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Jonathan W. Pillow

Education

Ph.D., New York University, Center for Neural Science — 1998-2005
Thesis: "Neural coding and the statistical modeling of neuronal responses."
Thesis Advisor: Eero Simoncelli

U.S. Fulbright Fellow, Rabat, Morocco. Francophone Literature of North Africa — 1997-1998

B.A. with honors, *summa cum laude*. — 1993-1997
University of Arizona. majors: mathematics and philosophy

Positions

Assistant Professor, Princeton Neuroscience Institute & Department of Psychology. Princeton University — Sept 2014-present

Assistant Professor, Departments of Psychology, Neuroscience, & Statistics, Center For Perceptual Systems, The University of Texas at Austin. — Jan 2009-2014

Postdoctoral Fellow, Gatsby Computational Neuroscience Unit, UCL — Oct 2005-2008

Postdoctoral Fellow, NYU and Howard Hughes Medical Institute — May-Oct 2005

Publications

1. **Pillow JW** & Park M (2016). Adaptive Bayesian methods for closed-loop neurophysiology. In *Closed Loop Neuroscience*, ed. A. El Hady, Elsevier. (to appear).
2. Wu A, Park IM, & **Pillow JW** (2015). Convolutional Spike-Triggered Covariance Analysis for Neural Subunit Models. *Advances in Neural Information Processing Systems 28, 1-9*.
3. **Pillow JW** (2015). Explaining the especially pink elephant. Nature Neuroscience 18: 1435–1436. (News & Views on Wei & Stocker 2015).
4. Latimer KL, Yates JL, Meister MLR, Huk AC, & **Pillow JW** (2015). Single-trial spike trains in parietal cortex reveal discrete steps during decision-making. *Science* 349(6244): 184-187.
5. Williamson RW, Sahani M & **Pillow JW** (2015). The equivalence of information-theoretic and likelihood-based methods for neural dimensionality reduction. *PLoS Comp Biol*, 11(4):1-31.
6. Bonnen K, Burge J, Yates J, **Pillow JW**, & Cormack LC (2015). Continuous psychophysics: Target-tracking to measure visual sensitivity. *Journal of Vision* 15(3):14, 1-16.
7. Latimer KW, Huk AC, & **Pillow JW** (2015). Bayesian inference for latent stepping and ramping models of spike train data. Chapter in Advanced State Space Methods for Neural and Clinical Data, Chen, Z, Ed., Cambridge University Press.
8. Park IM, Meister MLR, Huk AC, & **Pillow JW** (2014). Deciphering the code for sensorimotor decision-making in parietal cortex, *Nature Neuroscience* 17, 1395–1403.
9. Archer E, Park I, & **Pillow JW** (2014). Bayesian Entropy Estimation for Countable Discrete Distributions. *Journal of Machine Learning Research* 15 (Oct): 2833–2868.
10. Park M, Weller JP, Horwitz GD, & **Pillow JW** (2014). Bayesian active learning of neural firing rate

maps with transformed Gaussian process priors. *Neural Computation* 26(8):1519-1541.

11. Archer, EW, Koster U, **Pillow JW**, & Macke JH (2014).Low-dimensional models of neural population activity in sensory cortical circuits. *Advances in Neural Information Processing Systems 27*, 343-351.
12. Latimer KW, Chichilnisky EJ, Rieke F, **Pillow, JW** (2014). Inferring synaptic conductances from spike trains with a biophysically inspired point process model. *Advances in Neural Information Processing Systems 27*, 954-962.
13. Knudson KC, Yates JL, Huk AC, **Pillow, JW** (2014). Inferring sparse representations of continuous signals with continuous orthogonal matching pursuit. *Advances in Neural Information Processing Systems 27*, 1215-1223.
14. Wu A, Park M, Koyejo OO, **Pillow, JW** (2014). Sparse Bayesian structure learning with dependent relevance determination priors. *Advances in Neural Information Processing Systems 27*, 1628-1636.
15. Grabska Barwinska A, & **Pillow JW** (2014). Optimal prior-dependent neural population codes under shared input noise. *Advances in Neural Information Processing Systems 27*, 1880-1888.
16. Archer E, Park I & **Pillow JW** (2013). Bayesian entropy estimation for binary spike train data using parametric prior knowledge. *Advances in Neural Information Processing Systems 26*, 1700-1708.
17. Knudson, K., & **Pillow JW** (2013). Spike train entropy-rate estimation using hierarchical Dirichlet process priors. *Advances in Neural Information Processing Systems 26*, 2076-2084.
18. Park I, Archer E, Priebe NJ, & **Pillow JW** (2013). Spectral methods for neural characterization using generalized quadratic models. *Advances in Neural Information Processing Systems 26*, 2454-2462.
19. Park I, Archer E, Latimer K, & **Pillow JW** (2013). Universal models for binary spike patterns using centered Dirichlet processes. *Advances in Neural Information Processing Systems*, 2463-2471.
20. Park M, & **Pillow JW** (2013). Bayesian inference for low-rank spatiotemporal neural receptive fields. *Advances in Neural Information Processing Systems 26*, 2688-2696.
21. Archer E, Park I, & **Pillow JW** (2013). Bayesian and quasi-bayesian estimators for mutual information from discrete data. *Entropy 15*(5), 1738-1755.
22. **Pillow JW**, Shlens J, Chichilnisky EJ, & Simoncelli EP (2013). A model-based spike sorting algorithm for removing correlation artifacts in multi-neuron recordings. *PLoS ONE. 8*(5), 1-14. doi:10.1371/journal.pone.0062123
23. Park M, Koyejo S, Poldrack RA, Ghosh J, & **Pillow JW** (2013). Bayesian structure learning for functional neuroimaging. *Proceedings of the 16th International Conference on Artificial Intelligence and Statistics (AISTATS), Scottsdale, AZ, USA, 31,* 489-497.
24. Archer E, Pillow JW, & Park I (2012). Bayesian estimation of discrete entropy with mixtures of stick-breaking priors. In P. Bartlett, F. C. N. Pereira, C. J. C. Burges, L. Bottou, & K. Q. Weinberger (Eds.) *Advances in Neural Information Processing Systems 25,* 2024-2032.
25. Park M, & **Pillow JW** (2012). Bayesian active learning with localized priors for fast receptive field characterization. In P. Bartlett, F. C. N. Pereira, C. J. C. Burges, L. Bottou, & K. Q. Weinberger (Eds.) *Advances in Neural Information Processing Systems 25,* 2357-2365.
26. **Pillow JW, &** Scott, J.G. (2012) Fully Bayesian inference for neural models with negative-binomial spiking. In P. Bartlett, F. C. N. Pereira, C. J. C. Burges, L. Bottou, & K. Q. Weinberger (Eds.) *Advances in Neural Information Processing Systems 25,* 1907-1915.
27. Vidne, M., Ahmadian, Y., Shlens J, **Pillow JW,** Kulkarni, J., Litke, A. M., Chichilnisky EJ, Simoncelli, E., & Paninski, L. (2012). Modeling the impact of common noise inputs on the network activity of

retinal ganglion cells. *Journal of Computational Neuroscience*, *33*(1), 97-121.

28. Park I & **Pillow JW** (2011). Bayesian spike-triggered covariance analysis. In J. Shawe-Taylor, R. Zemel, P. Bartlett, F. Pereira & K. Weinberger (Eds.) *Advances in Neural Information Processing Systems 24,* 1692-1700.

29. Park M, Horwitz, G., & **Pillow JW** (2011). Active learning of neural response functions with Gaussian processes. In J. Shawe-Taylor J, R. Zemel, P. Bartlett, F. Pereira & K. Weinberger (Eds.) *Advances in Neural Information Processing Systems 24,* 2043-2051.

30. Park M, & **Pillow JW** (2011). Receptive field inference with localized priors. *PLoS Computational Biology 7*(10), 1-16.

31. **Pillow JW,** Ahmadian, Y., & Paninski, L. (2011). Model-based decoding, information estimation, and change-point detection techniques for multineuron spike trains. *Neural Computation 23*(1), 1-45.

32. Ahmadian, Y., **Pillow JW, &** Paninski, L. (2011). Efficient Markov chain Monte Carlo methods for decoding neural spike trains. *Neural Computation 23*(1), 46-96.

33. Histed, M. H., & **Pillow JW** (2011). The 8th annual computational and systems neuroscience (Cosyne) meeting. *Neural Systems & Circuits 1*(8), 1-3. (invited meeting review).

34. Nirenberg, S., Bomash, I., **Pillow JW, &** Victor J. D. (2010). Heterogeneous response dynamics in retinal ganglion cells: The interplay of predictive coding and adaptation. *Journal of Neurophysiology 103*(6), 3184-3194.

35. **Pillow JW** (2009). Time-rescaling methods for the estimation and assessment of non-Poisson neural encoding models. In Y. Bengio, D. Schuurmans, J. Laffferty, C. Williams and A. Culotta (Eds.) *Advances in Neural Information Processing Systems 22,* 1473-1481.

36. Berkes, P., Wood, F., & **Pillow JW** . (2009). Characterizing neural dependencies with copula models. In D. Koller, D. Schuurmans, Y. Bengio, L. Bottou (eds.) *Advances in Neural Information Processing Systems 21*, 129-136.

37. **Pillow JW**, Shlens J, Paninski, L., Sher, A., Litke, A. M., Chichilnisky EJ, & Simoncelli EP (2008). Spatio-temporal correlations and visual signalling in a complete neuronal population. *Nature 454*(21 August 2008), 995-999.

38. **Pillow JW** & Latham, P. (2008). Neural characterization in partially observed populations of spiking neurons. In J. C. Platt, D. Koller, Y. Singer, & S. Roweis (Eds.) *Advances in Neural Information Processing Systems 20*, 1161-1168.

39. **Pillow JW** (2007). Likelihood-based approaches to modeling the neural code. (K. Doya, S. Ishii, A. Pouget, & R. Rao, Eds.) In *Bayesian Brain: Probabilistic Approaches to Neural Coding* (pp. 53-70). Cambridge, MA: MIT press.

40. Paninski, L., **Pillow JW** & Lewi, J. (2007). Statistical models for neural encoding, decoding, and optimal stimulus design. (P. Cisek, T. Drew, & J. F. Kalaska, Eds.) In *Progress in Brain Research* (pp. 93-507). Oxford, UK: Elsevier B. V.

41. **Pillow JW** & Simoncelli EP (2006). Dimensionality reduction in neural models: An information-theoretic generalization of spike-triggered average and covariance analysis. *Journal of Vision*, *6*(4), 414-428.

42. Schwartz, O., **Pillow J. W.**, Rust, N. C., & Simoncelli EP (2006). Spike-triggered neural characterization. *Journal of Vision*, *6*(4), 484-507.

43. Paninski, L., **Pillow JW** & Simoncelli EP (2005). Comparing integrate-and-fire models estimated using intracellular and extracellular data. *Neurocomputing 65-66*(2005), 379-385.

44. **Pillow JW,** Paninski, L., Uzzell, V. J., Simoncelli EP, & Chichilnisky EJ (2005). Prediction and decoding

of retinal ganglion cell responses with a probabilistic spiking model. *Journal of Neuroscience 25*(47), 11003-11013.

45. Simoncelli EP, Paninski, L., **Pillow JW**, & Schwartz, O. (2004). Characterization of neural responses with stochastic stimuli. (M Gazzaniga, Ed.) In The *Cognitive Neurosciences III* (pp. 327-338). Cambridge, MA: MIT Press.

46. Paninski, L., **Pillow JW** & Simoncelli EP (2004). Maximum likelihood estimation of a stochastic integrate-and-fire neural encoding model. *Neural Computation, 16*(12), 2533-2561.

47. **Pillow JW**, Paninski, L., & Simoncelli EP (2004) Maximum likelihood estimation of a stochastic integrate-and-fire neural encoding model. In S. Thrun, L. K. Saul, & B. Schölkopf (Eds.) *Advances in Neural Information Processing Systems 16*. 8 pages. Cambridge, MA: MIT Press.

48. **Pillow JW** & Simoncelli EP (2003). Biases in white noise analysis due to non-Poisson spike generation. *Neurocomputing***,** *52-54*(2003), 109-115.

49. **Pillow JW** & Rubin N. (2002). Perceptual completion across the vertical meridian and the role of early visual cortex. *Neuron 33*(5), 805-13.

50. Zemel, R. S. & **Pillow JW** (2002). A probabilistic network model of population responses. (R. Rao, B. Olshausen, & M. Lewicki, Eds.) In *Probabilistic Models of the Brain: Perception and Neural Function* (pp. 223-242). Cambridge, MA: MIT Press.

51. Zemel, R. S. & **Pillow JW** (2000). Encoding multiple orientations in a recurrent network. *Neurocomputing*, *32-33* (June 2000), 609-616.

Research Support

Ongoing Support

- *CAREER: Unlocking the neural code with spikes, currents and conductances* (IIS-1150186). Faculty Early Career Development Program Award, National Science Foundation (PI: Pillow), 2012-2017.
- *CRCNS: Detailed multi-neuron coding of decisions in the parietal cortex.* (R01-MH099611), NIH/NSF Collaborative Research In Computational Neuroscience (PIs: JW Pillow & AC Huk), 2012-2017.
- *Neural time integration underlying higher cognitive function.* (R01EY017366), NIH/NEI (PIs: AC Huk & JW Pillow), 2014-2017.
- *McKnight Scholar Award*, 2012-2016.
- *Population dynamics across pairs of cortical areas in learning and behavior* - Simons Global Brain Award.(PIs: JW Pillow & SL Smith), 2014-2017.
- *Hierarchical methods for decoding high-dimensional brain imaging data* - Princeton Innovation Award: J. Insley Blair Pyne Fund for Innovation. (PIs: JW Pillow, BE Engelhardt, KA Norman), 2015-2016.
- *Simons Collaboration on the Global Brain Research Award*, Simons Foundation (PIs: JW Pillow & SL Smith), 2015-2017.

Completed Research Support

- *Sloan Research Fellowship*. 2011-2013.

Honors & Awards

Simons Collaboration on the Global Brain Research Award 2015-2017

Presidential Early Career Award for Scientists and Engineers (PECASE)	2014
NSF Career Award	2012-2017
McKnight Scholar Award	2012-2015
NSF Mentorship Travel Grant, Cosyne Annual Meeting	2012
Sloan Research Fellow	2011-2012
Royal Society USA/Canada Research Fellowship	2005-2008
Dean's Dissertation Fellowship Award	2003-2004
Best Student Paper, Neural Information Processing Systems (NIPS)	2003
National Science Foundation Graduate Fellowship	1997-2000
NCAA Graduate Fellowship	1997
U.S. Fulbright Fellowship	1997-1998
Freeman Medal (outstanding Univ. Arizona graduate)	1997
Sapphire Award (outstanding Univ. Arizona student-athlete)	1997
Outstanding Senior, Department of Mathematics	1997
Flinn Foundation Scholar	1993-1997
National Science Scholar	1993
Presidential Scholar	1993

Teaching

*Sensation & Perception (*PSY 345 / NEU 325; undergraduate) Princeton, Spring 2015.
Perception (PSY 323; undergraduate). UT Austin, Fall 2009-2013.
Topics in Statistics and Neural Coding - (PSY 394U/ NEU 394P; graduate) UT Austin, Spring 2010-2014

Summer Courses:
Co-organizer, *Computational Neuroscience: Vision*. Cold Spring Harbor Laboratory (July, 2014 & 2016).
Course faculty, *Methods in Computational Neuroscience*. Woods Hole, MA (Aug, 2014 & 2015).
Lecturer, *Neurotechnologies for Analysis of Neural Dynamics (NAND)*. Princeton University (July 2015).
Lecturer, *Neural Data Science*. Cold Spring Harbor Laboratory. (July, 2015).
Lecturer, *Methods in Computational Neuroscience*. Woods Hole, MA (Aug, 2008-2011, 2013).
Lecturer, *Berkeley summer course in mining and modeling of neuroscience data*. Berkeley, CA (July, 2011,2012,2013).
Lecturer, *Okinawa Computational Neuroscience Course*. Okinawa, Japan. (2004, 2013).
Lecturer, *Advanced Course in Computational Neuroscience*. Freiburg, Germany (Aug, 2008-2010).
Lecturer, *Bayesian Methods in Neuroscience*. PhD Programs in Neuroscience and Computational Biology. Instituto Gulbenkian de Ciencia, Lisbon, Portugal. (June 2009).
Lecturer, *Computational Neuroscience*. PhD Program in Computational Biology. Instituto Gulbenkian de Ciencia, Lisbon, Portugal. (June 2007).
Lecturer, *Dartmouth Summer Institute in Cognitive Neuroscience*, Lake Tahoe, CA (July 2003).
Teaching Assistant, *Computational Neuroscience: Vision*. Cold Spring Harbor, NY (July 2002).

Service

PNI Graduate Admissions Committee (Fall 2014).
Founder & Organizer, Computational Neuroscience Journal Club, Princeton University. (2015-).

Faculty search committee, Statistics and Scientific Computation (SSC), 2011 & 2012.

Faculty search committee, Center for Perceptual Systems (CPS), 2012.

General Chair (with Nicole Rust), Computational & Systems Neuroscience (Cosyne) Meeting 2013.

Program Chair (with Nicole Rust), Computational & Systems Neuroscience (Cosyne) Meeting 2012.

Program Committee, Computational & Systems Neuroscience (Cosyne) 2010 & 2011

Program Area Chair, Neural Information Processing Systems (NIPS) 2010, 2011 & 2013.

Program Committee, Bernstein Conference on Computational Neuroscience and Neurotechnology (BCCN, 2009)

Journal reviewer: Annals of Applied Statistics; IEEE Trans Neur. Sys. & Rehabilitation Engr., eNeuro, Frontiers in Comp. Neurosci, J. Comp Neurosci, J. Neurophys, J. Neurosci, J. Neurosci Methods, J. of Vision, Nature, Nature Neuroscience, Network: Computation in Neural Systems, Neural Computation, Neuron, PLoS Biology, PLoS Computational Biology, PLoS One, Proc. Nat. Academy Sci. (PNAS), Science, Vision Research.

Grant reviewer: NSF panelist (Robust Intelligence), NSF ad hoc reviewer (Perception, Action & Cognition), National Agency for Research in France (ANR), The Wellcome Trust, Human Frontier Science Program (HFSP).

Conference submission reviewer: Neural Information Processing Systems (NIPS) (2002-2015).

Workshop Organizer, "Scalable Models for High-Dimensional Neural Data." Cosyne 2014. (co-organized with Memming Park & Evan Archer).

Workshop Organizer, "The role of natural images in guiding our understanding of visual function" Cosyne 2006. (co-organized with Nicole Rust and Eero Simoncelli).

Workshop Organizer, "New Approaches to Characterizing Neural Responses," Cosyne 2005 (co-organized with Nicole Rust.)

Member: Society for Neuroscience (2003-present)

Public Outreach

Saturday Morning Math Group - *sponsored outreach program aimed at junior high and high school students, their teachers, and their parents* (http://www.ma.utexas.edu/users/smmg/index.html). Gave 2-hour lecture and problem session on information theory and neural coding, entitled "Information, Bits, Coding, and the Brain". April 13, 2013

First Bytes - *one-week residential camp program for high school girls, sponsored by UT Austin department of Computer Science* (http://www.cs.utexas.edu/outreach/first-bytes). Presented 1-hour lecture on "Computational neuroscience and neural coding". June 2013 & 2014.