DANIELLE RAGER, PhD

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SKILLS

Recurrent neural network simulation — Systems neuroscience expertise (Sensory perception)

Signal processing and Data analysis — Scientific writing and Research communication

Mathematical modeling (Dynamical systems, Stochastics, Statistical mechanics)

Probabilistic and Machine Learning models (Dimensionality reduction, Non-parametric statistics)

Scientific computing (Julia, Python, Matlab, R, C++, C)

Parallel and distributed computing solutions for large data (CUDA, GLSL, multi-core, clusters, Spark)

EDUCATION

Carnegie Mellon University *August 2013 - April 2020*
Doctor of Philosophy, Neural Computation
Dissertation: *The structure and dimension of variability across multi-area cortical circuits*
My thesis research used non-parametric regression models, dimensionality reduction techniques, and spiking neural network models to examine the propagation of shared variability across cortical regions and understand the dynamics of multi-area brain computation.

University of Pittsburgh *August 2008 - April 2012*
Bachelor of Science, Bioengineering, *magna cum laude*
Minors, Neuroscience and Music

FELLOWSHIPS AND SCHOLARSHIPS

US Dept. of Energy Computational Science Graduate Fellowship *August 2014 - August 2018*
4.5% acceptance rate
Whitaker International Fellowship for Biomedical Research *July 2012 - August 2013*
Fulbright Scholarship Finalist *2012*
University of Pittsburgh Swanson School of Engineering Scholarship *August 2008 - April 2012*
University of Pittsburgh Honors College Full Tuition Scholarship *August 2008 - April 2012*

RESEARCH

Spiking Neural Networks with Tuned Assemblies *2016-2020*
Advisor: Brent Doiron, University of Pittsburgh Department of Mathematics
Data: Smith Lab, Carnegie Mellon University Department of Biomedical Engineering
Presented new evidence that the dimension of shared variability increases from V4 to PFC during distributed processing of visual stimuli. Developed a mechanistic, multi-layer spiking network model with tuned assemblies that, through non-linear recurrent dynamics, replicated the dimensionality expansion observed *in vivo*.

Scalable Factor Analysis *2016*
Led a team of Computer Science and Data Science graduate students in developing a scalable, distributed implementation of Machine Learning technique Factor Analysis using cluster-computing framework Apache Spark.

Proprioceptive feedback modulates motor tuning during human BMI control *2013-2016*
Advisor: Valerie Ventura, Carnegie Mellon University Department of Statistics
Data: University of Pittsburgh Rehab Neural Engineering Lab
Discovered that motor tuning was overwhelmed by low-rank, shared variability in M1 activity when a human subject

with a motor neuropathy and intact sensation received proprioceptive feedback during use of an intracortical brain machine interface. Developed a new statistical model of M1 encoding that accounted for this latent, low-rank shared variability.

Tactile afferent stimulation patterns for sensory feedback in neural prostheses *2012-2013*
Advisor: Richard Vickery, University of New South Wales School of Medical Sciences
Tested a prototype of a novel multi-axial tactile sensor for prosthetic hands. Reconstructed 3D forces incident on the sensor's surface when it recorded a slipping object. Used a spiking neuron model to encode the sensor's recorded slip forces as a pattern of electrical activity for tactile nerve stimulation in patients with neuroprosthetics, enabling biomimetic slip and touch feedback.

Spline regression models for real-time decoding of primary afferent activity *2010-2012*
University of Pittsburgh Rehab Neural Engineering Lab
Developed a flexible, non-parametric spline regression model to predict limb kinematics from primary afferent activity for clinical use in closed loop neuroprosthetics.

WORK EXPERIENCE

Postdoctoral Researcher, Carnegie Mellon University Neuroscience Institute *2020-*

Lawrence Berkeley National Laboratory, Department of Energy Office of Science *2015-2016*
Biological Systems and Engineering Division
Developed hierarchical regression models of auditory tuning and recurrent connectivity in auditory cortex using the Union of Intersections Lasso technique, a novel statistical framework for model selection.

Johns Hopkins University Applied Physics Laboratory
National Security Analysis Division *2010 - 2012*
Contributed to the Stage 3 of the Defense Advanced Research Projects Agency Revolutionizing Prosthetics Initiative by studying cortical stimulation thresholds and complex percept feedback. Designed a training environment for a situational awareness experiment using transcranial direct current stimulation (tDCS). Collected and analyzed EEG and physiological data for a neuropsychological experiment.

Cyber Operations Division *2009 - 2011*
Developed a semantic web ontology designed to support the next generation of the Information Sharing and Collaboration Environment for governmental computer emergencies and cybersecurity attacks.

TEACHING EXPERIENCE

MATH 1370: Introduction to Computational Neuroscience, University of Pittsburgh *2015*
Teaching assistant to Prof. Brent Doiron. Responsible for teaching recitations and holding office hours.

SELECTED CONFERENCE TALKS

Computational and Systems Neuroscience (COSYNE) Conference 4.5% talk acceptance rate. *2020*
The Tactile Research Group Meeting *2011*

PUBLICATIONS

Rager, D. M., Alvares, D., Birznieks, I., Redmond, S. J., Morley, J. W., Lovell, N. H., & Vickery, R. M. (2013, July). Generating tactile afferent stimulation patterns for slip and touch feedback in neural prosthetics. *2013 35th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)* (pp. 5922-5925). IEEE.

Osorno, M., Millar, T.J., & **Rager, D.** (2011). Coordinated Cybersecurity Incident Handling: Roles, Processes, and Coordination Networks for Crosscutting Incidents.

In Progress

Rager, D. M., Khanna, S., Smith, M., & Doiron, B. Assembly structure expands the dimension of shared variability in cortical networks.

Rager, D. M., Downey, J., Collinger, J. L., Weber, D. J., Boninger, M., Ventura, V., & Gaunt, R. Proprioceptive feedback modulates motor cortical tuning during human brain-machine interface control.