Andrew J. Holbrook, Ph.D.

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Research Interests

Bayesian statistics and machine learning; dimension reduction; imaging statistics; viral epidemiology

Dissertation title: *Geometric Bayes*; Advisor: Babak Shahbaba, Ph.D.; Co-Advisor: Daniel L. Gillen, Ph.D.

Education

2013-2018, Ph.D., Statistics, University of California, Irvine, CA

2013-2015, M.S., Statistics, University of California, Irvine, CA

2005-2009, B.A., German and Classical Languages, *with Honors*, University of California, Berkeley, CA

Awards and Academic Honors

- NSF CAREER Award (2023)
- Toffler Scholar Award, The Karen Toffler Charitable Trust (2023)
- NIH K25 Career Development Award (2020)
- Leonard J. Savage Award, International Society for Bayesian Analysis (2018)
  Honorable Mention for a Dissertation in Theory and Methods
- Carl W. Cotman Young Investigator Award, UCI MIND (2018)
- UC Irvine Graduate Dean's Dissertation Fellowship Award (2017-2018)
- UCI MIND Aging Fellowship (2015-2017)
- Robert L. Newcomb 1st Year Graduate Student Award, UC Irvine Department of Statistics (2014)

Refereed Publications

18. **Holbrook A**. *Generating MCMC proposals by randomly rotating the regular simplex*. Journal of Multivariate Analysis, vol. 194, 105106, 2023.

17. Hassler G, Gallone B, Aristide L, Allen W, Tolkoff M, **Holbrook A**, Baele G, Lemey P, Suchard M. *Principled, practical, flexible, fast: a new approach to phylogenetic factor analysis*. Methods in Ecology and Evolution, vol. 13, pp. 2181-2197, 2022.

16. **Holbrook A**, Ji X, Suchard M. *From viral evolution to spatial contagion: a biologically modulated Hawkes model*. Bioinformatics, vol. 38, no. 7, pp. 1846-1856, 2022.

15. **Holbrook A**, Ji X, Suchard M. *Bayesian mitigation of spatial coarsening for a Hawkes model applied to gunfire, wildfire and viral contagion*. Annals of Applied Statistics, vol. 16, no. 1, pp. 573-595, 2022.

14. Tustison N, Cook P, **Holbrook A**, Johnson H, Muschelli J, Devanyi G, Duda J, Das S, Cullen N, Gillen D, Yassa M, Stone J, Gee J, Avants B. *ANTsX: A dynamic ecosystem for quantitative biological and medical imaging*. Scientific Reports, vol. 11, no. 9068, 2021.

13. **Holbrook A**, Loeffler C, Flaxman S, Suchard M. *Scalable Bayesian inference for self-excitatory stochastic processes applied to big American gunfire data*. Statistics and Computing, vol. 31, no. 4, 2021.

12. **Holbrook A**, Lemey P, Baele G, Dellicour S, Brockmann D, Rambaut A, Suchard M. *Massive parallelization boosts big Bayesian multidimensional scaling*. Journal of Computational and Graphical Statistics, vol. 30, no. 1, pp. 11-24, 2021.

11. Shahbaba B, Lan S, Streets J, **Holbrook A**. *Nonparametric Fisher geometry with application to density estimation*. Proceedings of the 36th Conference on Uncertainty in Artificial Intelligence (UAI), PMLR vol. 124, pp. 101-110, 2020.

10. **Holbrook A**, Tustison N, Marquez F, Roberts J, Yassa M, Gillen D. *Anterolateral entorhinal cortex thickness as a biomarker for early detection of Alzheimer's disease.* Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring, vol. 12, no. 1, 2020.

9. Ji X, Zhang Z, **Holbrook A**, Nishimura A, Baele G, Rambaut A, Lemey P, Suchard M. *Gradients* do *grow on trees: a linear-time O(N)-dimensional gradient for statistical phylogenetics.* Molecular Biology and Evolution, vol. 37, no. 10, pp. 3047-3060, 2020.

8. Lan S, **Holbrook A**, Elias G, Fortin N, Ombao H, Shahbaba B. *Flexible Bayesian Dynamic Modeling of Correlation and Covariance Matrices.* Bayesian Analysis, vol. 15, no. 4, pp. 1199-1228, 2020.

7. **Holbrook A**, Lumley T, Gillen D. *Estimating prediction error for complex samples.* Canadian Journal of Statistics, vol. 48, no. 2, pp. 204-221, 2020.

6. Tustison N, **Holbrook A**, Avants B, Roberts J, Cook P, Reagh Z, Stone J, Gillen D, Yassa M. *Longitudinal mapping of cortical thickness measurements: an Alzheimer's Disease Neuroimaging Initiative-based evaluation study.* Journal of Alzheimer's Disease, vol. 71, no. 1, pp. 165-183, 2019.

5. Li L, **Holbrook A**, Shahbaba B, Baldi P. *Neural network gradient Hamiltonian Monte Carlo.* Computational Statistics, vol. 34, no. 1, pp. 281-299, 2019.

4. **Holbrook A**. *Differentiating the pseudo determinant.* Linear Algebra and its Applications, vol. 548, pp. 293-304, 2018.

3. **Holbrook A**, Lan S, Vandenberg-Rodes A, Shahbaba B. *Geodesic Lagrangian Monte Carlo over the space of positive definite matrices: with application to Bayesian spectral density estimation.* Journal of Statistical Computation and Simulation, vol. 88, no. 5, pp. 982-1002, 2018.

2. **Holbrook A**, Vandenberg-Rodes A, Fortin N, Shahbaba B. *A Bayesian supervised dual-dimensionality reduction model for simultaneous decoding of LFP and spike train signals.* Stat Journal, vol. 6, no. 1, pp. 53-67, 2017.

1. Grill J, **Holbrook A**, Pierce A, Hoang D, Gillen D. *Attitudes toward Potential Participant Registries.* Journal of Alzheimer's Disease, vol. 56, no. 3, pp. 939-946, 2017.

Support

- NSF DMS 2236854 (PI) 07/01/2023 - 06/30/2028, $549,227.
  Title: CAREER: Data-Centric Evolutionary Contagion Models with Parallel and Quantum Parallel Computing

- Toffler Scholar Award, The Karen Toffler Charitable Trust, 2023, $20,000.

- NSF DMS 2152774 (PI) 07/01/2022 - 06/30/2025, $300,000.
  Title: Accelerating Bayesian Dimension Reduction for Dynamic Network Data with Many Observations

- NIH K25 AI153816 (PI) 06/01/2020 - 05/31/2025, $532,335.
  Title: Big Data Predictive Phylogenetics with Bayesian Learning

Software

- RCPPXSIMD: C++ header-only library files provide modern, portable C++ wrappers for SIMD intrinsics and parallelized, optimized math implementations (SSE, AVX, NEON, AVX512). By placing this library in our R package, we offer an efficient distribution system for Xsimd through CRAN (`https://cran.r-project.org/package=RcppXsimd`).

- MASSIVEMDS: Open-source, high-performance computing software enables Bayesian multidimensional scaling with GPU and vectorized/multi-core CPU. Available as R package, standalone C++ library or with Java API (`https://github.com/suchard-group/MassiveMDS`).

- HPHAWKES: Open-source, high-performance computing software enables Bayesian inference for the Hawkes process with GPU and vectorized/multi-core CPU. Available as R package, standalone C++ library or with Java API (`https://github.com/suchard-group/hawkes`).

Invited Talks

20. phyloseminar.org, "From viral evolution to spatial contagion: a biologically modulated Hawkes model" (Virtual; Aug 2022)

19. ISBA World Meeting 2022, Invited Session, *Recent Advances in Bayesian Functional Analysis, Network Regression and Parallel MCMC*, "A quantum parallel Markov chain Monte Carlo" (Montréal, CA; Jun 2022)

18. EcoSta 2022, Organized Invited Session, *Advances in High-Dimensional Sampling Methods*, "A quantum parallel Markov chain Monte Carlo" (Kyoto, JP; Jun 2022)

17. AMS Western Sectional Meeting, Special Session, *Mathematical Advances in Bayesian Statistical Inversion and Markov Chain Monte Carlo Sampling Algorithms*, "A quantum parallel Markov chain Monte Carlo" (Virtual; May 2022)

16. University of California, Irvine, Department of Statistics, "A quantum parallel Markov chain Monte Carlo" (Irvine, CA; Apr 2022)

15. Foxconn Quantum Computing Center, "A quantum parallel Markov chain Monte Carlo" (Taipei City, TW; Mar 2022)

14. Yale University, Department of Biostatistics, "Three challenges for spatiotemporal Hawkes modeling" (New Haven, CT; Sept 2021)

13. King Abdullah University of Science and Technology, Department of Biostatistics, "Three challenges for spatiotemporal Hawkes modeling" (Thuwal, KSA; Sept 2021)

12. Arizona State University, School of Mathematical and Statistical Sciences, "Three challenges for spatiotemporal Hawkes modeling" (Tempe, AZ; Sept 2021)"

11. JSM 2021, Invited Paper Session, *Geometry and Bayes: Better Together*, "A simple MCMC algorithm that chooses from multiple proposals at each step" (Virtual; Aug 2021)

10. Instituto de Ciencias Matemáticas (ICMAT), "From viral evolution to spatial contagion: a biologically modulated Hawkes model" (Madrid, ES; June 2021)

9. Bayesian Inference in Stochastic Processes (BISP12), "From viral evolution to spatial contagion: a biologically modulated Hawkes model" (Virtual; May 2021)

8. University of California, Los Angeles, Department of Mathematics, Applied Math Colloquium, "From viral evolution to spatial contagion: a biologically modulated Hawkes model" (Los Angeles, CA; Mar 2021)

7. University of California, Los Angeles, Department of Statistics, "Bayesian modeling of global viral diffusions at scale" (Los Angeles, CA; Dec 2020)

6. Tulane University, Department of Mathematics, "Bayes in the time of Big Data" (New Orleans, LA; Nov 2020)

5. University of California, San Francisco, Department of Epidemiology and Biostatistics, "Bayesian modeling of global viral diffusions at scale" (San Francisco, CA; Nov 2020)

4. University of Auckland, Department of Statistics, Bayesianz Research Group, "Bayes in the time of Big Data" (Auckland, NZ; Nov 2020)

3. Johns Hopkins University, Department of Biostatistics, Bayesian Learning and Spatial Temporal modeling (BLAST) working group, "Bayes in the time of Big Data" (Baltimore, MD; Oct 2020)

2. JSM 2019, Savage Award Session, "Excerpts from *Geometric Bayes*" (Denver, CO; Aug 2019)

1. Statistical Methods in Imaging, "Evaluating the ANTs longitudinal cortical thickness pipeline" (Irvine, CA; Jun 2019)

Teaching

- *Bayes Theory* (Biostats 202C); Fall 2022; Department of Biostatistics, UCLA
- *Stochastic Processes* (Biostats 270); Spring 2022; Department of Biostatistics, UCLA
- *Advanced Bayesian Computing* (Biostats 285); Spring 2021, Spring 2022; Department of Biostatistics, UCLA
- *Introduction to Probability and Statistics* (Stat 7); Fall 2014, Summer 2015; Department of Statistics, UC Irvine
- *Biostatistics* (Stat 8); Winter 2015; Department of Statistics, UC Irvine
- *Mathematics*; 2010-2011; Dalian American International School
- *English as a Second Language*; 2010-2011; Dalian American International School

Professional Experience

- Postdoctoral scholar with Prof. Marc A. Suchard, M.D., Ph.D. at the Department of Human Genetics, University of California, Los Angeles; Los Angeles, California (2018-2020)
- Statistical consultant, the Alzheimer's Disease Research Center at the University of California, Irvine; Irvine, California (2015-2017)

- Statistical consultant, the Center for Statistical Consulting at the University of California, Irvine; Irvine, California (Winter and Spring 2014)
- Trainee, the Summer Institute for Training in Biostatistics at North Carolina State University and the Duke Clinical Research Institute; Raleigh, North Carolina (Summer 2013)
- Teacher, the Dalian American International School; Dalian, People's Republic of China (2010-2011)

Service and Community Involvement
- Chair, ISBA World Meeting 2022, session *Sampling state-of-the-arts in Bayesian computation for large-scale applications*
- NSF panelist, Division of Mathematical Sciences (2022, 2023)
- Lead organizer, *Conference on philosophy of machine learning: knowledge and causality*. March 17-18, 2018 at the University of California, Irvine
- Member, American Statistical Association (2018-present)
- Member, International Society for Bayesian Analysis (2020-present)

Journal Reviewer

AISTATS

Alzheimer's & Dementia: The Journal of the Alzheimer's Association ($\times 2$)

Annals of Applied Statistics ($\times 2$)

Applied Mathematics and Computation

Bayesian Analysis ($\times 2$)

IEEE Transactions on Industrial Electronics

Journal of Computational and Graphical Statistics

Journal of Machine Learning Research

Journal of the American Statistical Association

PLOS Computational Biology

Scandinavian Journal of Statistics

SIAM Journal on Matrix Analysis and Applications

Statistics and Computing ($\times 2$)

WIREs Computational Statistics