

## Harish S. Bhat

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CONTACT INFORMATION	UC Merced Applied Mathematics Unit 5200 N. Lake Rd. Merced, CA 95343	hbhat@ucmerced.edu <a href="https://github.com/hbhat4000">https://github.com/hbhat4000</a> <a href="http://faculty.ucmerced.edu/hbhat/">http://faculty.ucmerced.edu/hbhat/</a>
EDUCATION	<b>California Institute of Technology</b> , Ph.D. 2005, Control and Dynamical Systems <b>Harvard University</b> , A.B. 2000, Mathematics ( <i>magna cum laude</i> )	
RESEARCH INTERESTS	Machine learning, stochastic processes, optimization, algorithms, with applications to equation discovery and suicide prediction	
EXPERIENCE	<b>University of California, Merced</b> , Applied Mathematics Unit, Merced, CA <i>Professor</i> July, 2020 - <i>Associate Professor</i> July, 2012 - June, 2020 <i>Graduate Group Chair</i> January, 2016 - June, 2018 <i>Assistant Professor</i> July, 2008 - June, 2012  <b>University of Utah</b> , Department of Mathematics, Salt Lake City, UT <i>Associate Professor</i> July, 2018 - June, 2019  <b>Silicon Valley Bank (SVB)</b> , San Francisco, CA <i>Collaborating/Consulting Statistician</i> October, 2010 - December, 2018  <b>Sandia National Laboratories</b> , Livermore, CA <i>Visiting Researcher</i> September, 2013 - January, 2014  <b>Claremont McKenna College</b> , Mathematics, Claremont, CA <i>Assistant Professor</i> July, 2007 - June, 2008  <b>Columbia University</b> , Applied Physics and Applied Mathematics, New York, NY <i>Assistant Professor</i> July, 2005 - June, 2007	
HONORS AND AWARDS	Award for Distinguished Graduate Teaching, UC Merced Academic Senate, 2015 Finalist, Data-Driven Discovery Investigator Competition, Moore Foundation, 2014 First Place, Stanford-Berkeley-Caltech Innovators Challenge, 2005 National Science Foundation Graduate Research Fellowship, 2000	
PROGRAMMING EXPERIENCE	Python, TensorFlow, C++, Armadillo, Eigen, R, CPLEX, Gurobi, NLOpt, Scala, Breeze, Apache Spark, OpenMP, C, PetSc, Fortran, Matlab, Mathematica	

PUBLICATIONS IN  
MACHINE  
LEARNING,  
STATISTICS, AND  
OPTIMIZATION

R. Razi-perchikolaei and H. S. Bhat (2019). A block coordinate descent proximal method for simultaneous filtering and parameter estimation. *Proceedings of the 36th International Conference on Machine Learning, PMLR 97*, pp. 5380-5388.

H. S. Bhat (2019). Learning and interpreting potentials for classical Hamiltonian systems. *ECML-PKDD Workshop on Advances in Interpretable Machine Learning and Artificial Intelligence & eXplainable Knowledge Discovery in Data Mining*, accepted. arXiv:1907.11806 [cs.LG].

H. S. Bhat and S. Rawat (2019). Learning stochastic dynamical systems via bridge sampling. *ECML-PKDD Workshop on Advanced Analytics and Learning on Temporal Data*, accepted.

H. S. Bhat, L.-H. Huang, and S. Rodriguez [2019], Driving Markov chains to desired equilibria via linear programming. *Proceedings of the 2019 Asilomar Conference on Signals, Systems, and Computers*, accepted.

R. Dale and H. S. Bhat (2018). Equations of mind: Data science for inferring nonlinear dynamics of socio-cognitive systems. *Cognitive Systems Research*, **52**, pp. 275-290.

R. Dale and H. S. Bhat (2018). *sindyr*: Sparse Identification of Nonlinear Dynamics. R package version 0.2.1. <https://CRAN.R-project.org/package=sindyr>

H. S. Bhat, R. W. M. A. Madushani, and S. Rawat (2018). Parameter inference for stochastic differential equations with density tracking by quadrature. In: Pilz J., Rasch D., Melas V., Moder K. (eds) *Statistics and Simulation*. IWS 2015. Springer Proceedings in Mathematics & Statistics, **231**. Springer, Cham.

H. S. Bhat and S. J. Goldman-Mellor (2017). Predicting adolescent suicide attempts with neural networks. *2017 NIPS (Neural Information Processing Systems) Workshop on Machine Learning for Health*, arxiv:1711.10057 [stat.ML].

H. S. Bhat, R. W. M. A. Madushani, and S. Rawat (2017) Bayesian inference of stochastic pursuit models from basketball tracking data. In: Argiento R., Lanzarone E., Antoniano Villalobos I., Mattei A. (eds) *Bayesian Statistics in Action*. *BAYSM 2016*. Springer Proceedings in Mathematics & Statistics, vol 194. Springer, Cham.

H. S. Bhat and R. W. M. A. Madushani (2016). Nonparametric adjoint-based inference for stochastic differential equations. *Proc. IEEE International Conference on Data Science and Advanced Analytics (DSAA)*, pp. 798-807.

H. S. Bhat, R. W. M. A. Madushani, and S. Rawat (2016). Scalable SDE filtering and inference with Apache Spark. KDD BigMine '16 (5th International Workshop on Big Data, Streams and Heterogeneous Source Mining). *Journal of Machine Learning Research W&CP*, **53**, pp. 18-34.

H. S. Bhat, R. W. M. A. Madushani and S. Rawat (2016). *Rdtq*: Density Tracking by Quadrature. R package version 0.1. <https://CRAN.R-project.org/package=Rdtq>

T. Bergmann, R. Dale, N. Sattari, E. K. Heit, and H. S. Bhat (2016). The interdisciplinarity of collaborations in Cognitive Science. *Cognitive Science*, **41** (5), pp. 1412-1418.

H. S. Bhat, N. Kumar, and G. J. Vaz (2015). Towards scalable quantile regression trees. *Proc. IEEE Conference on Big Data*, pp. 53-60.

H. S. Bhat, L.-H. Huang, S. Rodriguez, R. Dale, and E. K. Heit (2015). Citation prediction using diverse features. *Proc. IEEE Conference on Data Mining Workshops, Workshop on Data Science and Big Data Analytics*, pp 589-596.

H. S. Bhat, L.-H. Huang, and S. Rodriguez (2015). Learning stochastic models for basketball substitutions from play-by-play data. *ECML/PKDD 2015 Workshop on Machine Learning and Data Mining for Sports Analytics (MLSA 2015)*.

H. S. Bhat and N. Kumar (2015). Large-scale empirical tests of the Markov tree model. *International Journal of Financial Studies*, 3 (3), pp. 280-318.

H. S. Bhat and R. W. M. A. Madushani (2015). Computing the density function for a nonlinear stochastic delay system. *IFAC-PapersOnLine*, 48 (12), pp. 316-321.

H. S. Bhat (2014). Algorithms for linear stochastic delay differential equations. *Topics in Statistical Simulation (Research Papers from the 7th International Workshop on Statistical Simulation)*, Springer Proceedings in Mathematics and Statistics, 114, pp. 57-65.

H. S. Bhat and D. Zaelit (2014). Forecasting retained earnings of privately held companies with PCA and  $L^1$  regression. *Applied Stochastic Models in Business and Industry*, 30 (3), pp. 271-293.

H. S. Bhat, G. J. Vaz, and J. C. Meza (2013). Fast solution of load shedding problems via a sequence of linear programs. *Proc. IEEE Conference on Big Data*, Santa Clara, CA, Nov., 2013.

P. J. Becich, B. P. Stark, H. S. Bhat, and D. H. Ardell (2013). CMCpy: Genetic code-message coevolution models in Python. *Evolutionary Bioinformatics*, 9, pp. 111-125.

H. S. Bhat and N. Kumar (2012). Spectral solution of delayed random walks. *Physical Review E*, 86 (4) 045701.

H. S. Bhat and N. Kumar (2012). Option pricing under a normal mixture distribution derived from the Markov tree model. *European Journal of Operational Research*, 223 (3), pp. 762-774.

H. S. Bhat and D. Zaelit (2011). Predicting private company exits using qualitative data. *Proc. 15th Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD2011)*, Shenzhen, China, May, 2011.

H. S. Bhat and N. Kumar (2010). Markov tree options pricing. *Proc. SIAM Conference on Mathematics in Industry (MI '09)*, San Francisco, CA, Oct., 2009, pp. 162-173.

H. S. Bhat and N. Kumar (2010). On the derivation of the Bayesian Information Criterion. Preprint (cited 60+ times), <http://faculty.ucmerced.edu/hbhat/BICderivation.pdf>

PAPERS UNDER  
REVIEW  
(AVAILABLE UPON  
REQUEST)

H. S. Bhat and R. Raziperchikolaei [2019], Estimating Vector Fields with Neural Shape Functions.

H. S. Bhat and R. W. M. A. Madushani [2018]. Density tracking by quadrature for stochastic differential equations, arXiv:1610.09572 [stat.CO].

PUBLICATIONS IN OTHER AREAS OF THE

H. S. Bhat and G. J. Vaz (2013). Frequency response and gap tuning for nonlinear electrical oscillator networks. *PLoS ONE*, **8** (11): e78009.

MATHEMATICAL SCIENCES

H. S. Bhat and B. Osting (2011). Two-dimensional inductor-capacitor lattice synthesis. *IEEE Trans. on Computer-Aided Design of Integrated Circuits and Systems*, **30** (10), pp. 1483-1492.

H. S. Bhat and B. Osting (2011). Kirchhoff's laws as a finite volume method for a planar Maxwell system. *IEEE Trans. on Antennas and Propagation*, **59** (10), pp. 3772-3779.

H. S. Bhat, W. Lee, G. N. Lilis, and E. Afshari (2010). Steady-state perturbative theory for nonlinear circuits. *Journal of Physics A: Mathematical and Theoretical*, **43**, 205101.

G. N. Lilis, J. Park, W. Lee, G. Li, H. S. Bhat, and E. Afshari (2010). Harmonic generation using nonlinear LC lattices. *IEEE Trans. on Microwave Theory and Technique*, **58** (7), pp. 1713-1723.

H. S. Bhat and B. Osting (2010). Discrete diffraction in two-dimensional transmission line metamaterials. *Microwave and Optical Technology Letters*, **52** (3), pp. 721-725.

H. S. Bhat and B. Osting (2009). Diffraction on the two-dimensional square lattice. *SIAM Journal on Applied Mathematics*, **70** (5), pp. 1389-1406.

H. S. Bhat and B. Osting (2009). The zone boundary mode in periodic nonlinear electrical lattices. *Physica D*, **238**, pp. 1216-1228.

H. S. Bhat and R. C. Fetecau (2009). On a regularization of the compressible Euler equations for an isothermal gas. *Journal of Mathematical Analysis and Applications*, **358** (1), pp. 168-181.

H. S. Bhat and R. C. Fetecau (2009). The Riemann problem for the Leray-Burgers equation. *Journal of Differential Equations*, **246** (10), pp. 3957-3979.

H. S. Bhat and B. Osting (2008). Thin slit diffraction in conventional and dual composite right/left-handed transmission line metamaterials. *Proc. Asia-Pacific Microwave Conference (APMC '08)*, Hong Kong, Dec., 2008.

B. Osting and H. S. Bhat (2008). Dispersive diffraction in a two-dimensional hexagonal transmission lattice. *Proc. International Symposium on Antennas and Propagation (ISAP '08)*, Taipei, Taiwan, Oct., 2008.

H. S. Bhat and E. Afshari (2008). Nonlinear constructive interference in electrical lattices. *Physical Review E*, **77**, 066602.

H. S. Bhat and R. C. Fetecau (2008). Stability of fronts for a regularization of the Burgers equation. *Quarterly of Applied Mathematics*, **66**, pp. 473-496.

E. Afshari, H. S. Bhat, A. Hajimiri (2008). Ultrafast analog Fourier transform using two-dimensional LC lattice. *IEEE Trans. on Circuits and Systems I*, **55** (8), pp. 2332-2343.

H. S. Bhat, R. C. Fetecau, and J. B. Goodman (2007). A Leray-type regularization for the isentropic Euler equations. *Nonlinearity*, **20**, pp. 2035-2046.

E. Afshari, H. S. Bhat, X. Li, and A. Hajimiri (2006). Electrical funnel: a new signal combining method. *Proc. IEEE International Solid-State Circuits Conference (ISSCC '06)*, Feb., 2006, pp. 206-208.

E. Afshari, H. S. Bhat, A. Hajimiri, and J. E. Marsden (2006). Extremely wideband signal shaping using one- and two-dimensional nonuniform nonlinear transmission lines. *Journal of Applied Physics*, **99**, 054901.

H. S. Bhat and R. C. Fetecau (2006). Lagrangian averaging for the 1D compressible Euler equations. *Discrete and Continuous Dynamical Systems B*, **6** (5), pp. 979-1000.

H. S. Bhat and R. C. Fetecau (2006). A Hamiltonian regularization of the Burgers equation. *Journal of Nonlinear Science*, **16** (6), pp. 615-638.

H. S. Bhat, R. C. Fetecau, J. E. Marsden, K. Mohseni, and M. West (2005). Lagrangian averaging for compressible fluids. *Multiscale Modeling and Simulation*, **3** (4), pp. 818-837.

SELECTED  
INVITED TALKS

Data Science Institute Workshop, Lawrence Livermore National Lab, July 2019  
Salt Lake City Data Science Meetup, May 2019  
CMStatistics, Dec. 2018  
SIAM Conference on Uncertainty Quantification, Apr. 2018  
Northwestern University, Feb. 2018  
Lawrence Berkeley National Lab, Feb. 2018  
Banff International Research Station, Jan. 2017 and Jan. 2018  
Lawrence Livermore National Lab, Nov. 2017  
Pacific Northwest National Lab, July 2017  
University of Utah, Feb. 2016, Jan. 2018, Nov. 2018  
University of California, Santa Barbara, May 2013  
University of California, Davis, May 2012  
CSU Stanislaus, Nov. 2011  
CITRIS, University of California, Berkeley, May 2011  
Claremont Center for the Mathematical Sciences, Mar. 2011  
University of California, Santa Cruz, Nov. 2007 and Nov. 2017  
AMS Fall Western Sectional Meeting, University of British Columbia, Oct. 2008  
AMS Spring Western Sectional Meeting, Claremont McKenna College, Mar. 2008  
University of California, Merced, Oct. 2007, Dec. 2007, Oct. 2009, and Sep. 2010  
Claremont McKenna College, Jan. 2007  
Cornell University, Dec. 2006  
New Jersey Institute of Technology, April 2006  
Brookhaven National Lab, April 2006  
University of Washington, April 2005 and Nov. 2007

Columbia University, Feb. 2005

EXTRAMURAL  
GRANTS: PI AND  
CO-PI ROLES UC Firearm Violence Research Center (PI: Sidra Goldman-Mellor), 1/25/2019-12/31/2019, Predicting firearm suicide among emergency department patients: A statewide longitudinal study. Role: Co-PI.

Lawrence Livermore National Security/DOE Prime, Subcontract B632126 (PI: H. S. Bhat), 1/1/2019-9/30/2019 (renewal until 9/30/2020 under review), Stochastic Differential Equations for Modeling Latent Trajectories. Role: PI.

NSF DMS-1723272 (PI: H. S. Bhat), 9/1/2017-8/31/2020, Simulation and Inference Algorithms for Stochastic Differential Equations. Role: PI.

DOE DE-AC02-05CH11231, Subaward 7041635 (PI: J. C. Meza), 12/6/2012-8/30/2013, Computational Partnerships: Optimization and Control of Electric Power Systems. Role: Co-PI.

NSF DMS-0913048/DMS-0753983 (PI: H. S. Bhat), 9/1/2007-8/31/2011, Collaborative Research: Algorithms for Simulation and Design of Analog VLSI Lattices. Role: PI.

EXTRAMURAL  
GRANTS:  
PARTICIPATORY  
ROLES NSF DGE-1633722 (PI: R. Balasubramaniam), 9/15/2015-8/31/2021, NRT-DESE Intelligent Adaptive Systems: Training computational and data-analytic skills for academia and industry. Role: Core Participant.

NSF DMS-1331109 (PI: A. D. Kim), 10/1/2013-9/30/2018, EXTREEMS-QED: Data-Enabled Science and Computational Analysis Research, Training and Education for Students (DESCARTES) Program. Role: Core Participant.

INTERNAL  
GRANTS UC Merced Committee on Research (PI: Christine Isborn), 4/5/2018-6/1/2019, Applying Deep Learning Methods to Develop New Models of Molecular Charge Transfer. Role: Co-PI.

UC Merced School of Natural Sciences Research Infrastructure Grant (PI: H. S. Bhat), 3/28/2017-6/30/2017, GPU Servers for Deep Learning. Role: PI.

UC Merced Committee on Research (PI: H. S. Bhat), 5/18/2015-6/1/2016, Simulation and Inference Algorithms for Stochastic Differential Equations. Role: PI.

UC Merced Graduate Research Council (PI: H. S. Bhat), 3/21/2012-6/30/2013, Numerical Methods for Stochastic Delay Differential Equations. Role: PI.

PATENTS Afshari, E., Bhat, H. S., "Generation of high-frequency, high-power electrical signals from low-frequency, low-power lattice network structures as sources," US Patent 8692629, published 4/8/14.

Afshari, E., Bhat, H. S., Hajimiri, S. A., "2D Transmission Line-Based Apparatus and Method," US Patents 7456704 and 7671702, published on 11/25/08 and 3/2/10, respectively.

GRADUATE  
STUDENTS  
SUPERVISED Braxton Osting, M.S., Columbia University, 2006. (Associate Prof. at U. Utah)

Derek Sollberger, M.S., UC Merced, 2011. (Lecturer at UC Merced)  
 Bryan Sims, M.S., UC Merced, 2012. (Senior Data Scientist at Shipt)  
 Nitesh Kumar, Ph.D., UC Merced, 2013. (Head of Data Science at Affirm)  
 Garnet Vaz, Ph.D., UC Merced, 2014. (Principal Data Scientist at Microsoft)  
 Ai Chun Chen, M.S., UC Merced, 2016.  
 R. W. M. A. Madushani, Ph.D., UC Merced, 2017. (Postdoc at Boston Medical Center)  
 Li-Hsuan Huang, Ph.D., UC Merced, 2018. (Lecturer at UC Merced)  
 Shagun Rawat, Ph.D., UC Merced, 2018. (Machine Learning Engineer at Google)  
 Ramin Raziperchikolaei, Ph.D. EECS, UC Merced, 2019. (Research Scientist at Rakuten)

COURSES TAUGHT AT U. OF UTAH Math 5010/6805: Introduction to Probability (Fall 2018, Spring 2019)

COURSES TAUGHT AT UC MERCED Math 32: Probability and Statistics (Fall 2009, Fall 2011, Fall 2012, Spring 2016, and Fall 2019)  
 Math 180: Data Science and Modern Applied Statistics (Fall 2014, Fall 2016)  
 Math 181: Stochastic Processes (Spring 2015, Spring 2017)  
 Math 292 (Grad): Stochastic Processes (Spring 2012)  
 Math 292 (Grad): Mathematics of Deep Learning (Fall 2017, Spring 2020)  
 Math 221 (Grad): Partial Differential Equations I (Fall 2010)  
 Math 222 (Grad): Partial Differential Equations II (Spring 2011, Spring 2014)  
 Math 224 (Grad): Functional Analysis (Spring 2018)  
 Math 121: Partial Differential Equations (Fall 2008, Fall 2009)

COURSES TAUGHT ELSEWHERE Dynamical Systems, Ordinary Differential Equations, Partial Differential Equations, Numerical Analysis, and Calculus

PROFESSIONAL MEMBERSHIPS ACM and ASA

SERVICE (UC MERCED) Applied Mathematics Graduate Program:

- Chair (1/2016-6/2018).
- Assessment Organizer (2015-2018).
- Organizer of Preliminary Examinations (2009-2018).
- Coauthor of CCGA (Coordinating Committee on Graduate Affairs) proposal to establish M.S. and Ph.D. programs in Applied Mathematics at UC Merced, approved by the UC Office of the President in February, 2014.
- *ad hoc* Service to the Chair (2010-2016), Admissions/Recruiting Committee (2008-2012, 2015-2018), and Executive Committee (2014-2018).

Applied Mathematics Unit (includes Undergraduate Program and Hiring/Promotion):

- Member of  $\geq 5$  faculty search committees.
- Member of numerous merit/promotion committees.
- Overhauled lower-division course on probability and statistics (Math 32). Developed slides, homework assignments, and lab exercises that have been used by multiple instructors.
- Created new upper-division courses in data science (Math 180) and stochastic processes (Math 181). These courses form an integral part of a new undergraduate emphasis track in Computa-

tional and Data Science, and have contributed to achieving the aims of the NSF EXTREEMS-QED grant mentioned above.

- Participant in undergraduate program accreditation and assessment activities.

Service to the University and School of Natural Sciences:

- Member of faculty search committees in Computational Science and Data Analytics (AY 2015-16), Mechanical Engineering (AY 2012-13 search in the area of stochastic modeling, successful) and CITRIS (Center for Information Technology Research in the Interest of Society).
- UC Merced Undergraduate Council, Member, Fall 2014-Spring 2015.
- UC Merced General Education Subcommittee, Member, Fall 2014-Spring 2016. Participated in external review of UC Merced's GE Program in AY 2014-15.
- UC Merced School of Management Planning Committee (AY 2011-12).
- Contributor to UC Merced's NSF-NRT training program in Intelligent Adaptive Systems. Recruited/recommended students for NRT fellowships, and helped train NRT fellows in data science and machine learning. In particular, contributed guest lectures on deep learning, recurrent neural networks, and time series classification for the Spring 2018 NRT course on complex adaptive systems. Currently mentoring NRT fellow Majerle Reeves. See <http://www.nrt-ias.org/faculty.html>

Service to the Profession:

- Program Committee Member for the 2016, 2017, and 2019 Workshops on Machine Learning and Sports Analytics. These workshops were held at ECML, the European Conference on Machine Learning.
- Guest Editorial Board Member (2/2016 - 5/2016) for a special issue of the journal *Data Mining and Knowledge Discovery* in the area of Sports Analytics.
- Peer reviewer for *Machine Learning*, *European J. Operational Research*, *J. Operational Research Society*, *SIAM J. Applied Mathematics*, *PLoS ONE*, *Proc. Royal Society: Series A*, *J. Nonlinear Science*, *Physica D*, *J. Physics A*, *SIAM J. Applied Dynamical Systems*, *IEEE Trans. Computer-Aided Design of Integrated Circuits and Systems*, *J. Electromagnetic Waves and Applications*
- Panelist at the California Forum for Diversity in Graduate Education, CSU Sacramento, October 16, 2010.