Michael C. Burkhart

michael_burkhart@alumni.brown.edu

Research Interests

sequential Bayesian inference • neural decoding • Gaussian processes • semi-supervised learning • causality

Education

Brown University
Providence RI
Ph.D. Applied Mathematics — 2013–2019

Rutgers University
New Brunswick NJ
M.Sc. Mathematics — 2011–2013

Purdue University
West Lafayette IN
B.Sc.'s Mathematics, Statistics, & Economics — 2007–2011

Experience

Adobe Inc.
San José CA

Sr. Machine Learning Scientist — 2021–
Machine Learning Scientist — 2018–2021
- built and validated predictive models for user segmentation (PySpark/LightGBM)
- supervised intern projects in semi-supervised learning and causal inference (Keras/Tensorflow)

BrainGate Clinical Trial
Providence RI

Doctoral Researcher — 2014–2018
- developed and implemented a novel nonlinear filter for online neural decoding (Matlab/Python)
- framework enabled participants with quadriplegia to communicate and interact with their environments in real time using mental imagery alone
- experimented with Bayesian solutions to provide robustness against common non-stationarities for online decoding in Brain Computer Interfaces (BCI's)

Spotify USA Inc.
New York NY

Data Research Intern — 2017
- implemented online stochastic variational inference for topic models (Latent Dirichlet Allocation & Hierarchical Dirichlet Processes) on playlist data
- scaled training to 500M playlists using Google's BigQuery (SQL) and cloudML

Brown–Kobe Summer School
Kobe, Japan

Team Leader, High Performance Computing — 2016
- designed and supervised a project to create a parallelized particle filter for neural decoding
- taught topics in Bayesian filtering and programming in Tensorflow/Cython to graduate students from Brown and Kobe Universities

Argonne National Lab
Lemont IL

Graduate Research Aide — 2012
- propagated variance in a multi-step prediction model to better estimate prediction error (Matlab/R)
- used Monte Carlo Expectation Maximization to learn hyperparameters

Journal Publications

- M. Burkhart, D. Brandman, B. Franco, L. Hochberg, & M. Harrison. **The Discriminative Kalman Filter for Bayesian Filtering with Nonlinear and Nongaussian Observation Models**. Neural Computation 32(5), 969–1017 (2020)
- D. Brandman, M. Burkhart, J. Kelemen, B. Franco, M. Harrison, & L. Hochberg. **Robust closed-loop control of a cursor in a person with tetraplegia using Gaussian process regression**. Neural Computation 30(11), 2986–3008 (2018)
- D. Brandman, T. Hosman, J. Saab, M. Burkhart, B. Shanahan, J. Ciancibello, et al. **Rapid calibration of an intracortical brain computer interface for people with tetraplegia**. Journal of Neural Engineering 15(2), 026007 (2018)
- M. Burkhart, Y. Heo, & V. Zavala. **Measurement and verification of building systems under uncertain data: A Gaussian process modeling approach**. Energy and Buildings 75, 189–198 (2014)

Conference Publications

- M. Burkhart. **Discriminative Bayesian Filtering for the Semi-Supervised Augmentation of Sequential Observation Data**. International Conference on Computational Science, LNCS vol. 12743, 271–283 (2021)
- M. Burkhart & K. Shan. **Deep Low-Density Separation for Semi-Supervised Classification**. International Conference on Computational Science, LNCS vol. 12139, 297–311 (2020)
- M. Burkhart & K. Modarresi. **Adaptive Objective Functions and Distance Metrics for Recommendation Systems**. International Conference on Computational Science, LNCS vol. 11537, 608–621 (2019)
- M. Burkhart & K. Modarresi. **Determining Adaptive Loss Functions and Algorithms for Predictive Models**. International Conference on Computational Science, LNCS vol. 11537, 595–607 (2019)

Preprint

- M. Burkhart. **Discriminative Bayesian Filtering Lends Momentum to the Stochastic Newton Method for Minimizing Log-Convex Functions.** arXiv:2104.12949.

Thesis

- M. Burkhart. **A Discriminative Approach to Bayesian Filtering with Applications to Human Neural Decoding**. Ph.D. dissertation, advised by Professor Matthew T. Harrison. Division of Applied Mathematics, Brown University, Providence USA (2019)

Patents Pending

- M. Burkhart & K. Shan. **User Classification from Data via Deep Segmentation for Semi-supervised Learning**. U.S. Patent Application #16/681,239. Filed Nov. 2019. Published May 2021 as 2021/0142152A1.
- M. Burkhart & K. Modarresi. **Digital Experience Enhancement using an Ensemble Deep Learning Model**. U.S. Patent Application #16/375,627. Filed Apr. 2019. Published Oct. 2020 as 2020/0320382A1.

Teaching Experience

Graduate Teaching Assistant (Brown): Recent Applications of Probability & Statistics (Spr. '16, Spr. '18) • Statistical Inference (Spr. '17) • Computational Probability & Statistics (Fall '15) • Essential Statistics (Spr. '15)• Information Theory (Fall '14)

Talks and Presentations

- M. Burkhart, D. Brandman, & M. Harrison. **The Discriminative Kalman Filter for nonlinear and non-Gaussian sequential Bayesian filtering**. The 31st New England Statistics Symposium, Storrs, CT, 2017.
- D. Brandman, M. Burkhart, …, M. Harrison, & L. Hochberg. **Noise-robust closed-loop neural decoding using an intracortical brain computer interface in a person with paralysis**. Society for Neuroscience (SFN), Washington, DC, 2017.
- D. Brandman, M. Burkhart, …, M. Harrison, & L. Hochberg. **Closed loop intracortical brain computer interface cursor control in people using a continuously updating Gaussian process decoder**. Society for Neuroscience (SFN), San Diego, CA, 2016.
- M. Burkhart, D. Brandman, C. Vargas-Irwin, & M. Harrison. **Nonparametric discriminative filtering for neural decoding**. 2016 ICSA Applied Statistics Symposium. Atlanta, GA, 2016.
- D. Brandman, M. Burkhart, …, M. Harrison, & L. Hochberg. **Closed loop intracortical brain computer interface control in a person with ALS using a filtered Gaussian process decoder**. American Neurological Association Annual Meeting, Baltimore, MD, 2016.
- —. **Intracortical brain computer interface control using Gaussian processes**. Dalhousie University Surgery Research Day, Halifax, NS, 2016.
- —. **Closed loop intracortical brain computer interface control using Gaussian processes in a nonlinear, discriminative version of the Kalman filter**. 9th World Congress for Neurorehabilitation, Philadelphia, PA, 2016.
- D. Knott, U. Walther, & M. Burkhart. **Finding the non-reconstructible locus**. SIAM Conference on Applied Algebraic Geometry. Raleigh, NC, 2011.

Community Involvement

ICCS Conference Thematic Track	Program Committee Member • for the thematic track on Applications of Computational Methods in Artificial Intelligence and Machine Learning	2019–
Brown SIAM Student Chapter Providence RI	Vice President, Chapter Records • organized events within the applied math community	2016–2017
	Interdepartmenal Liaison Officer	2015–2016
Purdue Student Publishing Foundation West Lafayette IN	Member, Corporate Board of Directors • oversaw the Exponent, Purdue's Independent Daily Student Newspaper	2009–2011
	Chairman, Finance Committee • oversaw >$1 million annual budget, set student and faculty salaries, approved capital expenditures	2010–2011

Honors

Brown Institute for Brain Science Graduate Research Award	2016
Brown International and Conference Travel Awards (Arequipa, Peru)	2016
Brown-IMPA Partnership Travel Award (Rio de Janeiro, Brazil)	2015
Brown-Kobe Exchange in High Performance Computing Travel Award (Kobe, Japan)	2014, 2016
Rutgers Graduate Assistantship in Areas of National Need	2012
National Merit Scholar Finalist	2007

Find Me Online

https://burkh4rt.github.io