Michael C. Burkhart

michael_burkhart@alumni.brown.edu

Research Interests

Bayesian filtering • neural decoding • time series • Gaussian processes • topic models • variational inference

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 Statistics, Mathematics, & Economics — 2007–2011

Research Experience

Adobe Inc.
San José CA
Machine Learning Scientist — 2018–
- developed production pipelines for user segmentation (Pyspark / SQL / LightGBM)
- supervised summer intern research project in semi-supervised learning

BrainGate Clinical Trial
Providence RI
Doctoral Researcher — 2014–2018
- developed and implemented novel nonlinear filters for online neural decoding (Matlab / Python)
- 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

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 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

Stats/BCI Publications

- M. Burkhart, D. Brandman, B. Franco, M. Harrison, & L. Hochberg. **The Discriminative Kalman Filter for Bayesian Filtering with Nonlinear and Nongaussian Observation Models**. Neural Computation 32 (2020).
- M. Burkhart. "**A Discriminative Approach to Bayesian Filtering with Applications to Human Neural Decoding**." Brown University, Ph.D. dissertation (2019).
- 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 (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 (2018).

General ML Publications

- M. Burkhart & K. Shan. **Deep Low-Density Separation for Semi-Supervised Classification**. International Conference on Computational Science. LNCS vol. 12139 (2020).
- M. Burkhart & K. Modarresi. **Adaptive Objective Functions and Distance Metrics for Recommendation Systems**. International Conference on Computational Science. LNCS vol. 11537 (2019).
- M. Burkhart & K. Modarresi. **Determining Adaptive Loss Functions and Algorithms for Predictive Models**. International Conference on Computational Science. LNCS vol. 11537 (2019).
- M. Burkhart, Y. Heo, & V. Zavala. **Measurement and verification of building systems under uncertain data: A Gaussian process modeling approach**. Energy and Buildings 75 (2014).

Patents Pending

- M. Burkhart & K. Shan. **User Classification from Data via Deep Segmentation for Semi-supervised Learning**. U.S. Patent Application #16/681239. Filed Nov. 2019.
- M. Burkhart & K. Modarresi. **Digital Experience Enhancement using an Ensemble Deep Learning Model**. U.S. Patent Application #16/375627. Filed Apr. 2019.

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

Brown SIAM Student Chapter
Providence RI

Vice President, Chapter Records 2016–2017
- organized events within the applied math community

Interdepartmenal Liaison Officer 2015–2016

Purdue Student Publishing Foundation
West Lafayette IN

Member, Corporate Board of Directors 2009–2011
- oversaw the Exponent, Purdue's Independent Daily Student Newspaper

Chairman, Finance Committee 2010–2011
- oversaw >$1 million annual budget, set student and faculty salaries, approved capital expenditures

Teaching Experience

Graduate Teaching Assistant: 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)

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