Talmo Pereira

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Ph.D. Candidate in Neuroscience

Research Interests

I study how biological neural circuits perform the computations necessary to transform sensory information into motor behaviors by using the fruit fly (*Drosophila melanogaster*) as a model system.

I develop hardware for measuring animal motion at high resolution, as well as computational methods for analyzing social behaviors using deep learning and computer vision.

Education

2015 - Present	**Princeton University**, Princeton, NJ Ph.D. in Neuroscience
2015	**Marine Biological Laboratory**, Woods Hole, MA Brains, Minds & Machines Summer Course
2014	**Massachusetts Institute of Technology**, Cambridge, MA Quantitative Methods in Biology Workshop
2011 - 2015	**University of Maryland, Baltimore County** (UMBC), Baltimore, MD B.S. in Bioinformatics & Computational Biology

Research

7/2015 - Present	**Princeton Neuroscience Institute** *Advisors:* Mala Murthy and Joshua Shaevitz Using fruit flies (*Drosophila melanogaster*) to study how the brain integrates sensory information to pattern behavioral sequences. Developed hardware and software for acquisition and processing of high resolution video, audio and realtime instrument control. Developed computational methods that leverage computer vision, deep learning, signal processing and unsupervised machine learning for quantifying behavior through few shot pose estimation and manifold embedding. Working on mapping the substrates and function of biological neural circuits involved in patterning the structure of complex motor behaviors.
6/2019 - 12/2019	**Google AI** *Supervisors:* Shay Ohayon and Caroline Pantofaru Research internship at Google AI in Machine Perception. Developed deep learning systems for human action recognition.
6/2014 - 8/2014	**California Institute of Technology** *Advisor:* David J. Anderson Worked on computational analysis of aggressive behaviors in fruit flies using methods in computer vision for animal tracking and supervised machine learning for timeseries segmentation.
6/2013 - 8/2013 1/2014 - 5/2014	**Massachusetts Institute of Technology** *Advisor:* Sebastian Seung Worked on image processing algorithms for large scale (100-1000s GiB) electron microscopy image alignment/registration for connectomic reconstruction.

1/2013 - 6/2015	**University of Maryland, Baltimore County**
	Advisor: Ivan Erill
	Developed computational algorithm for GPU-accelerated transcription factor DNA binding site prediction in large scale (10-100s GiB) metagenomic sequencing data. to characterize transcriptional regulatory networks.
6/2012 - 8/2012	**Broad Institute of MIT and Harvard**
	Stanley Center for Psychiatric Research
	Advisor: Jon Madison
	Worked on characterizing interactions between proteins associated with psychiatric disease in the axon initial segment via immunochemical assays.
6/2010 - 6/2011	**National Institutes of Health**
	National Institute of Dental and Craniofacial Research (NIDCR)
	Advisor: Abner L. Notkins
	Characterized the learning and memory impairment induced by knockout of a type-1 diabetes-associated neuroendocrine transport gene in mice.

PUBLICATIONS

1. **Pereira, Talmo D**, J. W. Shaevitz, and M. Murthy. Understanding the brain by quantifying behavior. In review

2. **Pereira, Talmo D**, N. Tabris, S. Ravindranath, J. Li, E. S. Papadoyannis, Z. Y. Wang, D. M. Turner, G. C. McKenzie-Smith, S. D. Kocher, J. W. Shaevitz, and M. Murthy. SLEAP: Multi-animal pose tracking. 2020

3. J. M. Jones, W. Foster, C. R. Twomey, J. Burdge, O. M. Ahmed, **Pereira, Talmo D**, J. A. Wojick, G. Corder, J. B. Plotkin, and I. Abdus-Saboor. A machine-vision approach for automated pain measurement at millisecond timescales. *Elife*, 9, Aug. 2020

4. Princeton Open Ventilation Monitor Collaboration, P. Bourrianne, S. Chidzik, D. J. Cohen, P. Elmer, T. Hallowell, T. J. Kilbaugh, D. Lange, A. M. Leifer, D. R. Marlow, P. D. Meyers, E. Normand, J. Nunes, M. Oh, L. Page, **Pereira, Talmo**, J. Pivarski, H. Schreiner, H. A. Stone, D. W. Tank, S. Thiberge, and C. Tully. Inexpensive multi-patient respiratory monitoring system for helmet ventilation during COVID-19 pandemic. June 2020

5. A. S. Charles, B. Falk, N. Turner, **Pereira, Talmo D**, D. Tward, B. D. Pedigo, J. Chung, R. Burns, S. S. Ghosh, J. M. Kebschull, et al. Toward community-driven big open brain science: Open big data and tools for structure, function, and genetics. *Annual Review of Neuroscience*, 43, 2020

6. D. Deutsch, D. A. Pacheco, L. J. Encarnacion-Rivera, **Pereira, Talmo**, R. Fathy, A. Calhoun, E. C. Ireland, A. T. Burke, S. Dorkenwald, C. McKellar, et al. The neural basis for a persistent internal state in drosophila females. *bioRxiv*, 2020

7. **Pereira, Talmo D***, Aldarondo, Diego E*, L. Willmore, M. Kislin, S. S.-H. Wang, M. Murthy, and J. W. Shaevitz. Fast animal pose estimation using deep neural networks. *Nature methods*, 16(1):117, 2019

8. A. Badura, J. L. Verpeut, J. M. Metzger, **Pereira, Talmo D**, T. J. Pisano, B. Deverett, D. E. Bakshinskaya, and S. S. Wang. Normal cognitive and social development require posterior cerebellar activity. *eLife*, 7:e36401, 2018

9. J. Clemens, P. Coen, F. A. Roemschied, **Pereira, Talmo D**, D. Mazumder, D. E. Aldarondo, D. A. Pacheco, and M. Murthy. Discovery of a new song mode in drosophila reveals hidden structure in the sensory and neural drivers of behavior. *Current Biology*, 28(15):2400–2412, 2018

10. G. B. Hermsdorff, **Pereira, Talmo**, and Y. Niv. Quantifying humans' priors over graphical representations of tasks. In *International Conference on Complex Systems,* pages 281–290. Springer, 2018

11. A. Giovannucci, E. Pnevmatikakis, B. Deverett, **Pereira, T**, J. Fondriest, M. Brady, S.-H. Wang, W. Abbas, P. Parés, and D. Masip. Automated gesture tracking in head-fixed mice. *Journal of neuroscience methods,* 300:184–195, 2018

12. **Pereira, Talmo D** and M. Murthy. To fight or not to fight. *Neuron,* 95(5):986–988, 2017

13. A. Giovannucci, A. Badura, B. Deverett, F. Najafi, **Pereira, Talmo D**, Z. Gao, I. Ozden, A. D. Kloth, E. Pnevmatikakis, L. Paninski, et al. Cerebellar granule cells acquire a widespread predictive feedback signal during motor learning. *Nature neuroscience,* 20(5):727, 2017

14. Hobbs, Elizabeth T*, **Pereira, Talmo***, P. K. O'Neill, and I. Erill. A bayesian inference method for the analysis of transcriptional regulatory networks in metagenomic data. *Algorithms for Molecular Biology,* 11(1):19, 2016

PRESENTATIONS

2020 | **Massachusetts Institute of Technology**
Cambridge, MA
COMPUTATIONAL TUTORIAL: : Decoding Animal Behavior Through Pose Tracking

2020 | **American Physical Society March Meeting**
Denver, CO
TALK: Multi-animal pose tracking using deep neural networks

2020 | **Computational and Systems Neuroscience (Cosyne)**
Denver, CO
POSTER: Multi-animal pose tracking and predictive modeling of social interactions

2019 | **Junior Scientist Workshop on Machine Learning and Computer Vision**
Janelia Farm, Ashburn, VA
TALK: Few shot multi-animal pose estimation and tracking

2019 | **Annual BRAIN Initiative Investigators Meeting**
Washington, DC
POSTER: Few shot multi-animal pose estimation and tracking

2018 | **Society for Neuroscience Conference**
San Diego, CA
POSTER: Fast estimation of animal pose using deep neural networks

2018 | **Princeton Neuroscience Institute Departmental Retreat**
Avalon, NJ
TALK: Fast, automated pose estimation in freely moving animals

2017 | **Princeton Bioengineering Colloquium**
Princeton, NJ
TALK: Understanding acoustic communication through unsupervised behavioral quantification

2017 | **Computational and Systems Neuroscience (Cosyne)**
Salt Lake City, UT
WORKSHOP CO-ORGANIZER: Automated Tools for High Dimensional Neuro-Behavioral Analysis

2016	**Action Selection Across the Animal Kingdom Conference**
	Janelia Farm, Ashburn, VA
	POSTER: Quantifying fly courtship to discover principles for action selection

2016	**Society for Neuroscience Conference**
	San Diego, CA
	POSTER: High dimensional neuroanatomical and behavioral analysis for probing cerebellar involvement in nonmotor function

SCHOLARSHIPS & AWARDS

2019	**Porter Ogden Jacobus Fellowship**
	Top graduate student honor at Princeton University.

2019	**Princeton Intellectual Property Accelerator Fund**
	Awarded $100,000 to develop AI framework for animal pose estimation.

2015	**Princeton University President's Prize**
	Awarded honorific fellowship on admission to graduate program.

2015	**NSF Graduate Research Fellowship Program**
	One of 2,000 awardees selected from a pool of 16,500 applicants for the grant.

2014	**The Barry Goldwater Scholarship and Excellence in Education Program**
	Received an Honorable Mention from a pool of 1,166 nationwide nominees.

2013	**MARC Undergraduate Student Training in Academic Research**
	The MARC U-STAR scholarship is an award funded by the NIH in an effort to support undergraduates in pursuing experiences and a career in research. Provides a research stipend, full academic scholarship, funding for lab expenses and travel.

2012	**UMBC Undergraduate Research Award (URA)**
	Research grant awarded to undergraduates pursuing research on campus.

2012	**Howard Hughes Medical Institute Scholar**
	Highly selective HHMI-sponsored program aiming to increase diversity in the biomedical sciences. Supports students with a research stipend, pre-professional advising and funding for summer research.

2011	**Meyerhoff Scholar**
	Selective scholarship program at UMBC supporting students pursuing a career in research in the STEM fields.

2011	**Broad Prize Scholar**
	Broad Prize scholarships are awarded to graduating seniors who have a demonstrated record of improving their grades over the course of their high school career and have a financial need by the Eli and Edythe Broad Foundation. One of thirteen awardees in Montgomery County, MD.

Teaching

2018
2017 **Course Instructor**: Intro to Scientific Programming
Designed and taught an undergraduate summer course in computational methods in neuroscience at Princeton University.

2017 **Teaching Assistant**: NEU 457 - Measurement and Analysis of Neural Circuit Dynamics
Professors: David Tank and Andrew Leifer
Designed problem sets, lectured and graded senior/graduate level methods course in computational analysis of neural data at Princeton University.

2016 **Teaching Assistant**: NEU 201 - Fundamentals of Neuroscience
Professor: Ilana Witten
Led discussion/recitation sections for undergraduate introductory neuroscience at Princeton University.

2014 **Course Instructor**: Intro to Computer Programming for Biologists
Designed and taught a graduate-level winter course in computational methods in biology at MIT.

2013 **Teaching Assistant**: Introductory Biology
Served as undergraduate teaching assistant for discussion component of the introductory Biology class. Held weekly graded sessions for a class of 34 students.

2012 **Supplemental Instruction Leader**: Introductory Biology
Held two weekly sessions of guided study for the introductory Biology class in a fashion similar to a TA but using the SI philosophy and guidelines. SI targets high-risk classes where pass-to-fail ratios are exceptionally low by promoting collaborative learning in contrast to passive lecture-based instruction.

Service

2018 **SACNAS**
Recruited URMs at the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science Conference in with the Princeton Diversity and Inclusion team.

2017 **Princeton Diversity Hosting Weekend**
Hosted accepted URM graduate students, guided tours and served on panel.

2016 **ABRCMS**
Recruited URMs at the Annual Biomedical Research Conference for Minority Students with the Princeton Diversity and Inclusion team.