-24

Improving ethics education and responsible conduct of research in Biomedical Engineering through a Community of Practice.

- NIH SPARC Program OT2OD030524 [\$1.90M], **PI: ZC Danziger**. *A New Paradigm for Systems Physiology Modeling: Biomechanistic Learning Augmentation with Deep Differential Equation Representations (BLADDER)*. We lay the theoretical and computational groundwork to merge physiology-based ODE models of organs with data-driven machine learning models into a single framework to make predictions of systems level function while maximizing model interpretability. We test this framework in vascular, neural, and urinary physiological systems, with the long-term goal of using simulations to discover and optimize therapeutic interventions, such as neuromodulation. 2020-23
- NIH NINDS R01NS109257 [\$1.59M], **PI: ZC Danziger**. *An Intracortical Brain-Computer Interface Model for High Efficiency Development of Closed-Loop Neural Decoding Algorithms*. In this work, we emulate part of the human brain by having human participants interact in real-time with state-of-the-art machine learning algorithms, which are trained using intracortical data from nonhuman primates. The emulator will greatly advance our ability to understand a person's intentions from their brain recordings, thereby improving neurotechnology designed to assist people with paralysis. 2019-24
- NIH NIGMS T32GM132054 [training grant], **mentorship role**. *Transdisciplinary Training in Biomolecular and Biomedical Sciences*. FIU will establish a Transdisciplinary Biomolecular & Biomedical Sciences (TBBS) training program to support high-quality training of predoctoral students by mentors in multiple departments and colleges engaged in interdisciplinary collaborations. 2019-24
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- Craig H Neilsen Foundation pC ID 460399 [\$320k], **PI: ZC Danziger**. *Post-SCI Bladder Reflex Conditioning with Pelvic Neuromodulation*. The goals of the project are to 1) quantify the emergence and effectiveness of the pathological bladder voiding reflex that develops following spinal cord injury (SCI), and 2) test if targeted neuromodulation of the pelvic nerve following SCI enhances development speed and reduces hyperexcitability of the voiding reflex. 2017-21
- Wallace H Coulter SEED Grant [\$60k], **Co-PI: ZC Danziger**. *Non-Invasive Decoding of Neuromuscular Activity for Rehabilitation and Prosthetic Control*. The goals of this 1-year pilot project are to build a method for non-invasively decoding proprioceptive neural information in humans via high-density surface EMG recordings and to understand how proprioception is altered by neurological injury. 2018-19
- Wallace H Coulter SEED Grant [\$2k in **role as Co-I**, \$20k total], **PI: J Hutcheson**. *Exploring Neural Contributions to Aortic Valve Function and Disease*. The project focus is on the role of neural components in aortic valve leaflet physiology and pathology, and to identify novel therapeutic targets. My role is electrophysiology measurements of tissue and bioinformatics support. 2017-18
- NIH NIDDK F32DK098904 [\$110k], **PI: ZC Danziger**. *Neural Prosthetics Development for Treatment of Urinary Retention*. The overall goal of the project was to develop neural stimulation techniques to enhance sensation in the urethra to alleviate symptoms of urinary retention. We developed a comprehensive, mathematical model of urethral afferent responses to pressure, and developed the theoretical groundwork for a stimulation paradigm using stochastic resonance to enhance urethral afferent activity. 2013-15

NIH NINDS T32 Grant (**Fellow**): Competitively awarded within Duke University for 2012
 “Fundamental and Translational Neuroscience”.

NSF REU Grant (**Fellow**): Student research grant for hydrocephalus computational modeling. 2005

AWARDS / HONORS

Research

“FIU Top Scholar” award, given by the University president and Provost in recognition of 2021
 outstanding scholarly activity to 30 FIU faculty per year

Top-5 rated abstract in the Society for Pelvic Research Conference, “Loss of urethral 2020
 sensitivity leads to functional deficits in rat model: implications for age-related
 underactive bladder”

Publication selected as “Editor’s Choice” in Journal of Physiology: Danziger ZC, Grill WM, 2017
 “Sensory feedback from the urethra evokes state-dependent lower urinary tract reflexes
 in rat”

First Place Research Award: Multidisciplinary Benign Urology Research Day, Durham NC 2016

Platform Presentation and Travel Grant: Translational and Computational Motor Control 2010
 Conference group A presentation, San Diego CA

Travel Grant: IEEE Engineering Medicine and Biology Conference, grant awarded for 2008
 platform talk, Vancouver Canada

Education/Mentorship

Received FIU’s university-level “Award for Excellence in Postdoctoral Scholar Mentoring”, 2019
 given to one faculty per year

Service

Lead author on Biomedical Engineering Society *Code of Ethics*, ratified by the BMES 2021
 governing board in 2021 (<https://www.bmes.org/governance>)

TEACHING EXPERIENCE

Florida International University

- Biomedical Modeling and Simulation (BME 2740): Gateway course in numerical methods, introduction to programming, and models of biological processes

Term:	Fall 2017	Fall 2018	Spring 2018	Fall 2019	Fall 2020	Fall 2021
Student Assessment:	3.6/5.0	3.0/5.0	4.2/5.0	4.7/5.0	4.3/5.0	4.0/5.0
- Computational Analysis and Simulation of Physiological Processes (BME 6717): Course I created in modern methods of biomedical data analysis and modeling where students select course topics related to their theses and apply class concepts to their research

Term	Spring 2018	Spring 2019	Spring 2020	Spring 2022
Student Assessment	4.3/5.0	4.8/5.0	5.0/5.0	4.9/5.0
- Engineering Analysis of Biological Systems (BME 3403): Introduction to physiology for biomedical engineers, including protein structure, basic neurobiology, cardiology, etc.
 - Emergency stand-in instructor to cover for sick faculty in Fall 2017

SERVICE AND PROFESSIONAL ACTIVITIES

Professional Ethics and Integrity

- Member and key faculty in biomedical engineering community of ethical practice, a funded initiative through NSF (SMA 2124953 & 2124907). 2021-24
- Member: Committee for Student Conduct and Academic Integrity, Florida International University. Managing policies and presiding over cases related to violations of academic integrity codes at FIU. 2021-22
- Conference Co-Chair:** 9th International Conference on Ethics in Biology, Engineering and Medicine, Miami FL April 14th-15th 2018. Hosted 2 internationally renowned keynotes, 40 accepted abstracts, 70 registrants from 4 countries, 6 sponsors, and broad representation by institutions such as the CDC and CITI program. 2018
- Chair:** Ethics Subcommittee for BMES, the governing ethics body for the US national society of biomedical engineers. Generated major revisions to the code of ethics, developed online research ethics education materials for instructors, and other similar initiatives. 2018-22

General Public Engagement

- Co-founder and co-chair:** *Thirst for Science*, a South Florida public outreach group holding monthly events where FIU scientists explain their research (no slides) in an accessible way to a general audience at bars, coffee shops, galleries, startup incubators, etc., fielding questions, and relaxing with the attendees. Over 15 events held. <https://anil.fiu.edu/thirstforscience> 2018-23
- Manager: Science outreach program – high school tours of the Rehabilitation Institute of Chicago with educational focus on bioengineering and rehabilitative medicine research. 2009-10

Consulting and Advising

- NIH Advisory Committee to the Director, invited panelist for “Catalyzing the Development and Use of Novel Alternative Methods to Advance Biomedical Research” 2023
- Society of Urodynamics, Female Pelvic Medicine & Urogenital Reconstruction (SUFU) Winter Meeting, invited panelist for “Advances in Neural Engineering” 2023
- NIDDK Workshop, “Neurourology: Bridging Basic and Clinical Science to Understand Urologic Disease.” *Predicting neuromodulation outcomes using computational modeling* 2022
- Provisional Patent: *System for Developing Brain Computer Interface* 2021
- Meta (Facebook) Reality Labs ad hoc consultant 2021-22
- Represented FIU to local business chief information officers (annual CIO Council of South Florida meeting) to highlight bridges between industry and academic activities. 2016
- NIH NIA steering meeting for geriatric incontinence, participating member 2016

Peer Review

- Grant Panel Reviews:
- Neuromod Prize, an NIH Common Fund and NASA sponsored bioelectric medicine contract competition for breakthrough neuromodulation technologies 2022
 - NSF M3X program in CMMI ≥2022
 - Bridge2AI, NIH Director’s Office flagship program for applying machine learning to biomedicine and public health to establish multiple \$25-30M AI-U54 Centers 2021
 - NSF DARE program in CBET, multiple panels ≥2018
- Reviewing Editor: *Frontiers in Integrative Neuroscience* 2016-19
- Journal Reviewer: ≥2011

IEEE Access; Nature Scientific Reports; IEEE Transactions on Biomedical Engineering; IEEE Engineering Medicine and Biology; Frontiers in Computational Neuroscience; Computer Methods and Programs in Biomedicine; Neurourology and Urodynamics; Journal of Neurophysiology; Journal of Physiology - Renal Physiology; IEEE Control Systems Society Conference; PLOS ONE; Biological Cybernetics

Scientific Resource Development

Member of "Team Black", a consortium of researches invited by the NIH SPARC program to design and test their flagship web based computing technology and data management platform, o ² S ² PARC.	2021
AMEASURE method and software for long-term urodynamic analysis in rodent models https://anil.fiu.edu/wp-content/uploads/AMEASURE_Public.zip	2019
Open Source Software Packages: Code packages downloaded collectively over 25,000 times since 2009 from MATLAB file exchange. Codes includes geometric analyses of spatial trajectories, network design of spiking neuron models, novel analysis techniques for urodynamics, games, and other statistical tools. https://www.mathworks.com/matlabcentral/profile/authors/1044524	≥2009

Society Memberships

Biomedical Engineering Society	≥2018
American Urological Society	2017-20
American Physiological Society	2016-19
Society for Neuroscience	≥2012

PUBLICATIONS

Peer Reviewed Journal Articles

- Awasthi P*, Lin HS*, Bae J, Miller LE, **Danziger ZC**, "Validation of a non-invasive, real-time, human-in-the-loop model of intracortical brain-computer interfaces." *J. Neural Engineering*, 9:056038, 2022 (*: co-first authors)
- Jaskowak D, Nunez R, Alhajar E, Yin J, Guidoboni G, **Danziger ZC**, "Mathematical modeling of the lower urinary tract: a review." *Neurourology and Urodynamics*, 1-11, 2022
- Dargman V, Ng HH, Nasim S, Chaparro D, Irion CI, Seshadri SR, Barreto A, **Danziger ZC**, Shehadeh LA, Hutcheson JD, "S2 heart sound detects aortic valve calcification independent of hemodynamic changes in mice." *Frontiers in Cardiovascular Medicine*, 9, 2022
- Geramipour A, **Danziger ZC**, "Age is associated with reduced urethral pressure and afferent activity in rat." *Physiological Reports*, 9 (21):e15107, 2021
- Geramipour A, **Danziger ZC**, Sensitivity of urethral flow-evoked voiding reflexes decline with age in the rat: insights into age-related underactive bladder. *Amer. J. Physiol. Renal Phys.*, 318 (6):F1430-F1440, 2020
- Angoli D, Geramipour A, **Danziger ZC**, Validation of an efficient and continuous urodynamic monitoring system for awake, unrestrained, chronic rodent studies." *Amer. J. Phys. Renal Phys.*, 318: F86-F95, 2020
- McGee MJ, Swan BC, **Danziger ZC**, Amundsen CL, Grill WM, "Multiple reflex pathways contribute to bladder activation by intraurethral stimulation in persons with spinal cord injury." *Urology*, 109: 210-215, 2017

- **Danziger ZC**, Grill WM, "Sensory feedback from the urethra evokes state-dependent lower urinary tract reflexes in rat." *J. Physiology*, 595(16): 5687-5698, 2017 – *selected as "editor's choice"*
- Cho K, Yoon D, Qiu S, **Danziger Z**, Grill WM, Wetsel WC, Ferreira PA, "Loss of Ranbp2 in motor neurons causes the disruption of nucleocytoplasmic and chemokine signaling and proteostasis of hnRNPH3 and Mmp28, and the development of amyotrophic lateral sclerosis (ALS)-like syndromes." *Dis. Model. Mech.* 10: 559-579, 2017
- **Danziger ZC**, Grill WM, "Estimating post-void residual volume without measuring residual bladder volume during serial cystometrograms." *Amer. J. Phys. Renal Phys.*, 311(2): F459-F468, 2016
- **Danziger ZC**, Grill WM, "Sensory and circuit mechanisms mediating lower urinary tract reflexes." *Auto. Neurosci.: Basic and Clinical*, 200: 21-28, 2016
- **Danziger ZC**, Grill WM, "Dynamics of the sensory response to urethral flow over multiple time scales in rat." *J. Physiology*, 593(15): 3351-3371, 2015
- **Danziger Z**, Grill WM, "A neuron model of stochastic resonance using rectangular pulse trains." *J. Comp. Neurosci.*, 38(1): 53-66, 2015
- McGee MJ, **Danziger ZC**, Bamford JA, Grill WM, "A spinal GABAergic mechanism is necessary for bladder inhibition by pudendal afferent stimulation." *Amer. J. Phys. Renal Phys.*, 307(8): 921-930, 2014
- **Danziger Z**, "A reductionist approach to the analysis of learning in brain-computer interfaces." *Biological Cybernetics*, 108(2) 183-201, 2014
- **Danziger Z**, Mussa-Ivaldi F, "The influence of visual motion on motor learning." *J. Neuroscience*, 32(29) 9859-9869, 2012
- Mussa-Ivaldi F, Casadio M, **Danziger Z**, Mosier KM, Scheidt RA, "Sensory motor remapping of space in human-machine interfaces." *Prog. Brain Res.*, 191: 45-64, 2011
- Casadio M, Pressman A, Fishbach A, **Danziger Z**, Acosta S, Chen D, Tseng HY, Mussa-Ivaldi FA, "Functional reorganization of upper body movement after spinal cord injury." *Exp. Brain Res.*, 207(3-4): 233-247, 2010
- **Danziger Z**, Fishbach A, Mussa-Ivaldi F, "Learning algorithms for human-machine interfaces." *IEEE Trans. Biomed. Eng.*, 56(5) 1502-1511, 2009
- Mussa-Ivaldi F, **Danziger Z**, "The remapping of space in motor learning and human-machine interfaces." *J. Physiology – Paris*, 103(3-5) 263-275, 2009
- Linninger AA, Tsakiris C, Tzu DC, Xenos M, Roycewicz P, **Danziger Z**, Penn R. "Pulsatile cerebrospinal fluid dynamics in the human brain." *IEEE Trans. Biomed. Eng.* 52(4):557-65, 2005

Peer Reviewed Conference Papers

- Demirkaya A, Imbiriba T, Lockwood K, Rampersad S, Alhajjar E, Guidoboni G, **Danziger Z**, Erdogmus D, "Cubature Kalman Filter Based Training of Hybrid Differential Equation Recurrent Neural Network Physiological Dynamic Models." 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC) Virtual, 2021
- Casadio M, Pressman A, Acosta S, **Danziger Z**, Fishbach A, Mussa-Ivaldi FA, "Body machine interface: remapping motor skills after spinal cord injury." ICORR, Zurich Switzerland, 2011
- **Danziger Z**, Mussa-Ivaldi FA, "Visuo-motor learning is guided by the Riemannian structure of the observed kinematics." *Translational and Computational Motor Control*, San Diego CA, 2010
- Casadio M, Pressman A, **Danziger Z**, Tseng HY, Fishbach A, Mussa-Ivaldi F, "Functional reorganization of upper-body movements for wheelchair control." *IEEE EMBC*, Minneapolis MN, 2009
- **Danziger Z**, Fishbach A, Mussa-Ivaldi F, "Adapting Human-Machine Interfaces to User Performance," *IEEE EMBC*, Vancouver British Columbia, Canada, 2008

Theses

- **Danziger Z**, "Human Learning and its Facilitation in Human-Machine Interfaces." For the completion of Doctor of Philosophy in Biomedical Engineering at Northwestern University, 2011
- **Danziger Z**, "Learning Algorithm for Human-Machine Interfaces." For the completion of Master of Science at Northwestern University, 2009

SEMINARS AND PRESENTATIONS

Invited Seminars

- Case Western Reserve University FES Center, Neural Prosthetics Seminar Series: *Hybrid models for accelerated development of neural interfaces* 2022
- Northwestern University Department of Physical Therapy and Human Movement Science: *Clinical relevance of computational and hybrid models in design of therapy* 2022
- University of Michigan Ann Arbor Department of Biomedical Engineering: *Human interactions with adaptive controllers in body-machine interfaces* 2021
- Meta (Facebook) Reality Labs: *Design of adaptive algorithms for human-machine interaction* 2021
- University of Miami Institute of Neural Engineering: *Learning and error in human-machine interfaces* 2020
- University of Tennessee Health Science Center Department of Pharmacy: *Optimizing cystometric analysis in animal models of the urinary tract* 2019
- Marquette University & Medical College of Wisconsin Department of Biomedical Engineering: *New models for invasive brain-computer interfaces* 2019
- Mount Sinai Medical Center Miami Beach Department of Urology: *The future of animal models in neurourology* 2017

Abstract Presentations

- Ramachandran R, Jaskowak D, Nunez R, Alhajjar E, Guidoboni G, **Danziger Z**, Yin J, "Modeling bladder health: a preliminary study". Collaborating for the Advancement of Interdisciplinary Research in Benign Urology, Madison Wisconsin, 2022.
- Lin T, Awasthi P, Miller LE, **Danziger ZC**, "A human-operated real-time intracortical brain-computer interface simulation platform". Society for Neuroscience, San Diego CA, 2022
- Jaskowak D, **Danziger ZC**, "The bladder accommodates to vast differences in filling rate to maintain constant pressure and volume micturition reflex thresholds". Society for Neuroscience, San Diego CA, 2022
- Khan S, **Danziger ZC**, "Learning high dimensional body control of a robotic arm is largely independent of mapping structure". Neural Control of Movement, Dublin Ireland, 2022
- Awasthi P, Lin T, Miller LE, **Danziger ZC**, "Validation of a non-invasive, real-time, human-in-the-loop model of intracortical brain-computer interfaces". Society for Neuroscience, Chicago IL, 2021
- **Danziger ZC**, "Pairing ethical analysis with present and future stages of brain-computer interface technology". 10th International Conference on Ethics in Biology, Engineering, and Medicine, Seattle WS, 2021
- Geramipour A, **Danziger ZC**, "Loss of urethral sensitivity leads to functional deficits in rat model: implications for age-related underactive bladder". Society for Pelvic Research Conference, Virtual Meeting, 2020 – *selected as top 5 among all abstracts by reviewer ratings*

- Bae J, Perich MG, Miller LE, **Danziger ZC**, "Neural signal emulation for closed-loop intracortical brain computer interface decoder design". Society for Neuroscience, Chicago IL, 2019
- Geramipour A, **Danziger ZC**, "Age-related reduction of urethra afferent sensitivity". Society for Neuroscience, Chicago IL, 2019
- Geramipour A, **Danziger ZC**, "Age-related deficits in sensory-mediated reflex bladder control in rat". Society for Pelvic Research Conference, New Orleans LA, 2018
- Angoli D, Geramipour A, **Danziger ZC**, "Weeks-long continuous monitoring of rodent urodynamic parameters including post void residual volumes using a novel hybrid physical-computational metabolic cage system". Society for Pelvic Research Conference, New Orleans LA, 2018
- Geramipour A, **Danziger ZC**, "Age-related degradation of urinary tract reflexes in rat". Society for Neuroscience Proceedings, San Diego CA, 2018
- Angoli D, Geramipour A, **Danziger ZC**, "Novel high resolution system for continuous urodynamic monitoring of bladder function in chronic rodent studies". Society for Neuroscience Proceedings, San Diego CA, 2018
- Geramipour A, Siu R, **Danziger ZC**, "The necessity of training and collaboration in animal studies". 9th International Conference on Ethics in Biology, Engineering, and Medicine, Miami FL, 2018
- **Danziger ZC**, Grill WM, "State dependent lower urinary tract reflexes". Society for Neuroscience Proceedings, Washington DC, 2017
- **Danziger ZC**, Grill WM, "Novel method for non-invasive measurement of post-void residual volume in continuous animal cystometry". Duke Multidisciplinary Benign Research Day, Durham NC, 2016
- **Danziger Z**, Grill WM, "Novel method for non-Invasive measurement of post-void residual volume in continuous animal cystometry". Pelvic Medicine Research Consortium Multidisciplinary Benign Urology Research Day, Durham NC, 2016
- **Danziger Z**, Grill WM, "Urethral sensory neuron activation by flow: electrophysiological quantification and modeling". Society for Neuroscience Proceedings, Chicago IL, 2015
- **Danziger Z**, Grill WM, "Characterizing and modeling sensory activity of the pudendal nerve in response to flow and pressure". Society for Neuroscience Proceedings, Washington DC, 2014
- **Danziger Z**, Grill WM, "Modulation of urethral afferent activity through minimally invasive electrical stimulation." Society for Neuroscience Proceedings, San Diego CA, 2013
- **Danziger Z**, Grill WM, "Enhancement of sensory processing in the urinary bladder." Society for Neuroscience Proceedings, New Orleans LA, 2012
- **Danziger Z**, Mussa-Ivaldi F, "Visuomotor learning is guided by the Riemannian structure of the observed kinematics." Translational and Computational Motor Control San Diego CA, 2010
- **Danziger Z**, Mussa-Ivaldi F, "The integration of multiple goals in machine learning algorithms for human-machine interfaces." Society for Neuroscience Proceedings, Chicago IL, 2009
- **Danziger Z**, Mussa-Ivaldi F, "Explicit joint angle information does not facilitate the control of a two-joint arm in a human-machine interface." Society for Neuroscience, Washington DC, 2008
- **Danziger Z**, Fishbach A, Mussa-Ivaldi F, "Learning algorithms for human-machine interfaces." Society for Neuroscience Proceedings, San Diego CA, 2007
- **Danziger Z**, Fishbach A, Mussa-Ivaldi F, "Dual learning algorithm for human-machine interfaces." Neural Control of Movement Proceedings, Barcelona Spain, 2007