

**Eric T. Shea-Brown**

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**EDUCATION:**

**PRINCETON UNIVERSITY**, Princeton, NJ, 1999 – 2004

Ph.D. (2004), M.S. (2001), Applied and Computational Mathematics

**Advisor:** Philip Holmes

**Co-Advisor:** Jonathan Cohen

**Dissertation:** *Neural oscillators and integrators in the dynamics of decision tasks*

**UNIVERSITY OF CALIFORNIA AT BERKELEY**, Berkeley, CA, 1994 – 1998

B.S. (1998), Engineering Physics (with High Honors)

**ACADEMIC AND SCIENTIFIC POSITIONS:**

**Professor, Department of Applied Mathematics, University of Washington**, Seattle, WA

(Associate professor Sept. 2012-Sept. 2016; Assistant professor, Jan. 2008-Sept. 2012)

Research and teaching in theoretical and computational neuroscience, and applied dynamical systems.

**Co-director:** UW Computational Neuroscience Center

**Affiliate Investigator:** Allen Institute for Brain Science

**Adjunct faculty:** Departments of Physiology and Biophysics, Electrical and Computer Engineering

**Affiliated faculty:** Program in Neurobiology and Behavior, Bloedel Hearing Research Center

**Visiting faculty:** Group for Neural Theory, École normale supérieure, Paris (sabbatical, Winter 2014); Allen Institute for Brain Science, Seattle (sabbatical, Spring-Fall 2014).

**Postdoctoral research fellow, Courant Institute for Mathematical Sciences and Center for Neural Science, New York University**, New York, NY, Sept. 2004-Dec. 2007

Mentor: John Rinzel.

Research in applied dynamics and mathematical neuroscience (neural mechanisms for the representation of time intervals, dynamics of structured oscillator networks, models of correlated spiking in neural populations).

**Research associate, Program in Applied and Computational Mathematics, Princeton University**, Princeton, NJ, Summer 2004

Research in applied dynamics and mathematical neuroscience (dynamics and neural mechanisms of optimal decision algorithms).

**Research fellow, Lawrence Livermore National Laboratory (LLNL)**, Livermore, CA, 1996 – 1999

Associated Western Universities and Dept. of Energy (SERS) programs

Research in computational modeling of chemical transport through geologic domains.

**HONORS AND AWARDS:**

**Boeing Endowed Professor of Applied Mathematics** (2015-2018)

**Lecturer**, (HKUST Inst. Adv. Study Distinguished Lecture '18, Bernstein Plenary Lecture '18, COSYNE Invited Lecture '19)

**Recipient**, National Science Foundation CAREER Award (2011-2016)

**Recipient**, Simons Fellowship in Mathematics (2014)

**Co-recipient**, 2011 D.G. Marquis Award for best paper of the year in *Behavioral Neuroscience* (Matell et al, 2011)

**Recipient**, Burroughs Wellcome Career Award at the Scientific Interface (2006-2013)

**Recipient** of the 2004 Council of Graduate Schools / University Microfilms International Distinguished Dissertation Award in the field of Mathematics, Science, and Engineering (awarded Nov. 2004)

**Mathematical Sciences Postdoctoral Fellow**, National Science Foundation (2004-2007)

**Porter Ogden Jacobus Fellow**, Princeton University (2003 – 2004)

**Fellow**, Burroughs Wellcome Graduate Training Program in Biological Dynamics (2001 – 2004)

**Fellow**, National Science Foundation Graduate Fellowship Program (1999 – 2002)

**Recipient**, 1999 UC-Berkeley Departmental Citation in Engineering Science

**Recipient**, DOE (SERS), Associated Western Universities Fellowships, LLNL (1996-1998)

**Member**, Phi Beta Kappa, Tau Beta Pi Societies (1998 - present)

### **PUBLICATIONS:**

- Yuhan Helena Liu, Stephen Smith, Stefan Mihalas, Eric Shea-Brown, and Uygur Sumbul. A solution to temporal credit assignment using cell-type-specific modulatory signals, *BioRxiv*, and *to appear, Proc. Nat. Acad. Sci. USA*, 2021.
- Doris Voina, Stefano Recanatesi, Brian Hu, Eric Shea-Brown, and Stefan Mihalas. Single circuit in V1 capable of switching contexts during movement using VIP population as a switch, *BioRxiv* and *to appear, Neural Computation*, 2021.
- Alison Weber, Eric Shea-Brown, and Fred Rieke. Identification of multiple noise sources improves estimation of neural responses across stimulus conditions. *BioArXiv* and *eNeuro*. 2021 Jul-Aug; 8(4), 2021.
- Matthew Farrell, Stefano Recanatesi, R. Clay Reid, Stefan Mihalas, Eric Shea-Brown. Autoencoder networks extract latent variables and encode these variables in their connectomes. *ArXiv*, and *to appear, Neural Networks*, 2021.
- Gabrielle Gutierrez, Fred Rieke, and Eric Shea-Brown. Nonlinear convergence boosts information coding in circuits with parallel outputs. *BiorXiv*, and *PNAS* 118 (8) e1921882118, 2021.
- Stefano Recanatesi, Matthew Farrell, Guillaume Lajoie, Sophie Deneve, Mattia Rigotti, and Eric Shea-Brown. Predictive learning as a network mechanism for extracting low-dimensional latent space representations. *BioRxiv*, and *Nature Communications*, 2021.
- S. DeVries, J. Lecoq, M. Buice, et al. A large-scale, standardized physiological survey reveals higher order coding throughout the mouse visual cortex. *BioRxiv*, and *Nature Neuroscience*, 2019.
- Iris Shi, Eric Shea-Brown, and Michael Buice. Comparison Against Task Driven Artificial Neural Networks Reveals Functional Properties in Mouse Visual Cortex. *NeurIPS*, 2019.
- Daniel Zdeblick, Eric Shea-Brown, Daniela Witten, and Michael Buice. Data-Driven Discovery of Functional Cell Types that Improve Models of Neural Activity. Workshop paper, *NeurIPS*, 2019
- Stefano Recanatesi, Gabe Ocker, Michael Buice, and Eric Shea-Brown. Dimensionality in recurrent spiking networks: Global trends in activity and local origins in connectivity. *BioRxiv* and *PLOS Computational Biology* 5(7): e1006446, 2019.
- Y. Hu, S. Brunton, N. Cain, S. Mihalas, J. N. Kutz, E. Shea-Brown. Feedback through graph motifs relates structure and function in complex networks. *ArXiv q-Bio.NC/1605.09073*, and *Phys. Review E* 98, 062312, 2018.
- B. Brinkman, F. Rieke, E. Shea-Brown, and M. Buice. Predicting How and When Hidden Neurons Skew Measured Synaptic Interactions. *ArXiv q-Bio.NC/1702.00865* and *PLOS Computational Biology* 14(10): e1006490, 2018.
- J. Knox, K. Harris, N. Graddis, J. Whitesell, H. Zeng, J. Harris, E. Shea-Brown, S. Mihalas. High resolution data-driven model of the mouse connectome. *BioRxiv* and *Network Neuroscience* 3(1), 217-236, 2019.
- A. Cayco-Gajic, J. Zylberberg, and E. Shea-Brown. A moment-based maximum entropy model for fitting higher-order interactions in neural data. *Entropy* 20, 489, 2018.
- H. Choi, A. Pasupathy, and E. Shea-Brown. Predictive coding in area V4: dynamic shape discrimination under partial occlusion. *ArXiv q-Bio.NC/ 1612.05321*, and *Neural Computation*, 30(5), 2018.

- G. Ocker, K. Josic, E. Shea-Brown, M. Buice. Linking structure and activity in nonlinear spiking networks. ArXiv q-Bio.NC/1610.03828, and *PLOS Computational Biology* 13(6): e1005583, 2017.
- A. Fyall, Y. El-Shamayleh, H. Choi, E. Shea-Brown, and A. Pasupathy. Dynamic representation of occluded objects in primate prefrontal and visual cortices. *eLife* 6:e25784, 2017.
- G. Ocker, Y. Hu, M. Buice, B. Doiron, K. Josic, R. Rosenbaum, E. Shea-Brown. From the statistics of connectivity to the statistics of spike times in neuronal networks. ArXiv q-Bio.NC/1703.03132, and *Current Opinion in Neurobiology* 46: 109-119, 2017.
- K. Harris, T. Dashevskiy, J. Mendoza, A. Garcia, J. Ramirez, E. Shea-Brown. Differential roles for inhibition in excitatory rhythm generators. ArXiv q-Bio.NC/1610.04258, and *J. Neurophysiology*, 118: 2070-2088, 2017.
- R. Kass, (~20 authors), E. Shea-Brown, ..., and M. Kramer. Computational neuroscience: mathematical and statistical perspectives. *Annual Review of Statistics and Its Application*, 5: 183-214, March 2018.
- J. Zylberberg, A. Pouget, P. Latham, and E. Shea-Brown. Robust information propagation through noisy neural circuits. ArXiv q-Bio.NC/1608.05706, and *PLOS Computational Biology* 13(4): e1005497, 2017.
- G. Lajoie, K. Lin, J.-P. Thivierge, and E. Shea-Brown. Revisiting chaos in stimulus-driven spiking networks: signal encoding and discrimination. ArXiv q-Bio.NC/1605.07497, and *PLOS Computational Biology* 12(12) e1005258, 2016.
- B. Brinkman, A. Weber, F. Rieke, and E. Shea-Brown. How Do Efficient Coding Strategies Depend on Origins of Noise in Neural Circuits? *PLOS Computational Biology*, 12(10): e1005150, 2016.
- K. Harris, S. Mihalas, and E. Shea-Brown. Nonnegative spline regression of incomplete tracing data reveals high resolution neural connectivity. ArXiv q-Bio.NC/1605.08031, and *NIPS*, 2016
- J. Zylberberg, J. Cafaro, M. Turner, E. Shea-Brown, and F. Rieke. Direction-selective circuits shape noise to ensure a precise population code. *Neuron* 89: 369-383, 2016.
- M. Hawrylycz et al (Shea-Brown as part of “Mindscope Project” authorship). Inferring cortical function in the mouse visual system through large-scale systems neuroscience. *PNAS* 113 (27) 7337-7344, 2016.
- J. Zylberberg and E. Shea-Brown. Input nonlinearities can shape beyond-pairwise correlations and improve information transmission by neural populations. ArXiv q-Bio.NC/1212.3549 and *Physical Review E* 92: 062707, 2015.
- D. Leen and E. Shea-Brown. A simple mechanism for higher-order correlations in integrate-and-fire neurons. ArXiv q-Bio.NC/1306.5275 and *Journal of Mathematical Neuroscience* 5:17, 2015.
- M. Schwemmer, A. Fairhall, S. Deneve, and E. Shea-Brown. Constructing precisely computing networks with biophysical spiking neurons. ArXiv q-Bio.NC/1411.1391 and *Journal of Neuroscience* 35(28): 10112-10134, 2015.
- A. Cayco Gajic, J. Zylberberg, and E. Shea-Brown. Impact of triplet correlations on neural population codes. ArXiv q-Bio.NC/1412.0363 and *Frontiers in Comp. Neuroscience*, 9:57, 2015.
- G. Lajoie, J.P. Thivierge, and E. Shea-Brown. Structured chaos shapes spike-response noise entropy in balanced neural networks. *Frontiers in Comp. Neuroscience* 8:123, 2014.
- Y. Hu, J. Trousdale, K. Josic, and E. Shea-Brown. Local paths to global coherence: cutting networks down to size. ArXiv q-Bio.NC/1212.4239 and *Physical Review E*, 89, 032802 2014.
- A. Barreiro, J. Gjorgjieva, F. Rieke, and E. Shea-Brown. When are feedforward microcircuits well-modeled by maximum entropy methods? ArXiv q-Bio/1011.2797, *Frontiers in Comp. Neuroscience*, 8:10, 2014.
- Y. Hu, J. Zylberberg, and E. Shea-Brown. The sign rule and beyond: Boundary effects, flexibility, and optimal noise correlations in neural population codes. ArXiv q-Bio/1307.3235, and, *PLOS Comp. Biology*, 10(2): e1003469, 2014.
- J. Trousdale, Y. Hu, E. Shea-Brown, and K. Josic. A generative spike train model with time-structured higher order correlations. *Frontiers in Comp. Neuroscience* 7:84, 10.3389, 2013.

- G. Lajoie, K. Lin, and E. Shea-Brown. Chaos and reliability in balanced spiking networks. ArXiv nlin/1209.3051 and *Physical Review E*, 87:052901-052913, 2013.
- N. Cain, A. Barreiro, M. Shadlen, and E. Shea-Brown. Neural integrators for decision making: A favorable tradeoff between robustness and sensitivity. ArXiv q-Bio.NC/1111.6573 and *J. Neurophysiology* 109(10):2542-59, 2013.
- A. Cayco Gajic and E. Shea-Brown. Neutral stability, rate propagation, and critical branching in feedforward networks. ArXiv q-Bio.NC/1210.8406 and, *Neural Computation*, 25(8), 1768-1806, 2013.
- Y. Hu, J. Trousdale, K. Josic, and E. Shea-Brown. Motif Statistics and Spike Correlations in Neuronal Networks. ArXiv q-Bio.NC/1206.3537 and *J. Statistical Mechanics* P03012:1-51, 2013.
- N. Cain and E. Shea-Brown. Impact of correlated neural activity on decision making performance. ArXiv q-Bio.NC/1207.5159 and, *Neural Computation* 13(25) 2: 289–327, 2013.
- A. Fairhall, E. Shea-Brown, and A Barreiro. Information theoretic approaches to understanding circuit function. *Current Opinion in Neurobiology*, 22(4): 653-659, 2012.
- A. Barreiro, E. Thilo, and E. Shea-Brown. The A-current and Type I / Type II transition determine collective spiking from common input. ArXiv q-Bio.NC/1106.0863, 2011, and *J. Neurophysiology* 108(6):1631-45, 2012.
- J. Goldwyn, J. Rubinstein, and E. Shea-Brown. A point process framework for modeling electrical stimulation of the auditory nerve. ArXiv q-Bio.NC/1201.5428 and *J. Neurophysiology*, 108:1430-1452, 2012.
- N. Cain and E. Shea-Brown. Computational models of decision making: integration, nonlinearity, and noise. *Current Opinion in Neurobiology* 22:1–7, 2012.
- J. Trousdale, Y. Hu, E. Shea-Brown, and K. Josic. Impact of network structure and cellular response on spike time correlations. ArXiv q-Bio.NC/1110.4914, 2011, and *PLOS Comp. Biol.*, 8(3): e1002408, 2012.
- J. Goldwyn and E. Shea-Brown. The what and where of adding channel noise to the Hodgkin-Huxley equations. ArXiv q-Bio/1104.4823 and *PLOS Comp. Biol.* 7:1002247, 2011.
- G. Lajoie and E. Shea-Brown. Shared inputs and desynchrony in elliptic bursters: from slow passage to discontinuous circle maps. ArXiv math.DS/1010.2809 and *SIAM J. App. Dyn. Sys.* (10): 1232-1271, 2011.
- J. Goldwyn, N. Imennov, M. Famulare, and E. Shea-Brown. On stochastic differential equation models for ion channel noise in Hodgkin-Huxley neurons. *Phys. Rev. E*, 041908, 2011 (Also ArXiv q-Bio/1009.4172).
- M. Matell, E. Shea-Brown, A. Wilson, C. Gooch, and J. Rinzel. A heterogeneous population code for elapsed time in rat medial agranular cortex. *Behavioral Neuroscience*, 125(1): 54–73, 2011. (Winner of 2011 D.G. Marquis Award.)
- J. Goldwyn, E. Shea-Brown, and J. Rubinstein. Encoding and decoding amplitude-modulated cochlear implant stimuli – a point process analysis. *J. Comp. Neuroscience*, 28(3):405-424, 2010.
- A. Barreiro, E. Shea-Brown, and E. Thilo. Timescales of spike-train correlation for neural oscillators with common drive. *Phys. Rev. E*, 81:011916, 2010.
- K. Josic, E. Shea-Brown, J. de la Rocha, and B. Doiron. Stimulus-dependent correlations and population codes. *Neural Computation*, 21(10): 2774-2804, 2009.
- K. Lin, E. Shea-Brown, and L-S. Young. Spike-time reliability of layered neuronal oscillator networks, *Journal of Comp. Neuroscience*, 27(1):135-160, 2009. Extension of: K. Lin, E. Shea-Brown, and L-S. Young. Reliability of layered neuronal oscillator networks. Fast communication in *Comm. Math. Sci.*, 7(1): 239-247, 2009.
- K. Lin, E. Shea-Brown, and L-S. Young. Reliability of coupled oscillators. *J. Nonlin. Sci.*, 19(5): 497-545, 2009 and ArXiv Tnlin.CD/0708.3061, 2007, ArXiv Tnlin.CD/0708.3063, 2007 (with additional unpublished material).
- E. Shea-Brown, K. Josic, J. de la Rocha, and B. Doiron. Correlation and synchrony transfer in integrate-and-fire neurons: basic properties and consequences for coding. *Physical Review Letters* 100, 108102, 2008, and ArXiv q-bio.NC/0703037.

- E. Shea-Brown, M. Gilzenrat, and J. D. Cohen. Optimization of decision making in multilayer networks: The role of Locus Coeruleus. *Neural Computation*, 20:2863-2894, 2008.
- J. de la Rocha, B. Doiron, E. Shea-Brown, K. Josic, and A. Reyes. Correlation between neural spike trains increases with firing rate. *Nature* 448, 802-806, 2007.
- X. Feng, E. Shea-Brown, H. Rabitz, B. Greenwald, and R. Kosut. Optimal Deep Brain Stimulation of the subthalamic nucleus: a computational study. *Journal of Comp. Neuroscience* 23(3): 265-282, 2007.
- X. Feng, E. Shea-Brown, H. Rabitz, B. Greenwald, and R. Kosut. Toward Closed-Loop Optimization of Deep Brain Stimulation for Parkinson's Disease: Concepts and Lessons from a Computational Model. *Journal of Neuroengineering*, 4: L14-L21, 2007.
- S. Coombes, B. Doiron, K. Josic, and E. Shea-Brown. Toward blueprints for network architecture, biophysical dynamics, and signal transduction. *Phil. Trans. Royal Soc. A*, 364: 3301-3318, 2006.
- R. Bogacz, E. Brown, J. Moehlis, P. Hu, P. Holmes, and J. D. Cohen. The physics of optimal decision making: A formal analysis of models of performance in two-alternative forced choice tasks. *Psychological Review*, 113: 700-765, 2006.
- J. Moehlis, E. Shea-Brown, and H. Rabitz. Optimal inputs for phase models of spiking neurons. *ASME Journal of Computational and Nonlinear Dynamics*, 1(4): 358-367, 2006.
- M. Golubitsky, K. Josic, and E. Shea-Brown. Winding numbers and average frequencies in phase oscillator networks. *Journal of Nonlinear Science*, 16, 201-231, 2006.
- E. Shea-Brown, J. Rinzel, B. Rakitin, C. Malapani. A firing-rate model of Parkinsonian deficits in interval timing. *Brain Research*, 1070, 189-201, 2006.
- P. Holmes, E. Shea-Brown, J. Moehlis, R. Bogacz, J. Gao, G. Aston-Jones, E. Clayton, J. Rajkowski, and J.D. Cohen. Optimal decisions: From neural spikes, through stochastic differential equations, to behavior. *IEICE Transactions on Fundamentals of Electronics, Communications and Computer Science*, 88 (10), 2496-2503, 2005.
- E. Brown, J. Gao, P. Holmes, R. Bogacz, M. Gilzenrat and J.D. Cohen. Simple neural networks that optimize decisions. *Int. Journal of Bifurcation and Chaos*, 15(3): 803-826 2005. (Highlighted by P. Dayan in Journal Club section of *Nature* 435, p. 251 (2005).) Also appears in World Scientific Series on Nonlinear Science, Series B - Vol. 13, E. Doedel, G. Domokos, and I. Kevrekidis, eds.
- E. Brown, J. Moehlis, P. Holmes, E. Clayton, J. Rajkowski, and G. Aston-Jones. The influence of spike rate and stimulus duration on noradrenergic neurons. *Journal of Comp. Neuroscience* 17 (1), 5-21, 2004.
- E. Brown, J. Moehlis, and P. Holmes. On the phase reduction and response dynamics of neural oscillator populations. *Neural Computation*, 16: 673-715, 2004.
- E. Brown, P. Holmes, and J. Moehlis. Globally coupled oscillator networks. In: *Perspectives and Problems in Nonlinear Science: A Celebratory Volume in Honor of Larry Sirovich*, E. Kaplan, J. Marsden, K. Sreenivasan, Eds., pp. 183-215. Springer: New York, 2003.
- H. Rabitz, G. Turinici, and E. Brown. Control of Molecular Motion: Concepts, Procedures, and Future Prospects. In: *Handbook of Numerical Analysis, Volume X*, P. Ciarlet and J. Lions, Eds., pp. 833-887. Elsevier: Amsterdam, 2003.
- R. Cho, L. Nystrom, E. Brown, A. Jones, T. Braver, P. Holmes, and J. D. Cohen. Mechanisms underlying performance dependencies on stimulus history in a two-alternative forced choice task. *Cognitive, Affective, and Behavioral Neuroscience*, 2(4): 283-299, 2002.
- E. Brown and H. Rabitz. Some mathematical and algorithmic challenges in the control of quantum dynamics. *Journal of Mathematical Chemistry* 31(1):17-63, 2002. Also appears (in Russian) in *Control of molecular and quantum systems*, A.L.Fradkov, O.A.Yakubovskii, Eds., Moscow-Izhevsk, Institute for Computer Studies, 2003.

- E. Brown and P. Holmes. Modeling a simple choice task: stochastic dynamics of mutually inhibitory neural groups. *Stochastics and Dynamics* 1(2):159-191, 2001.

### **PREPRINTS ON ARXIV AND BIORXIV:**

- Jiaqi Shang, Eric Shea-Brown, Stefan Mihalas. Cortical representation variability aligns with in-class variances and can help one-shot learning, BioArxiv, 2021.
- Daniel Burnham, Eric Shea-Brown, and Stefan Mihalas. Learning to predict in networks with heterogeneous and dynamic synapses, ICLR workshop paper, and BioArxiv, 2021.
- Stefano Recanatesi, Serena Bradde, Vijay Balasubramanian, Nicholas A Steinmetz, Eric Shea-Brown. A scale-dependent measure of system dimensionality. BioRxiv 2020
- Jianghong Shi, Michael A. Buice, Eric Shea-Brown, Stefan Mihalas, Bryan Tripp, A Convolutional Network Architecture Driven by Mouse Neuroanatomical Data, BioRxiv, 2020.
- David Dahmen, Stefano Recanatesi, Gabriel Ocker, Xiaoxuan Jia, Moritz Helias, Eric Shea-Brown. Strong coupling and local control of dimensionality across brain areas, BioRxiv, 2020
- Merav Stern, Eric Shea-Brown, and Daniela Witten. Inferring Neural Population Spiking Rate from Wide-Field Calcium Imaging. BioRxiv, 2020.
- Timothy Oleskiw, Wyeth Bair, Eric Shea-Brown, Nicolas Brunel. Firing rate of the leaky integrate-and-fire neuron with stochastic conductance-based synaptic inputs with short decay times. ArXiv q-Bio arXiv:2002.11181, 2020.
- Stefano Recanatesi, Matthew Farrell, Madhu Advani, Timothy Moore, Guillaume Lajoie, Eric Shea-Brown. Dimensionality compression and expansion in deep neural networks. ArXiv 1906:00443, 2019.
- Alex Cayco-Gajic, Séverine Durand, Michael Buice, Ramakrishnan Iyer, Clay Reid, Joel Zylberberg, Eric Shea-Brown. Transformation of population code from dLGN to V1 facilitates linear decoding. BioRxiv, 2019.
- Matthew Farrell, Stefano Recanatesi, Guillaume Lajoie, and Eric Shea-Brown. Dynamic compression and expansion in a classifying recurrent network. BioRxiv, 2019.
- S. Chen, A. Shojaie, E. Shea-Brown, and D. Witten. The multivariate Hawkes Process in high dimensions: Beyond mutual excitation. ArXiv, 2017.

### **OTHER ARTICLES AND EXPOSITORY MATERIAL:**

- M. Stern and E. Shea-Brown. Network Dynamics Governed by Lyapunov Functions: From Memory to Classification. Spotlight in Trends in Neurosciences, 2020.
- E. Shea-Brown. Exploring Connectivity in the Brain's Network of Neurons. Front-page story in *SIAM News* 47(8), 2014.
- Featured book review with K. Josic, on two books in mathematical neuroscience and state of field, *SIAM Review* 53(3), 577-583, 2011.
- “Isochron,” “Periodic Orbit,” and “Stability” entries, co-authored with P. Holmes, J. Moehlis and K. Josic. In peer-reviewed *Scholarpedia, Dynamical Systems*, E. Izhikevich, Ed. (online). p.2509, p.2464, and p.4208 (respectively). 2006. [www.scholarpedia.org](http://www.scholarpedia.org)
- “Brain Dynamics: the Mathematics of the Spike,” with B. Doiron. SIAM *Whydomath* initiative, 2008. [www.whydomath.org](http://www.whydomath.org)
- R. Bogacz, E. Brown, J. Moehlis, P. Holmes and J.D. Cohen. How a biological decision network can implement a statistically optimal test. *Modelling Natural Action Selection: Proceedings of an International Workshop*, 3-8. AISB Press, Brighton, UK (2005).



## **TECHNICAL REPORTS:**

- E. Brown, M. Gilzenrat, and J. D. Cohen. The locus coeruleus, adaptive gain, and the optimization of simple decision tasks. *Technical Report #04-02*, Center for the Study of Mind, Brain, and Behavior, Princeton University (2004).
- J. Moehlis, E. Brown, R. Bogacz, P. Holmes, J. D. Cohen. Optimizing reward rate in two alternative forced choice tasks: mathematical formalism. *Technical Report #04-01*, Center for the Study of Mind, Brain, and Behavior, Princeton University (2004).
- E. Brown, S. Doss, F. Hoffman, R. Gelinias, K. Fox, and J. O'Boyle. Adaptive-grid computational model of VOC transport across fine-and coarse-grained sediment contacts. In *LDRD Final Report, Lawrence Livermore National Laboratory* (UCRL-ID-129845), pp. 5.1-5.37, Livermore, CA (1998).

## **SELECTED RESEARCH GRANTS AND FUNDING:**

- NIH BRAIN R01 1RF1DA055669 (E. Shea-Brown and Stefan Mihalas, PIs, \$1.15M). From diverse dynamics to diverse computation via neural cell types. 08/2021-07/2024.
- NSF NCS-FO #2024364 (PI; co-PI Nick Steinmetz, \$1M). *Variability and the Global Brain*. 10/2020-09/2024.
- NSF Accelnet #2019976 (Co-PI; PI Adrienne Fairhall, \$755K). *International Network for Brain-Inspired Computation*. 01/2021-12/2023.
- NIH BRAIN R01EB026908 (Co-Investigator; Daniela Witten and Michael Buice, PIs). Models and Methods for Calcium Imaging Data with Application to the Allen Brain Observatory. 08/2018-06/2021.
- NSF DMS Grant #1514743. *Collaborative research: The ever-changing network – How changes in architecture shape neural computations*. 7/15-6/19 (PI, component to my group, \$90K).
- Ongoing support to PI and group from Allen Institute for Brain Science, 2014-2021
- Simons Fellowship in Mathematics. *Statistics and dynamics of neural population codes*. 6/14-12/14 (PI; \$74K).
- NSF CRCNS Grant #DMS-1208027. *CRCNS: Collective coding in retinal circuits*. 9/12-9/17 (PI; Fred Rieke co-PI, \$500K).
- NSF DMS Grant #1122106. *Collaborative research: Relating architecture and temporal correlations in networks of spiking neurons*. 10/11-9/16 (PI, component to my group, \$130K).
- NSF CAREER Award DMS-1056125. *Bridging dynamical and statistical models of neural circuits -- a mechanistic approach to multi-spike synchrony*. 3/11-3/17 (PI, \$469K).
- NSF DMS Grant #0818153. *Collaborative research: Correlations in neural dynamics and coding*. 8/08-7/11 (PI, component to my group, \$143K).
- NIH R01DC012142 (Co-Investigator; Julie Berier, PI), *Perceptual implications of cochlear implant electrode-neuron interfaces*, 04/2012 - 04/2017.
- Burroughs Wellcome Career Award at the Scientific Interface. *Neurobiological Dynamics of Timing and Decisions*. 8/08-7/11 (PI, \$500K). 01/06-12/12.
- Northwest Center for Neural Engineering Seed Grant. *Do robust feedback circuits underlie neural dynamics in decision tasks?* (PI, \$13K). 5/09-4/10.
- NSF Teragrid Scientific Computing allocation TG-IBN090004 (startup category, 410,000 hours of processor time awarded). 10/2009 – 12/2011.

## **TRAINING AND CENTER GRANTS:**

- PI, with A. Fairhall: NIH T90/R90 Training Program in Neural Computation and Engineering at the University of Washington: 5T90DA032436-07 / 5R90DA033461-07, 2016-2021 (~\$1+M).

- Thrust leader or co-leader in computational neuroscience, NSF ERC for Sensorimotor Neural Engineering, 2014-2021 (Total ERC Grant ~\$30M).
- Member of faculty leadership team for NIH T90/R90 Grant *Computing and the brain: training the next generation of neuroscientists* (A. Fairhall, PI), 2011-2016.

## **RESEARCH ADVISING:**

### **Postdoctoral fellows:**

Stefano Recanatesi, University of Washington, Swartz Center for Theoretical Neuroscience at the University of Washington (2017-current; dimensionality in neural networks)

Gabrielle Gutierrez, University of Washington, Applied Mathematics and Physiology and Biophysics (*co-advised with Fred Rieke*, 2016-2021; interplay of network interactions and intrinsic dynamics for retinal coding)

Hannah Choi, University of Washington, Applied Mathematics and Biological Structure (*co-advised with Wyeth Bair*, 2016-2020; dynamics and predictive coding in higher visual circuits)

Merav Stern, University of Washington, Applied Mathematics and Allen Institute for Brain Science (*co-advised with Shawn Olsen*, 2016-2019; cortical dynamics of learning in visual tasks)

Braden Brinkman, University of Washington, Applied Mathematics and Physiology and Biophysics (*co-advised with Fred Rieke*, 2013-2017; currently Assist. Prof. Physiology and Biophysics, Stony Brook University; optimal coding in nonlinear circuits, rescaling and renormalization approaches)

Joel Zylberberg, University of Washington, Applied Mathematics (2012-2015; currently Canada Research Chair in Computational Neuroscience and Assist. Prof. of Physics and Astronomy, York University; cooperative coding and higher-order correlations in neural circuits)

Andrea Barreiro, University of Washington, Applied Mathematics (2008-2011, currently Assoc. Prof. of Mathematics, SMU; mathematical analysis of neural integrators and correlated spiking dynamics)

*External advisor for:* Michael Schwemmer (*co-advised with Adrienne Fairhall; based at MBI*), Mathematical Biosciences Institute (MBI), (2013-14; long timescale computations in recurrent networks)

### **Ph.D. students:**

Joshua Goldwyn, University of Washington, Applied Mathematics (Ph.D. 2011, Currently Asst. Prof. of Mathematics, Swarthmore University, via postdoctoral fellow at Ctr. for Neural Sci. and Courant Institute, NYU; computational models of signal encoding in auditory neuroscience. Funding award received as advisee: NIH NRSA F-31 Fellowship).

Nicolas Cain, University of Washington, Applied Mathematics (Ph.D. 2012, currently Developer, Google via Fellow, Google and Scientist at Allen Institute for Brain Science; dynamics and signal processing in neural integrator networks; applications to cognitive neuroscience)

Guillaume Lajoie, University of Washington, Applied Mathematics (Ph.D. 2013, Currently Asst. Prof. of Mathematics, University of Montreal and MILA, via UWIN Innovation Fellow and Bernstein Fellowship in Computational Neuroscience; synchrony and rhythms in forced neural networks; Funding award as advisee: NSERC Graduate Fellowship).

Yu Hu, University of Washington, Applied Mathematics (PhD 2014, **2014 Top-ranked dissertation at UW in Mathematics, Physical Sciences and Engineering**, “Collective Activity in Neural Networks: the Mathematical Structure of Connection Graphs and Population Codes.” Fellow at Harvard Ctr. For Brain Research; currently Assistant Professor, Hong Kong University of Science and Technology (HKUST); correlations and coding in recurrent neural networks)

Natasha (Alex) Cayco Gajic, University of Washington, Applied Mathematics (PhD 2015; dynamics and statistical mechanics in neural networks; Funding award as advisee: NSF Graduate Fellowship; Currently Assistant Professor, ENS-Paris).



Tim Oleskiw, (PhD 2017, *co-advised with Wyeth Bair and Anitha Pasupathy, UW Biological Structure, University of Washington, Applied Mathematics (dynamics and coding of higher-order visual features; currently postdoctoral fellow, NYU)*)

Kameron Harris, University of Washington, Applied Mathematics (PhD 2018; synchrony and topology in rhythm-generating networks; inference of network connectivity from sparse observations; currently Asst. Professor of Computer Science, Western Washington U., via WRF Research Fellow)

Alison Weber, (*co-advised with Fred Rieke*), University of Washington, Neuroscience (PhD 2019; nonlinear signal processing in early visual networks; currently WRF Research Fellow)

Doris Voina, (*co-advised with Stefan Mihalas*), University of Washington, Applied Mathematics (current; POMDP models for staged decision making, cell-type specific circuits for contextual computation)

Iris Shi, (*co-advised with Michael Buice*), University of Washington, Applied Mathematics (current; relating activity in convolutional neural networks and neural recordings)

Matthew Farrell, University of Washington, Applied Mathematics PhD 2020; dynamics and chaos in heterogeneous network networks; currently Postdoctoral Fellow, Harvard U.)

Daniel Zdeblick, (*co-advised with Michael Buice*) University of Washington, Electrical Engineering (current; extracting cell-type specific dynamics and function from population recordings)

Helena Liu, University of Washington, Applied Mathematics (current; multiplexed learning rules in neural networks)

#### **Masters Students:**

Daniel Burnham, University of Washington, Applied Mathematics (2020-2021); synaptic diversity and learning capacity in artificial neural networks

Shane Shang, University of Washington, Applied Mathematics (2019-2021); role of variability in neural coding, learning, and generalization

Michael Wojnowicz, University of Washington, Mathematics (2012, Masters Thesis: *The Ornstein-Uhlenbeck Process In Neural Decision-Making: Mathematical Foundations And Simulations Suggesting the Adaptiveness of Robustly Integrating Stochastic Neural Evidence*).

David Leen, University of Washington, Applied Mathematics (2013; higher-order activity correlations in neural circuits)

#### **Undergraduate students:**

Chloe Winston, University of Washington, Computer Science (2020-2021); role of cellular dynamics in network learning

Zachary McNulty, University of Washington, Applied Mathematics (2019); predictive learning of physical laws in recurrent neural networks

Timothy Moore, University of Washington, Mathematics (2018-2019); role of chaos and instability in learning for artificial neural networks.

Joshua Mendoza, University of Washington, Applied Mathematics (2014-2015, and 2016-2018); dynamics of respiratory rhythm generation; Senior Honors Thesis: *The effects of network structure in creating a two-phase breathing pattern in the Botzinger and pre-Botzinger complexes*. Project-specific support received by Mendoza as advisee: UWIN Postbac Fellowship.

Tyler Kekona, University of Washington, (2016); statistical models of neural circuits and effects of hidden units.

Dirir Abdullahi, University of Washington, Neuroscience (Summer 2014; synchrony in sparse inhibitory networks of Boolean neurons)

Yoni Browning, University of Washington, Neurobiology (2012-2013; learning optimal connections in feedforward networks).

Kendrick Tang, University of Washington, Mathematics (2012; correlations in recurrent neural networks).

Megan Lacy, University of Washington, Neurobiology (2012-2013; computational models of network dynamics in Parkinson's disease). Project-specific support received by Lacy as advisee: UW Mary Gates Undergraduate Research Fellowship.

Evan Thilo, University of Washington, Neurobiology (2008-2009; Senior Thesis (Spring '09): *Correlation transfer in conductance-based neuron models*). Project-specific support received by Thilo as advisee: UW Mary Gates Undergraduate Research Fellowship.

Travis Johnson, University of Washington, Applied and Computational Mathematical Sciences (2009; correlation transfer in reduced neuron models – role of saddle-node and Hopf bifurcations)

Brian Greenwald, Princeton University, Chemistry (role: graduate student mentor; Senior Thesis: *Explorations in the Control, Optimization, and Analysis of Neural Systems*, 2004)

#### **Additional rotation students (Ph.D.):**

Biraj Pandey, University of Washington, Applied Mathematics (2019; machine learning and localized codes)

Helena Liu, University of Washington, Applied Mathematics (2020; low-rank, cell-type specific learning rules)

Gabrielle O'Brien, University of Washington, Neurobiology and Behavior (2013; models of cochlear implant perception)

Shin Kira, University of Washington, Neurobiology and Behavior (2009; dynamic models of evidence accumulation in simple neural circuits)

Yanping Huang, University of Washington, Physiology and Biophysics (2008; variational methods for identifying level sets of equivalent neural network models)

Riju Srimal, New York University, Center for Neural Science (2007; mentor for Srimal rotation in working group of Prof. John Rinzel; phase plane methods and applications to firing rate models for cognitive tasks)

#### **High school students:**

Katherine Leon (2005; co-mentor, Bronx Science High School, project *Biological Networks*, 2005)

#### **Selected additional committee memberships (Ph.D.):**

##### ***University of Washington:***

***Applied Math:*** Woo Kim (*reader*); Ying Zhou; Peizhe Shi (*reader*); Minsun Kim (*reader*); Dean Gull (*reader*); Edwin Ding (*reader*); Lisa Bishop (*reader*); Christine Lind (*reader*); Pedro Maia; Jacob Grosek (*reader*), Syuzanna Sargsyan (*reader*), Felix Ye, Bethany Lusch (*reader*), Sam Rudy, Lowell Thompson, Megan Morrison, Kathleen Champion, Roman Levin

***Biostatistics:*** Shizhe Chen

***Physiology and Biophysics:*** Barry Wark, John Cafaro (*reader*)

***Physics:*** Mike Famulare (*reader*), Charlie Fiesler (*reader*)

***Computer Science:*** Yanping Huang

***Bioengineering:*** Nikita Imenov (*reader*), Julien Bloch, Kyle Medley, Si Jia Li

***Neuroscience:*** Shin Kira, Heather Barnett, Maxwell Turner, Dina Popovkina, Gabrielle O'Brien, Jonathan Browning, Dean Pospisil, Tomek Fraczek

***Statistics:*** Jane M. Lange

##### ***National and International:***

David Lyttle and Patrick Greene (Applied Math, Arizona: *reader*), Philip Eckhoff (Applied Math, Princeton: *reader*), Geoffroy Hermann (Ecole Polytechnique; *reader*), Samuel Feng (Applied Math, Princeton: *reader*), Danielle Rager (Neural Computation, CMU), Jay Hennig (CMU), Munenori Takaku (Okinawa Inst. Sci. Tech.)

#### **TEACHING:**

#### **COURSES**

**Instructor and designer of new course,** University of Washington, *Dynamics of Neurons and Networks* (AMATH 534), Winter 2016, 2018, 2020

**Instructor and designer of new course** (with Adrienne Fairhall), University of Washington, Neurobiology and Behavior (NBIO 303), *Neuronal coding and computation* (Winter 2012, 2013, 2015); retitled AMATH 342 (Winter 2016, 2017, 2018, 2019, 2020, 2021)

**Instructor and designer of new course**, University of Washington, Applied Mathematics (AMATH 410/510-422/522), *Introduction to Computational Biology and Chemistry* (renamed *Computational Models in Biology*). (Winter 2008, Spring 2008, Winter 2009, 2010, 2011, 2013, 2015, Autumn 2015, 2016, 2017, 2018, 2019, 2020, 2021)

**Instructor**, University of Washington, Applied Mathematics (AMATH 301), *Beginning Scientific Computing* (Winter 2009), (AMATH 402/502) *Introduction to Nonlinear Dynamics and Chaos* (Winter 2010, 2011, 2012)

**Instructor**, AMATH 500, Journal Club in Theoretical Neuroscience (2012-present)

**Instructor**, University of Washington, Applied Mathematics. Small-group or individual reading courses on (1) basic computational neuroscience (2) survey of the modern mathematical neuroscience literature (3) stochastic methods in neuroscience (4) Dynamical systems in neuroscience (Winter 2009, Fall 2009, Spring 2010, Summer 2011)

**Guest Lecturer**, Graduate courses on mathematical neuroscience. (U. Washington, 2008-2011, New York University, 2005-2007)

**Teaching Assistant / Unit Lecturer**: Princeton University, APC/MOL/EEB 514 *Biological Dynamics*. Delivered course lectures on population models and synchrony in neuroscience, developed some course materials. (half semester, Fall 2003).

**Teaching Assistant**: Princeton University, MOL437 *Computing Networks and Computational Neurobiology* (Fall 2000); University of California at Berkeley, E24 freshman seminar *Exploring Curvature* (elementary ideas from geometry of surfaces). (Spring 1998).

### **ADDITIONAL TEACHING, TUTORIALS AND SUMMER SCHOOLS**

**Summer school co-director**: Allen Institute / UW Summer Workshop on the Dynamic Brain (2019 -)

**Summer school faculty**: Methods in Computational Neuroscience (Wood's Hole MBL, 2011, 2012, 2013), Allen Institute / UW Summer Workshop on the Dynamic Brain (2014, 2015, 2016, 2018, 2019), Berkeley Summer Course in Mining and Modeling of Neuroscience Data (2015), CNeuro (2020, 2021)

**Summer BRIDGE Research Mentor**: Intensive tutorial and research exposure for incoming UW first-years (especially underrepresented minorities). Topic: Learning and signal integration in neural network models (UW, 2 weeks, 2011, 2012; 1 week, 2014)

**Selected tutorials given**: Physiome Project Summer School (U. Washington, 2009-10), Mathematical Neuroscience (Edinburgh, 2011), SIAM Life Sciences Meeting (2010).

### **PROFESSIONAL SERVICE AND LEADERSHIP:**

#### **Positions and Leadership**

Co-founder and Co-director, University of Washington Computational Neuroscience Center (2017-)

Co-director, NIH Training Program in Computational Neuroscience, University of Washington (2016-)

Co-director, Swartz Center for Theoretical Neuroscience at the University of Washington (2015-)

Co-director, Graduate Certificate Program in Neural Computation and Engineering (2016-)

Lead / Co-lead, Thrust in Computational Neuroscience, Center for Sensorimotor Neural Engineering (2015-)

Member of Executive Committee, Neuroscience Graduate Program (2015-2019)

Member of Executive Committee, University of Washington Institute for Neuroengineering (2014-)

Section Chief Editor for Tutorials and Teaching Material, SIAM DSWeb Dynamical Systems Web Portal (2010-2013)

Member of the Advisory Board, SIAM Activity Group on Dynamical Systems (2010-2012)

Institute Partnership Representative for University of Washington -- NSF Mathematical Biosciences Institute (2008-2014)

Member, Princeton University Graduate School Leadership Council (2006-2008)

### **Departmental committees**

Faculty representative, DEI committee, University of Washington (2019-)

Member of on executive, computing, budget, qualifying exam, merit, promotion, hiring committees, Department of Applied Mathematics, University of Washington (varied years, 2014-)

Service on hiring committees, Department of Physiology and Biophysics, University of Washington (2018, 2021)

### **Conferences**

General Chair, COSYNE 2018; Co-Chair of Program Committee, COSYNE 2017; Co-Chair of Diversity and Inclusion Committee, 2019-2021. Member of Program Committee COSYNE 2010, 2015.

Co-organizer, Swartz Theoretical Neuroscience Meeting, 2021.

Local Co-organizer, CNS\*18, Seattle (2018)

Co-organizer, Collaborative Research in Computational Neuroscience Conference (International CRCNS meeting), Seattle (2015)

Co-organizer, Banff International Research Station (BIRS) Workshop “Connecting Network Architecture and Network Computation” (with 5 co-organizers; 2015)

Co-organizer, Theme Year on Mathematical Neuroscience and Workshops on Mathematical Challenges in Neural Networks and Cognitive Neuroscience, NSF Mathematical Biosciences Institute (2012-2013)

Co-organizer, Conference on Neural Dynamics and Computation in honor of John Rinzel, NYU (June 2009)

Co-organizer, UW and Northwest Computational Neuroscience Connections (2009 -2014; proposals for funding granted by NSF Mathematical Biosciences Institute and UW CSNE)

Co-organizer, Banff International Research Station (BIRS) Workshop “Linking neural dynamics and coding: correlations, synchrony, and information” (with 5 co-organizers; Oct. 2010)

### **Conference sessions**

Session organizer, ICIAM 2011 Congress on Applied Mathematics

Session co-organizer, SIAM 2010 Conference on Life Sciences

Session co-organizer, SIAM 2009 Conference on Applications of Dynamical Systems

Session organizer, SIAM 2008 Annual Meeting (Dynamical systems track; invited)

### **Seminars**

Co-organizer, Computational Neuroscience Colloquium, University of Washington (2009-present)

Organizer, Burroughs Wellcome Fellows Seminars in Biological Dynamics, Princeton University (2001-2004)

Organizer, Applied Mathematics Graduate Student Seminars, Princeton University (2000-2002)

### **Proposal, journal, and book reviewing or editing**

Panelist, NSF, (2011-2013, 2017, 2018)

Reviewer, Washington Research Foundation and Mary Gates Fellowships (2010-12, 2016)

Member, Royalty Research Fund Review Committee, University of Washington (2008-2009)

Grant referee, Marsden Foundation (2008)

Editorial Board member, Oxford Reference Encyclopedia, Neuroscience (2018-)

Reviewer, Washington Research Foundation and Mary Gates Fellowships (2010-12, 2016)

Book review of “Modeling Differential Equations in Biology,” *SIAM Review* 50(4): 807 (2008)

Referee for *Nonlinearity*, *Journal of Computational Neuroscience*, *Journal of Nonlinear Science*, *Cerebral Cortex*, *Physica D*, *Network: Computation in Neural Systems*, *Neural Computation*, *Mathematical Biosciences and Engineering*, *Communications in Math. Science*, *SIAM J. Appl. Dynamical Systems*, *Biophysical Journal*, *Physical Review Letters*, *PLOS Computational Biology*, *Biological Cybernetics*, *Frontiers in Computational Neuroscience*, *Frontiers in Decision Neuroscience*, *Journal of Neural Engineering*, *Journal of Neuroscience*, *Journal of Neurophysiology*, *PLOS Biology*, *Nature Neuroscience*, *Journal of Mathematical Neuroscience*, *Elife*, *Nature* (2003-present)

### **Further outreach**

Lectures on mathematics and brain science at: University of Washington Louis Stokes Alliance for Minority Participation Summer STEM Institute (2010,13), UW Research Exposed course, UW ACMS Undergraduate Seminar series (2012), and several undergraduate research organizations at University of Washington and Rutgers Universities.

### **ADDITIONAL TEACHING AND LEADERSHIP EXPERIENCE:**

**Instructor**, North Carolina Outward Bound School. Taught science, writing, and outdoor leadership for accredited high school Summer Scholars Program (Summer 1998) and outdoor leadership and rock climbing for general courses. (Summers 1996, 1997)

**Expedition assistant**, Patagonian Bros. Expeditions, Argentinean Andes (Cerro Aconcagua, 22,800 ft.; Winter 1996)

### **PROFESSIONAL AFFILIATIONS**

Member of Society for Industrial and Applied Mathematics (2000-present)

Member of Society for Neuroscience (2004-present)

Member of American Physiological Society (2011-2014, 2017-2019)

### **FURTHER RESEARCH COMMUNICATIONS:**

#### **SELECTED ABSTRACTS**

- Eric Shea-Brown, Stefano Recanatesi, David Dahmen, Moritz Helias. Dimensionality control in the critical regime of balanced networks. COSYNE 2020.
- Merav Stern, Eric Shea-Brown, and Daniela Witten. Inferring Neural Population Spiking Rate from Wide-Field Calcium Imaging. COSYNE 2020.
- J. Bloch, E. Shea-Brown, A. Yazdan-Shahmorad, A computational model of neural connectivity dynamics in response to optogenetic stimulation of non-human primate sensorimotor cortex. SFN, 2019.
- Stefano Recanatesi, Matthew Farrell, Guillaume Lajoie, Sophie Deneve, Mattia Rigotti, Eric Shea-Brown, Signatures of low-dimensional neural predictive manifolds. COSYNE 2019.
- Matthew Farrell, Stefano Recanatesi, Timothy Moore, Guillaume Lajoie, Eric Shea-Brown, Dimensionality expansion via chaotic dynamics facilitates classification in a trained network. COSYNE 2019.
- Jianghong Shi, Gabriel Ocker, Michael Oliver, Nicholas Cain, Peter Ledochowitsch, Daniel Millman, Saskia de Vries, Eric Shea-Brown, Michael A. Buice, Representational Similarity Analysis Reveals Population Coding Complexities in Mouse Visual Cortex. COSYNE 2019.
- J. Knox et al. A high resolution data-driven model of the mouse connectome. COSYNE, 2018.
- A. Cayco-Gajic et al. Transformation of population code from LGN to V1 facilitates linear decoding. COSYNE, 2018.

- M. Stern et al. In the Footsteps of Learning: Changes in Network Dynamics and Dimensionality with Task Acquisition. COSYNE, 2018.
- M. Stern, et al. A Link Between Brains, Learning and Recurrent Neural Networks. SFN, 2017.
- A. Weber, et al. Disentangling multiple sources of variability in the responses of retinal ganglion cells. SFN, 2017.
- G. Ocker, K. Josic, E. Shea-Brown, and M. Buice. Linking structure and activity in nonlinear spiking networks. COSYNE, 2017.
- B. Brinkman, F. Rieke, E. Shea-Brown, and M. Buice. Explicit calculation of effective interactions in strongly-coupled networks. COSYNE, 2017.
- H. Choi, A. Pasupathy, E. Shea-Brown. Predictive coding in area V4 as a mechanism for recognition of partially occluded shapes. COSYNE, 2017.
- N. Graddis, K. Harris, J. Whitesell, K. Hirokawa, E. Shea-Brown, J. Harris, S. Mihalas. An inter-region model of the mouse brain mesoscale connectome. *Abstracts (online), Society for Neuroscience*, 467.08, 2016.
- J. Zylberberg, P. Latham, A. Pouget, E. Shea-Brown. Robust information propagation in noisy neural population codes, COSYNE 2016.
- A. Weber, E. Shea-Brown, F. Rieke. Disentangling the contributions of multiple noise sources to neuronal variability, COSYNE 2016.
- K. Harris, T. Dashevskiy, A. Garcia, E. Shea-Brown, J. Ramirez. Sparsity and inhibition in the pre-Botzinger complex can explain levels of synchrony and the presence of expiratory neurons, *Society for Neuroscience*, 2015.
- G. Lajoie, K. Lin, J.P. Thivierge, E. Shea-Brown. Encoding and discrimination of multi-dimensional signals using chaotic spiking activity, COSYNE 2015.
- B. Brinkman, A. Weber, E. Shea-Brown, F. Rieke. Multiple noise sources shape optimal encoding strategies in fundamentally different ways, COSYNE 2015.
- Y. Hu, K. Josic, E. Shea-Brown, M. Buice. From structure to dynamics: origin of higher-order spike correlations in network motifs, COSYNE 2015.
- T. Oleskiw, W. Bair, E. Shea-Brown. Divisive inhibition of rate response via input timescale, COSYNE 2015.
- Y. Hu, J. Zylberberg, E. Shea-Brown. The sign rule and beyond: boundary effects, flexibility, and noise correlations in population codes, COSYNE 2014.
- M. Schwemmer, S. Deneve, E. Shea-Brown, and A. Fairhall. Predictive coding in Hodgkin-Huxley type neurons, COSYNE 2014.
- J. Zylberberg, M. Turner, J. Cafaro, F. Rieke, E. Shea-Brown. A novel rate-correlation relationship might significantly improve population coding in retina, COSYNE 2014.
- G. Lajoie, J.P. Thivierge, E. Shea-Brown. Structured chaos shapes population noise entropy in driven chaotic networks, COSYNE 2014.
- N. Cayco Gajic, J. Zylberberg, and E. Shea-Brown. Population coding with higher order correlations. *Abstracts, Society for Neuroscience*, 235.03, 2013.
- Y. Hu, J. Trousdale, K. Josic, E. Shea-Brown. Inferring collective spiking from motif statistic data of neural networks. *Abstracts, Society for Neuroscience*, 490.12, 2013.
- G. Lajoie, K. Lin, E. Shea-Brown. Structured chaos and spike responses in stimulus-driven networks, COSYNE 2013.
- Y. Hu, J. Trousdale, K. Josic, and E. Shea-Brown. Network motifs and collective spiking in neuronal networks, COSYNE 2013.
- J. Zylberberg, N. Cayco Gajic, and E. Shea-Brown. Dendritic nonlinearities shape beyond-pairwise correlations and improve (spiking) population coding, COSYNE 2013.

- G. Lajoie, K. Lin, E. Shea-Brown, Reliable and unreliable spike times in sparsely connected networks, COSNYE 2012.
- Barreiro, J. Gjorgjieva, F. Rieke, E. Shea-Brown. Filtering and recurrent connectivity shape higher-order correlations in retinal circuits, COSNYE 2012.
- E. Shea-Brown, A. Barreiro, A. Cayco Gajic, J. Gjorgjieva, and F. Rieke. A mechanistic approach to multi-spike patterns in neural circuits. *Abstracts (online), Society for Neuroscience*, 560.02, 2011.
- A. Barreiro, E. Thilo, and E. Shea-Brown. The A-current and Type I / Type II transition determine collective spiking from common input. *Abstracts (online), Society for Neuroscience*, 220.01, 2011.
- N. Cain, E. Shea-Brown, A. Barreiro, and M. Shadlen. A favorable tradeoff between robustness and performance in sequential decision tasks. COSYNE, 2011.
- N. Cayco Gajic and E. Shea-Brown. Information transmission and the critical regime in feedforward networks. COSYNE, 2011.
- J. Trousdale, K. Josic, Y. Hu, and E. Shea-Brown. Understanding network interactions through linear response theory. COSYNE, 2011.
- J. Goldwyn, M. Famulare, N. Imenov, A. Fairhall, J. Rubinstein, and E. Shea-Brown. Rethinking approximations of channel noise in stochastic Hodgkin-Huxley models. *Abstracts (online), Society for Neuroscience*, 414.1, 2010.
- A. Barreiro, E. Shea-Brown, F. Rieke, and J. Gjorgjieva. When are microcircuits well-modeled by pairwise interactions? *Abstracts (online), Society for Neuroscience*, 165.13, 2009.
- N. Cain, A. Barreiro, M. Shadlen, and E. Shea-Brown. Performance of a model robust neural integrator in a two-alternative forced-choice task. *Abstracts (online), Society for Neuroscience*, 803.3, 2009.
- E. Shea-Brown, E. Thilo, A. Barreiro, K. Josic, J. de la Rocha, T. Johnson, and B. Doiron. How does spike generation control how correlated inputs become correlated spikes? *Abstracts (online), Society for Neuroscience*, 321.19, 2009.
- E. Shea-Brown, K. Lin, and L.-S. Young. Reliability of spike times in neural oscillator networks *Abstracts (online), Society for Neuroscience*, 437.5, 2008.
- J. Goldwyn and E. Shea-Brown. Simulating cochlear implant psychophysics with a stochastic model of the auditory nerve. *Abstracts (online), Society for Neuroscience*, 664.2, 2008.
- C. Gooch, A. Wilson, E. Shea-Brown, J. Rinzel, and M. Matell. Firing patterns of premotor cortex are correlated with temporal estimates in the rat. *Abstracts (online), Society for Neuroscience*, 15.5, 2006.
- E. Shea-Brown, X. Feng, H. Rabitz, B. Greenwald, and R. Kosut. Optimal deep brain stimulation of the subthalamic nucleus -- a computational feasibility study. *Abstracts (online), Society for Neuroscience*, 174.9, 2006.
- E. Shea-Brown, J. Rinzel, B. Rakitin, C. Malapani. A firing-rate model of Parkinsonian deficits in interval timing. *Abstracts (online), Society for Neuroscience*, 774.5, 2005.
- M. S. Gilzenrat, E. T. Brown, G. Aston-Jones, J. D. Cohen. Locus coeruleus, adaptive gain, and the optimization of decision tasks. *Abstracts (online), Society for Neuroscience*, 899.6, 2004.
- R. Bogacz, J. Moehlis, E. Brown, P. Holmes, J. D. Cohen. Neural mechanisms for decision optimization. *Abstracts (online), Society for Neuroscience*, 197.6, 2003.
- R. Cho, L. Nystrom, P. Holmes, E. Brown, B. Casey, and J. D. Cohen. A connectionist model of conflict and control in a forced-choice task. *Abstracts, Society for Neuroscience*, v.26, 2000.

### **SELECTED TALKS**

**Mathematical Biology Seminar**, U. Penn. Ctr. for Mathematical Biology, *When do high-dimensional networks produce low-dimensional activity?* (Nov. 2021)



**Mathematical Biology Seminar**, Washington State University. *When do high-dimensional networks produce low-dimensional activity?* (Sept. 2021)

**Neuroscience Seminar**, U. Chicago. *When do high-dimensional networks produce low-dimensional activity?* (Nov. 2021)

**Neuroscience Seminar**, U. Chicago. *When do high-dimensional networks produce low-dimensional activity?* (Nov. 2019)

**Neuroscience Seminar**, U. Oregon Institute for Neuroscience. *When do high-dimensional networks produce low-dimensional activity?* (July 2019)

**Theoretical Neuroscience Seminar**, Columbia University. *When do high-dimensional networks produce low-dimensional activity?* (Sept. 2019)

**Neurofutures Conference**, Portland. *When do high-dimensional networks produce low-dimensional activity?* (July 2019)

**Symposium on Neural and Neuronal Networks**, Applied Mathematics: The Next 50 Years conference, University of Washington. *When do high-dimensional networks produce low-dimensional activity?* (June 2019)

**Brain Science Seminar**, University of Calgary. *When do high-dimensional networks produce low-dimensional activity?* (June 2019)

**Northwest Data Science Summit**, University of Washington. *When and why do high-dimensional networks produce low-dimensional activity?* (May 2019)

**Applied Mathematics Seminar**, University of Arizona. *What makes high-dimensional networks produce low-dimensional activity?* (Mar. 2019)

**COSYNE 2019**, Lisbon (Invited). *What makes high-dimensional networks produce low-dimensional activity?* (Feb. 2019)

**Institute for Advanced Study Distinguished Seminar**, HKUST, Hong Kong. *Dimensionality in biological networks — a mechanistic approach.* (Dec. 2018)

**Bernstein Conference on Computational Neuroscience**, Berlin (Plenary). *When do high-dimensional networks produce low-dimensional activity?* (Sept. 2018)

**MIT Brains, Minds, and Machines Seminar** *Linking the statistics of network activity and network connectivity.* (Sept. 2018)

**Swartz Center Seminar**, NYU. *Trying to link the statistics of network activity and network connectivity.* (March 2018)

**Gatsby Center Seminar**, London. *Assembling Collective activity in Neural Circuits.* (June 2016)

**International Congress on Mathematical Neuroscience**, Juan-les-Pins, France. *Assembling Collective activity in Neural Circuits.* (June 2016)

**Joint Mathematics Meetings**, Seattle, WA. *Assembling Collective activity in Neural Circuits.* (Jan 2016)

**Workshop on Topics in Applied Dynamical Systems: Equivariance and Beyond**, OSU, OH. *Assembling Collective activity in Neural Circuits.* (May 2015)

**SIAM Conference on Applications of Dynamical Systems**, Snowbird, UT. *Assembling Collective activity in Neural Circuits.* (May 2015)

**Allen Institute for Brain Science Seminar**. Allen Institute for Brain Science, Seattle. *Assembling population codes in neural circuits.* (Oct. 2014)

**CRCNS Investigators' Meeting**. Tempe, AZ. *Population coding in the direction selective circuit of the retina.* (Oct. 2014)

**Janelia Conference on Signal Transforms in the Early Visual System**. HHMI Janelia Farms Research Campus. *Population coding in the direction selective circuit of the retina.* (Sept. 2014)

**Sloan-Swartz Meeting for Computational Neuroscience**. Seattle, WA. *Assembling collective activity in neural circuits.* (Jul. 2014)

**Neurotheory Seminar**, HHMI Janelia Farms Research Campus. *Assembling collective activity in neural circuits*. (May 2014)

**Applied Mathematics Seminar**, Centre de Recerca Matemàtica, Barcelona. *Neural Integrators: What's optimal and what can we get away with?* (Feb. 2014)

**Neuroscience Seminar**, École normale supérieure, Paris. *Collective spiking and population codes*. (March 2013)

**Center for Neuroengineering Annual Symposium**, Houston, TX. *Collective spiking and population codes*. (Oct. 2013)

**Workshop on Modeling Neural Activity**, Lihue, HI. *Cooperative dynamics in simple neural circuits*. (June 2013)

**SIAM Conference on Applications of Dynamical Systems**, Snowbird, UT. *Spike-based coding in chaotic neural networks*. (May 2013)

**University of Chicago Scientific and Statistical Computing and Neuroscience Seminars**. *Cooperative dynamics in simple neural circuits*. (Feb., April 2013)

**MBI Workshops on Mathematical Neuroscience**, Columbus, OH. *Reliable and unreliable spiking in random neural networks* and *Neural Integrators: What's optimal and what can we get away with?* (Oct., Dec. 2012)

**International Conference on Theory and Applications in Dynamical Systems**, Seattle. *Reliable and unreliable spiking in random neural networks*. (Aug. 2012)

**Symposium on Neural Coding and Dynamics, UT San Antonio**. *Cooperative dynamics in neural circuits*. (March 2012)

**Applied Mathematics Seminar, Columbia University**, New York. *Cooperative dynamics in neural circuits*. (Jan. 2012)

**Workshop on Mean-field methods and multiscale analysis of neuronal populations, CIRM**, Marseille France. *A mechanistic approach to multi-spike patterns in neural circuits*. (Oct. 2011)

**International Congress on Applied and Industrial Mathematics**, Vancouver. *Cooperative dynamics in simple neural circuits*. (July 2011)

**SIAM Conference on Applications of Dynamical Systems, Snowbird, UT**. *Shared inputs, entrainment, and desynchrony in bursting neurons: From slow passage to circle maps*. (May 2011)

**Neuroscience Seminar, UC Davis**. *Multi-spike patterns in neural circuits: how much complexity should we expect to find?* (May 2011)

**Mathematical Biology Seminar, UC Davis**. *Driven Elliptic Bursters – Entrainment, Desynchrony, and Optimization*. (May 2011)

**Mathematical Neuroscience 2011**, International Center for Mathematical Sciences, Edinburgh. *Cooperative dynamics in simple neural circuits*. (Apr. 2011)

**Applied Mathematics Colloquium**, University of Colorado at Boulder. *Cooperative dynamics in simple neural circuits*. (Dec. 2010)

**Theoretical Neuroscience Colloquium**, University of Waterloo. *Cooperative dynamics in simple neural circuits*. (Nov. 2010)

**Applied Mathematics Colloquium**, University of Arizona. *Cooperative dynamics in simple neural circuits*. (Oct. 2010)

**Gulf Coast Consortium Annual Computational Neuroscience Meeting**, Houston, Texas. *Can common input desynchronize networks during Deep Brain Stimulation?* (Oct. 2009)

**Lorentz Center Workshop on Brain Waves**, Leiden, Netherlands. *Simulating DBS in layered networks: optimization and entrainment*. (June 2009)

**Frontiers in Applied and Computational Mathematics**, Newark, NJ. *Neural coding and dynamics under cochlear implant stimulation*. (June 2009)

**SIAM Conference on Applications of Dynamical Systems**, Snowbird, UT. *What limits cooperative spiking*

*in feedforward networks?* (May 2009)

**Center for Control, Dynamical Systems, and Computation Seminar**, UC-Santa Barbara, Santa Barbara, CA. *Dynamics of correlation and coding in simple neural circuits.* (May 2009)

**Applied Mathematics Seminar**, Univ. of Michigan, Ann Arbor, MI. *Dynamics of correlation and coding in simple neural circuits.* (April 2009)

**Neurobiology and Behavior Seminar**, Univ. of Washington, Seattle, WA. *Reliable and unreliable spike times in model networks--a role for feedback?.* (April 2009)

**Bioengineering Seminar**, Univ. of Washington, Seattle, WA. *When does feedback destroy the reliability and precision of neural spike times? Some first steps.* (Feb. 2009)

**Institute for Applied Mathematics Seminar**, University of British Columbia, Vancouver, Canada. *Dynamics of correlation and coding in simple neural circuits.* (October 2008)

**SIAM Conference on the Life Sciences**, Montreal, Canada. *Reliable and unreliable dynamics in driven oscillator networks.* (August 2008)

**5<sup>TH</sup> European Congress of Mathematics**, Amsterdam, Holland. *Reliable and unreliable dynamics in driven oscillator networks.* (July 2008)

**Machine Learning and Biological Computation Seminar**, Univ. of Bristol, Bristol, UK. *Tuned correlation transfer and consequences for coding.* (June 2008)

**Applied Mathematics Seminar**, Univ. of Washington, Seattle, WA. *Touring computational neuroscience.* (April 2008)

**Mathematics and Statistics Colloquium**, Portland State Univ., Portland, OR. *Dynamics of correlation and coding in simple neural circuits.* (Feb. 2008)

**Physiology and Biophysics Seminar**, Univ. of Washington, Seattle, WA. *Tuned correlation transfer and consequences for coding.* (Feb. 2008)

**Neurobiology Seminar**, Yale Univ., New Haven, CT. *Tuned correlation transfer and consequences for coding.* (Oct. 2007)

**Workshop on Mathematical Neuroscience**, CRM, University of Montreal, Montreal. *Tuned correlation transfer and consequences for coding.* (Sept. 2007)

**Fellows' Seminar, Center for Neural Science**, New York Univ., New York, NY. *Simple models for encoding elapsed time.* (May 2007)

**SIAM Conference on Applications of Dynamical Systems**, Snowbird, UT. *Reliable and unreliable dynamics in coupled theta neurons.* (May 2007)

**Seminar, Princeton University**, Princeton, NJ. *Dynamics of correlation and coding in simple neural circuits.* (Feb. 2007)

**Theoretical Biophysics Seminar, UC San Diego**, San Diego, CA. *Spike-to-spike correlation and neural coding: basic roles for membrane and circuit dynamics.* (Feb. 2007)

**Biomedical Engineering Seminar, Duke University**, Durham, NC. *Dynamics of integration, correlation, and encoding in simple decision tasks.* (Feb. 2007)

**Applied Mathematics Seminar, Northwestern University**, Evanston, IL. *Dynamics of correlation and coding in simple neural circuits.* (Feb. 2007)

**Neural Engineering Seminar, Pennsylvania State University**, University Park, PA. *Spike-to-spike correlation and neural coding: basic roles for membrane and circuit dynamics.* (Jan. 2007)

**Applied Mathematics Seminar, University of Washington**, Seattle, WA. *Spike-to-spike correlation and neural coding: basic roles for membrane and circuit dynamics.* (Jan. 2007)

**Applied Mathematics Seminar, Columbia University**, New York, NY. *Dynamics of integration and correlation in neural encoding and decisions.* (Dec. 2006)

**Neuroscience Seminar, Brandeis University**, Waltham, MA. *Dynamics of integration and correlation in encoding and simple decisions*. (Dec. 2006)

**Courant Institute Applied Mathematics Seminar**, New York, NY. *A theory of correlations for spiking neurons* (Oct. 2006)

**Neuromath '06 Conference on Mathematical Neuroscience**, Andorra. *Reliability, recurrence, and rhythm in a pair of phase oscillators*. (Sept. 2006)

**Sloan-Swartz Summer Meeting**, New York, NY. *Spike-to-spike correlations: modeling and mechanisms*. (July 2006)

**Seminar, Center for Theoretical Neuroscience, Columbia University**, New York, NY. *Dynamics of integration and correlation in timing and decisions*. (June 2006)

**Theoretical and Applied Mechanics Seminar**, Cornell University, Ithaca, NY. *Spiking Dynamics in Phase Oscillator Networks*. (April 2006)

**Mathematical Biology Seminar**, New Jersey Institute of Technology, Newark, NJ. *How network architecture restricts spiking patterns in networks of phase oscillators*. (April 2006)

**2006 Joint Mathematics Meetings**, San Antonio, TX. *How architecture restricts spiking patterns in networks of phase oscillators*. (Jan. 2006)

**International Workshop on Applied Dynamical Systems**, Centre de recherches mathématiques, Montreal. *How architecture restricts spiking patterns in networks of phase oscillators*. (Oct. 2005)

**Seminar, Applied Mathematics Laboratory**, Mount Sinai School of Medicine, New York, NY. *How network architecture and cell type restrict spiking patterns for phase oscillators*. (July 2005)

**SIAM Conference on Applications of Dynamical Systems**, Snowbird, UT. *On the phase reduction and response dynamics of neural oscillator populations*. (May 2005)

**Computational Neuroscience Seminar**, University College London, UK. *From spikes to speed-accuracy via the locus coeruleus*. (April 2005)

**Interdisciplinary/Applied Mathematics Seminar**, University of Illinois at Urbana-Champaign, Champaign, IL. *Modeling optimal decisions with neural integrators and oscillators*. (March 2005)

**Courant Institute Dynamical Systems Seminar**, New York, NY. *Spikes, Synchrony, and Decisions: A From-Scratch Tour of Some Dynamical Systems in Neuroscience*. (March 2005)

**Courant Institute Applied Mathematics Seminar**, New York, NY. *From spikes to speed-accuracy via the brainstem*. (Sept. 2004)

**13<sup>th</sup> Annual Computational Neuroscience Meeting**, Baltimore, MD. *On the phase reduction and response dynamics of neural oscillator populations*. (July 2004)

**SIAM Life Sciences Meeting**, Portland, OR. *A neural mechanism for optimizing task performance*. (July 2004)

**AIMS 5<sup>th</sup> International Conference on Dynamical Systems and Differential Equations**, Pomona, CA. *On the phase reduction and response dynamics of neural oscillator populations*. (June 2004)

**Seminar, Institute for Biophysical Dynamics and Center for Neural Computation and Engineering**, University of Chicago, Chicago, IL. *From spikes to speed-accuracy via the locus coeruleus*. (May 2004)

**SIAM Conference on Applications of Dynamical Systems**, Snowbird, UT. *Response dynamics and phase oscillators in the brainstem*. (May 2003)

**Computational Neuroscience Forum**, New York University, New York, NY. *Response dynamics and phase oscillators in the brainstem*. (January 2003)