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## Education

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**Ph.D., Biomathematics**, minor in Statistics Raleigh, NC  
North Carolina State University 2009-2011  
Dissertation: *Nonlinear, Noninvasive Assessment of Cerebral  
Autoregulation in Stroke*  
Advisor: Mette S. Olufsen, Ph.D.  
Committee members: Marie Davidian, PhD; Vera Novak, MD, PhD;  
Hien Tran, PhD

**M.S., Biomathematics** Raleigh, NC  
North Carolina State University, 2006–2009

**B.S., Kinesiology and Physical Education** Long Beach, CA  
Concentration: Exercise Science, Minor: Chemistry 1999–2005  
California State University, Long Beach

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## Research experience

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**Postdoctoral Associate** Princeton, NJ  
Princeton Neuroscience Institute, Princeton University Jan. 2015 - present  
Advisor: Jonathan Pillow, Ph.D.  
–Developing methods for analyzing high-dimensional  
datasets from neurophysiological experiments

**Postdoctoral Associate** Boston, MA  
Cognitive Rhythms Collaborative, Sep. 2011-Dec. 2014  
Department of Mathematics & Statistics, Boston University  
Primary Advisor: Uri Eden, Ph.D.  
–Developed methods from statistics and signal processing  
for studying rhythmic synchrony in the brain.

**Research Fellow** Raleigh, NC  
Center for Quantitative Research in Biology 2010–2011  
North Carolina State University  
–Developed inference for hierarchical, patient-specific  
models of clinically-relevant biophysical parameters.

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| <b>Research Assistant</b><br>Department of Mathematics, North Carolina State University,<br>–Developed parameter optimization methods<br>for biophysical models of cerebral blood flow.   | Raleigh, NC<br>2008–2010    |
| <b>Research Fellow</b><br>Harvard-Wide Translational Research in Aging Training Program<br>Beth Isreal Deaconess Medical Center, Division of Gerontology<br>Harvard Medical School<br>–Worked with clinical collaborators studying cerebral blood<br>flow regulation. | Boston, MA<br>Summer 2008   |
| <b>Research Fellow</b><br>Comparative Muscle Physiology Lab,<br>Department of Biology, California State University, Long Beach<br>–Studied codon usage bias in myosin mRNA coding sequences.  | Long Beach, CA<br>2005–2006 |
| <b>Research Intern</b><br>HealthIQ/Lnx Research<br>–Developed in-house data analysis software for social network<br>analysis of scientific thought leaders.   | Orange, CA<br>2005–2006     |

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### Teaching

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| <b>Invited lecturer</b><br>Princeton Neuroscience Institute, Princeton University<br>–Delivered lecture on neural coding to 1st-year<br>neuroscience graduate students   | Princeton, NJ<br>Oct 2019                 |
| <b>Lecturer</b><br>Department of Mathematics & Statistics, Boston University<br>–Wrote and delivered lectures for first-semester Calculus course   | Boston, MA<br>Fall 2014                   |
| <b>Recitation leader</b><br>Department of Mathematics, North Carolina State University<br>– Reviewed problem sets with students for Calculus II  | Raleigh, NC<br>Fall 2010                  |
| <b>Teaching Assistant</b><br>Department of Mathematics, North Carolina State University<br>– Assistance and informal instruction for a introductory calculus course<br>Department of Statistics, North Carolina State University<br>– Assistance and informal instruction for a course in statistics for<br>engineers and scientists | Raleigh, NC<br>2007–2008<br><br>2005–2007 |

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### Publications

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#### Preprints

1. **Aoi MC**, Mante V, and JW Pillow. Prefrontal cortex exhibits multi-dimensional dynamic encoding during decision-making. *bioRxiv*, 2019. [Online]. Available: <https://www.biorxiv.org/content/early/2019/10/21/808584>. *In Review*
2. **Aoi MC** and JW Pillow. Scalable Bayesian inference for high-dimensional neural receptive fields. *bioRxiv 212217*; doi: <https://doi.org/10.1101/212217>. 2017.
3. Wu A, **Aoi MC**, and JW Pillow. Exploiting gradients and Hessians in Bayesian optimization and Bayesian quadrature. *arXiv preprint arXiv:1704.00060*. 2017.
4. **Aoi MC**. On the influence of history-dependence on the spectrum and coherence of neuronal spike trains. *Available as preprint upon request*

### Published manuscripts

1. **Aoi MC** and JW Pillow. Model-based targeted dimensionality reduction for neuronal population data. *Advances in neural information processing systems*. 2018
2. Shvartsman M, Sundaram N, **Aoi MC**, Charles AS, Wilke TL, and JD Cohen. Matrix-normal models for fMRI analysis *AISTATS*. 2017.
3. Pillow JW and **MC Aoi**(2017). Is population activity more than the sum of its parts?. *Nat. Neurosci.* 20, 1196-1198. (News & Views on Elsayed and Cunningham 2017).
4. Stanley DA, Roy JE, **Aoi MC**, Kopell NJ, and EK Miller. Low-Beta oscillations turn up the gain during category judgements. *Cerebral Cortex*. 1-15. 2016
5. **Aoi MC**, Lepage KQ, Kramer MA, Eden, UT. Rate-adjusted spike-LFP coherence comparisons from spike-train statistics. *J. Neurosci. Methods*, 240:141-53. 2015.
6. **Aoi MC**, Lepage KQ, Eden UT, Lim Y, Gardner T. An approach to time-frequency analysis with the ridges of the continuous chirplet transform. *IEEE Transactions on Signal Processing*, Accepted 2014 doi 10.1109/TSP.2014.2365756.
7. K.Q. Lepage, G.G. Gregoriou, MA. Kramer, **M Aoi**, SJ. Gotts, UT Eden, R Desimone. A Procedure for Testing Across-Condition Rhythmic Spike-field Association Change. *J. Neurosci. Methods*, 213(1):43-62. doi: 10.1016/j.jneumeth.2012.10.010, 2012.
8. **Aoi MC**, Hu K, Zhao P, Selim M, Olufsen MS, Novak V. Impaired Cerebral Autoregulation Is Associated with Brain Atrophy and Worse Functional Status in Chronic Ischemic Stroke. *PLoS ONE* 7(10): e46794. doi:10.1371/journal.pone.0046794, 2012.
9. **Aoi MC**, Rourke BC. Interspecific and intragenic differences in codon usage bias among vertebrate myosin heavy-chain genes. *Journal of Molecular Evolution*. 73(3-4), 74-93. 2011.
10. **Aoi MC**, Kelley CT, Novak V, Olufsen MS. Optimization of a mathematical model of cerebral autoregulation using patient data, *7th IFAC Symp Modelling and Control in Biomedical Systems*, Volume 7, Part 1, DOI 10.3182/20090812-3-DK-2006.0088, Feb 2010. 6 pages.
11. **Aoi MC**, Gremaud P, Tran HT, Novak V, Olufsen MS. Modeling cerebral blood flow and regulation, *IEEE Proc* 2009. 4 pages.

### Conference Proceedings

1. Pagan M, Tang V, **Aoi M**, Pillow J, and C Brody. Representations and causal contributions of frontal cortical regions during a flexible decision-making task. *Program No. 599.12. 2019 Neuroscience Meeting Planner. Chicago, IL: Society for Neuroscience, 2019. Online.*
2. **Aoi MC**, Scott B, Wu A, Thiberge S, Brody C, Tank D, and J Pillow. Gradient-based analysis of wide-field calcium imaging data using gaussian processes. *Cosyne abstracts 2019*, Lisbon, Portugal
3. **Aoi MC**, Scott B, Constantinople C, Brody C, and JW Pillow. Shared neuronal variability accounts for behavioral variability in count discrimination tasks. *Cosyne 2018*, poster session
4. Shvartsman M, Sundaram N, **Aoi MC**, Charles AS, Wilke TL, and JD Cohen. Matrix-normal models for fMRI analysis *Cosyne 2018*. poster session.
5. **Aoi MC**, Mante V, and JW Pillow. Dimensionality reduction and dynamic encoding in PFC during context-dependent decision making. *Society for Neuroscience Conference. 2017.*
6. **Aoi MC**, Wu A, Smith I, Smith S, and JW Pillow. Fast, scalable Bayesian inference for high-dimensional neural receptive fields. *Cosyne 2016*, poster session
7. **Aoi MC**, Mante V, and JW Pillow. Bayesian targeted dimensionality reduction for neural population activity. *Cosyne abstracts 2016.*
8. **Aoi MC**, Lepage KQ, Kramer MA, Eden UT. Spike-field coherence: Rate and history confounds. *2012 Society for Neuroscience Conference, New Orleans, LA.*
9. **Aoi MC**, Matzuka BJ, Tran H, Olufsen MS, Online, model-assisted assessment of cerebral autoregulation. *2011 IEEE Engineering in Medicine and Biology Conference, Boston, MA.*
10. **Aoi MC**, Olufsen MS. Estimation of cerebral autoregulation by mathematical models. *7th International Congress on Industrial and Applied Mathematics - ICIAM 2011*, July 18-22, Vancouver, BC Canada.
11. **Aoi MC** Hu K, Zhao P, Desrochers L, Lo MT, Liu Y, Peng CK, Novak P, Selim M, Lipsitz LA, Novak V. Nonlinear measures of cerebral autoregulation can predict brain structural changes and functional outcomes. *Oral Abstracts, American Heart Association 2009 International Stroke Conference. San Diego, CA 2/19/09.*
12. Desrochers L, Hu K, **Aoi MC**, Selim M, Lipsitz LA, Zhao P, Caplan L, Novak V. Cerebral Blood flow velocity is maintained during orthostatic stress. *Poster Presentation, American Heart Association 2009 International Stroke Conference. San Diego, CA 2/19/09.*
13. **Aoi MC**, Gramaud P, Tran H, Novak V, Olufsen MS. Modeling and Estimation of Cerebral Autoregulation. Cardiovascular and Respiratory Systems Section. *2009 IEEE Engineering in Medicine and Biology Conference, Minneapolis, MN.*
14. **Aoi MC**, Tran H, Novak V, Olufsen MS. Modeling cerebral blood flow and regulation. MBI Poster Presentation. Current Topics Workshop on Computational Challenges in Integrative Biological Modeling.

### Professional activities

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**Reviewer**

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| Cosyne Conference                                | 2019–present |
| Journal of Computational Neuroscience            | 2018–present |
| Neural Information Processing Systems Conference | 2017–present |
| International Conference of Machine Learning     | 2017–present |
| PLoS Computational Biology                       | 2015–present |
| IEEE Transactions on Signal Processing           | 2014–present |

**Event co-organizer:**

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| Mathematics of Deep Learning, New York, NY<br>Corporate/Academic–sponsored, 2 day conference<br>on mathematical theories of deep learning.<br>Invited and contributed talks and poster sessions<br><a href="https://deepmath-conference.com">https://deepmath-conference.com</a> | Oct 31 – Nov 1, 2019 |
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| Princeton University and Institute for Advanced Study,<br>Joint Symposium on the Mathematical theory of deep<br>neural networks, Princeton, NJ.<br>2–day workshop, sponsored by Princeton University and IAS<br>with invited speakers giving talks on theoretical work<br>aimed at understanding deep neural networks<br><a href="https://sites.google.com/site/princetonondeepmath/">https://sites.google.com/site/princetonondeepmath/</a> | March 20, 2018 |
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| Computational and Systems Neuroscience (Cosyne)<br>Conference workshops                              |      |
| –New Methods for Understanding Neural Dynamics<br>and Computation                                    | 2017 |
| –Dimensionality reduction for the analysis and interpretation<br>of high-dimensional neural datasets | 2016 |

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|---|------|
| <b>Workshop Program Committee, Member</b>   | 2018 |
| –Neural Information Processing Systems Conference<br><i>All of Bayesian nonparametrics</i><br><a href="https://sites.google.com/view/nipsbnp2018/">https://sites.google.com/view/nipsbnp2018/</a> |      |

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**Honors and awards**

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- Lucas Research Award, 2012: For exceptional dissertation research in the Biomathematics graduate program.
- Travel grant for EMS-SMI Cortona Summer School. 2008. EMS-SMI Cortona Summer School. Cortona, Italy. *Mathematical and Numerical Models for the Cardiovascular System* presented by Dominique Chapelle, Piero Colli-Franzone, and Alfio Quarteroni.  
<http://mox.polimi.it/cortona08/>.

**Professional Affiliations**

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- Society for Industrial and Applied Mathematics
- American Statistical Association
- Society for Neuroscience