

# Bharath Kumar Sriperumbudur Vangeepuram

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## Research Interests

Machine Learning, Statistical Learning Theory, Non-parametric Estimation, Regularization and Inverse Problems, Reproducing Kernel Spaces in Probability and Statistics, Functional Data Analysis, Topological Data Analysis, Optimal Transport and Gradient Flows

## Education

**University of California, San Diego** 09/2005–11/2010  
Ph.D., Electrical and Computer Engineering (emphasis in Machine Learning and Computational Statistics)  
Dissertation: *Reproducing Kernel Space Embeddings and Metrics on Probability Measures*  
Advisor: Prof. Gert R. G. Lanckriet

**Indian Institute of Technology, Kanpur, India** 08/2000–03/2002  
M.Tech., Electrical Engineering (emphasis in Signal Processing)  
Thesis: *A Model Based Approach to Non-Uniform Vowel Normalization*  
Advisor: Prof. S. Umesh

**Sri Venkateswara University, Tirupati, India** 07/1995–06/1999  
B.Tech., Electronics and Communication Engineering

## Employment

### Academic Positions

**Department of Statistics, The Pennsylvania State University**  
Associate Professor 06/2020–present  
Assistant Professor 08/2014–05/2020

**Statistical Laboratory, University of Cambridge** 09/2012–08/2014  
Research Fellow in Statistics

**Gatsby Computational Neuroscience Unit, University College London** 12/2010–09/2012  
Post-doctoral Research Associate

### Visiting Positions

**The Institute of Statistical Mathematics, Tokyo** 10/2012  
Host: Prof. Kenji Fukumizu

**National ICT Australia, Canberra** 10/2011  
Host: Prof. Robert Williamson

**Faculty of Mathematical Sciences, Queensland University of Technology** 10/2011  
Host: Prof. Peter Bartlett (also with the Department of Statistics, University of California-Berkeley)

**Institute for Stochastics and Applications, University of Stuttgart**  
Host: Prof. Dr. Ingo Steinwart

04/2011

### *Internships*

**The Institute of Statistical Mathematics, Tokyo**  
Advisor: Prof. Kenji Fukumizu

10–12/2009

**Max Planck Institute for Biological Cybernetics, Tübingen**  
Advisors: Prof. Dr. Bernhard Schölkopf and Dr. Arthur Gretton

2007/2008

**Swartz Center for Computational Neuroscience, University of California San Diego**  
Advisor: Dr. Scott Makeig

06–08/2006

### *Industry Positions*

**Imaging Technologies Lab, General Electric Global Research, Bangalore, India**  
Research Engineer

04/2002–08/2005

**Wipro Technologies, Bangalore, India**  
Systems Engineer

11/1999–07/2000

## Honors, Awards & Fellowships

NSF CAREER Award 2020

Travel Award, Fourth Conference of the International Society for Nonparametric Statistics, Salerno 2018

Travel Award, Third Conference of the International Society for Nonparametric Statistics, Avignon 2016

Travel Award, Spring School on “Structural Inference in Statistics”, Berlin 2014

Herman Goldstine Memorial Postdoctoral Fellowship in Mathematical Sciences, IBM Research<sup>1</sup> 2012

Travel Award, Workshop on “Machine Learning: Theory and Computation”, Institute for Mathematics and its Applications, University of Minnesota 2012

Honorable Mention, Best Student Paper, Twenty-Third Annual Conference on Neural Information Processing Systems 2009

Travel Award, Twenty-Third Annual Conference on Neural Information Processing Systems 2009

Travel Award, International Conference on Machine Learning 2007, 2008

Travel Award, Machine Learning Summer School, Tübingen 2007

Cal-(IT)<sup>2</sup> Fellowship, University of California, San Diego 2005–2006

Bronze Patent Medal, General Electric Global Research, Bangalore 2004

Hats-off Award, General Electric Global Research, Bangalore 2003

General Electric Scholarship 2000–2002

## Publications

Available for download from <http://www.personal.psu.edu/bks18/Publications.html>

<sup>1</sup>Declined to accept the Research Fellow position at Statslab, University of Cambridge.

## Monograph

1. Muandet, K., K. Fukumizu, B. K. Sriperumbudur and B. Schölkopf (2017). Kernel Mean Embedding of Distributions: A Review and Beyond. *Foundations and Trends in Machine Learning*, 10(1-2), 1–141.

## Journal Articles

1. Steinwart, I., B. K. Sriperumbudur and P. Thomann (2023). Adaptive Clustering using Kernel Density Estimators. *Journal of Machine Learning Research*. To appear.
2. Sheng, T. and B. K. Sriperumbudur (2023). On Distance and Kernel Measures of Conditional Dependence. *Journal of Machine Learning Research*, 24(7): 1–16.
3. Reimherr, M., B. K. Sriperumbudur and H. B. Kang (2023). Optimal Function-on-Scalar Regression over Complex Domains. *Electronic Journal of Statistics*, 17(1): 156–197.
4. Sterge, N. and B. K. Sriperumbudur (2022). Statistical Optimality and Computational Efficiency of Nyström Kernel PCA. *Journal of Machine Learning Research*, 23(337): 1–32.
5. Sriperumbudur, B. K. and N. Sterge (2022). Approximate Kernel PCA Using Random Features: Computational vs. Statistical Trade-off. *Annals of Statistics*, 50(5): 2713–2736.
6. Lam-Weil, J., A. Carpentier and B. K. Sriperumbudur (2022). Local minimax rates for closeness testing of discrete distributions. *Bernoulli*, 28(2): 1179–1197.
7. Kanagawa, M., B. K. Sriperumbudur and K. Fukumizu (2020). Convergence Analysis of Deterministic Kernel-based Quadrature Rules in Misspecified Settings. *Foundations of Computational Mathematics*, 20: 155–194.
8. Reimherr, M., B. K. Sriperumbudur and B. Taoufik (2018). Optimal Prediction for Additive Function-on-function Regression. *Electronic Journal of Statistics*, 12(2), 4571–4601.
9. Szabó, Z. and B. K. Sriperumbudur (2018). Characteristic and Universal Tensor Product Kernels. *Journal of Machine Learning Research*, 18(233), 1–29.
10. Tolstikhin, I., B. K. Sriperumbudur and K. Muandet (2017). Minimax Estimation of Kernel Mean Embeddings. *Journal of Machine Learning Research*, 18(86), 1–47.
11. Sriperumbudur, B. K., K. Fukumizu, R. Kumar, A. Gretton, and A. Hyvärinen (2017). Density Estimation in Infinite Dimensional Exponential Families. *Journal of Machine Learning Research*, 18(57), 1–59.
12. Szabó, Z., B. K. Sriperumbudur, B. Póczos and A. Gretton (2016). Learning Theory for Distribution Regression. *Journal of Machine Learning Research*, 17(152), 1–40.
13. Muandet, K., B. K. Sriperumbudur, K. Fukumizu, A. Gretton and B. Schölkopf (2016). Kernel Mean Shrinkage Estimators. *Journal of Machine Learning Research*, 17(48), 1–41.
14. Sriperumbudur, B. K. (2016). On the Optimal Estimation of Probability Measures in Weak and Strong Topologies. *Bernoulli*, 22(3): 1839–1893.
15. Sejdinovic, D., B. K. Sriperumbudur, A. Gretton and K. Fukumizu (2013). Equivalence of Distance-based and RKHS-based Statistics in Hypothesis Testing. *Annals of Statistics*, 41(5): 2263–2291.
16. Sriperumbudur, B. K., K. Fukumizu, A. Gretton, B. Schölkopf and G. R. G. Lanckriet (2012). On the Empirical Estimation of Integral Probability Metrics. *Electronic Journal of Statistics*, 6: 1550–1599.
17. Sriperumbudur, B. K. and G. R. G. Lanckriet (2012). A Proof of Convergence of the Concave-Convex Procedure Using Zangwill’s Theory. *Neural Computation*, 24(6): 1391–1407.
18. Sriperumbudur, B. K., K. Fukumizu and G. R. G. Lanckriet (2011). Universality, Characteristic Kernels and RKHS Embedding of Measures. *Journal of Machine Learning Research*, 12(Jul): 2389–2410.

19. Sriperumbudur, B. K., D. A. Torres and G. R. G. Lanckriet (2011). A Majorization-Minimization Approach to the Sparse Generalized Eigenvalue Problem. *Machine Learning*, 85(1): 3–39.
20. Sriperumbudur, B. K., A. Gretton, K. Fukumizu, B. Schölkopf and G. R. G. Lanckriet (2010). Hilbert Space Embeddings and Metrics on Probability Measures. *Journal of Machine Learning Research*, 11(Apr): 1297–1322.
21. Gretton, A., K. Fukumizu and B. K. Sriperumbudur (2009). Discussion of: Brownian Distance Covariance. *The Annals of Applied Statistics*, 3(4): 1285–1294.
22. Bharath Kumar, S. V. and S. Umesh (2008). Non-Uniform Speaker Normalization Using Affine Transformation. *Journal of the Acoustic Society of America*, 124(3): 1727–1738.

### Under Submission

1. Hagrass, O., B. K. Sriperumbudur and B. Li (2023). Spectral Regularized Kernel Goodness-of-Fit Tests. <http://arxiv.org/pdf/2308.04561.pdf>.
2. Arya, S. and B. K. Sriperumbudur (2023). Kernel  $\epsilon$ -Greedy for Contextual Bandits. <https://arxiv.org/pdf/2306.17329.pdf>.
3. Hagrass, O., B. K. Sriperumbudur and B. Li (2022). Spectral Regularized Kernel Two-Sample Tests. <http://arxiv.org/pdf/2212.09201.pdf>.
4. Utpala, S. and B. K. Sriperumbudur (2023). Shrinkage Estimation of Higher Order Bochner Integrals. <https://arxiv.org/pdf/2207.06357>.
5. Zhang, Z., Z. Goldfeld, Y. Mroueh and B. K. Sriperumbudur (2023). Gromov-Wasserstein Distances: Entropic Regularization, Duality and Sample Complexity. <https://arxiv.org/pdf/2212.12848.pdf>.
6. Vishwanath, S., K. Fukumizu, S. Kuruki and B. K. Sriperumbudur (2022). On the Limits of Topological Data Analysis for Statistical Inference. <https://arxiv.org/pdf/2001.00220.pdf>.
7. Vishwanath, S., B. K. Sriperumbudur, K. Fukumizu, and S. Kuruki (2022). Robust Topological Inference in the Presence of Outliers. <https://arxiv.org/pdf/2206.01795.pdf>.
8. Singh, S., B. K. Sriperumbudur and B. Póczos (2020). Minimax Estimation of Quadratic Fourier Functionals. <https://arxiv.org/pdf/1803.11451.pdf>.

### Under Revision

1. He, Y., K. Balasubramanian, B. K. Sriperumbudur, and J. Lu (2022). Regularized Stein Variational Gradient Flow. <https://arxiv.org/pdf/2211.07861>.
2. Siapoutis, N., D. Richards and B. K. Sriperumbudur (2022). Mean Shrinkage Estimation for High-Dimensional Diagonal Natural Exponential Families. <https://arxiv.org/pdf/2010.08071.pdf>.
3. Balasubramanian, K., H-G. Müller, and B. K. Sriperumbudur (2022). Unified RKHS Methodology and Analysis for Functional Linear and Single-Index Models. <https://arxiv.org/pdf/2206.03975.pdf>.
4. Kangawa, M., P. Henning, D. Sejdinovic and B. K. Sriperumbudur (2018). Gaussian Processes and Kernel Methods: A Review on Connections and Equivalences. <https://arxiv.org/pdf/1807.02582.pdf>.

### Peer Reviewed Conference Papers

1. Zhang, Z., Y. Mroueh, Z. Goldfeld and B. K. Sriperumbudur (2022). Cycle Consistent Probability Divergences Across Different Spaces. In *Proceedings of the 24th International Conference on Artificial Intelligence and Statistics*. (Accepted: 492/1685, 29%)

2. Vishwanath, S., K. Fukumizu, S. Kuruki and B. K. Sriperumbudur (2020). Robust Persistence Diagrams Using Reproducing Kernels. In *Advances in Neural Information Processing Systems* 34. (Accepted: 1900/9454, 20%)
3. Kpotufe, S. and B. K. Sriperumbudur (2020). Gaussian Sketching yields J-L Lemma in RKHS. In *Proceedings of the 23rd International Conference on Artificial Intelligence and Statistics*, Palermo, Italy.
4. Sterge, N., B. K. Sriperumbudur, L. Rosasco and A. Rudi (2020). Gain with No Pain: Efficient Kernel PCA by Nyström Sampling. In *Proceedings of the 23rd International Conference on Artificial Intelligence and Statistics*, Palermo, Italy.
5. Szabó, Z. and B. K. Sriperumbudur (2019). On Kernel Derivative Approximation with Random Fourier Features. In *Proceedings of the 22nd International Conference on Artificial Intelligence and Statistics*, Okinawa, Japan. (Accepted: 360/1111, 32%)
6. Tolstikhin, I., B. K. Sriperumbudur and B. Schölkopf (2016). Minimax Estimation of Maximal Mean Discrepancy with Radial Kernels. In *Advances in Neural Information Processing Systems* 28. (Accepted: 568/2500, 23%)
7. Kanagawa, M., B. K. Sriperumbudur and K. Fukumizu (2016). Convergence Guarantees for Kernel-Based Quadrature Rules in Misspecified Settings. In *Advances in Neural Information Processing Systems* 28. (Accepted: 568/2500, 23%)
8. Sriperumbudur, B. K. and Z. Szabó (2015). Optimal Rates for Random Fourier Features. In *Advances in Neural Information Processing Systems* 27. (Accepted for spotlight: 67/1838, 4%; Overall: 403/1838, 22%)
9. Szabó, Z., A. Gretton, B. Póczos and B. K. Sriperumbudur (2015). Two-stage Sampled Learning Theory on Distributions. In *Proceedings of the 18th International Conference on Artificial Intelligence and Statistics*, San Diego, USA. (Accepted for plenary oral: 27/442, 6%; Overall: 127/442, 29%)
10. Muandet, K., B. K. Sriperumbudur and B. Schölkopf (2014). Kernel Mean Estimation via Spectral Filtering. In *Advances in Neural Information Processing Systems* 27. (Accepted: 370/1467, 25%)
11. Muandet, K., K. Fukumizu, B. K. Sriperumbudur, A. Gretton and B. Schölkopf (2014). Kernel Mean Estimation and Stein's Effect. In *Proceedings of the 31st International Conference on Machine Learning*, Beijing, China. (Accepted: 310/1238, 25%)
12. Kar, P., B. K. Sriperumbudur, P. Jain and H. Karnick (2013). On the generalization ability of online learning algorithms for pairwise loss functions. In *Proceedings of the 30th International Conference on Machine Learning*, Atlanta, USA.
13. Balasubramanian, K., B. K. Sriperumbudur and G. Lebanon (2013). Ultrahigh Dimensional Feature Screening Using RKHS Embeddings. In *Proceedings of the 16th International Conference on Artificial Intelligence and Statistics*, 126–134, Scottsdale, Arizona, USA. (Accepted: 71/211, 34%)
14. Gretton, A., B. K. Sriperumbudur, D. Sejdinovic, H. Strathmann, S. Balakrishnan, M. Pontil and K. Fukumizu (2012). Optimal Kernel Choice for Large-Scale Two-Sample Tests. In *Advances in Neural Information Processing Systems* 25. (Accepted: 370/1467, 25%)
15. Sejdinovic, D., A. Gretton, B. K. Sriperumbudur and K. Fukumizu (2012). Hypothesis Testing Using Pairwise Distances and Associated Kernels. In *Proceedings of the 29th International Conference on Machine Learning*, 1111–1118. (Accepted: 243/890, 27%)
16. Sriperumbudur, B. K. and I. Steinwart (2012). Consistency and Rates for Clustering with DBSCAN. In *Proceedings of the 15th International Conference on Artificial Intelligence and Statistics*, 1090–1098, La Palma, Canary Islands. (Accepted: 134/400, 34%)
17. Sriperumbudur, B. K., K. Fukumizu and G. R. G. Lanckriet (2011). Learning in Hilbert vs. Banach Spaces: A Measure Embedding Viewpoint. In *Advances in Neural Information Processing Systems* 24. (Accepted: 305/1400, 22%)

18. Sriperumbudur, B. K. (2011). Mixture Density Estimation Via Hilbert Space Embedding of Measures. In *Proceedings of the 2011 IEEE International Symposium on Information Theory*, 1027–1030, St. Petersburg, Russia.
19. Sriperumbudur, B. K., K. Fukumizu, A. Gretton, B. Schölkopf and G. R. G. Lanckriet (2010). Non-Parametric Estimation of Integral Probability Metrics. In *Proceedings of the 2010 IEEE International Symposium on Information Theory*, 1428–1432, Austin, Texas.
20. Sriperumbudur, B. K., K. Fukumizu and G. R. G. Lanckriet (2010). On the Relation Between Universality, Characteristic Kernels and RKHS Embedding of Measures. In *Proceedings of the 13th International Conference on Artificial Intelligence and Statistics*, 773–780, Sardinia, Italy. (Accepted for plenary oral: 24/308, 8%; Overall: 125/308, 41%)
21. Jegelka, S., A. Gretton, B. Schölkopf, B. K. Sriperumbudur and U. von Luxburg (2009). Generalized Clustering via Kernel Embeddings. In *Proceedings of the 32nd Annual German Conference on Artificial Intelligence*, 144–152, Paderborn, Germany.
22. Sriperumbudur, B. K., K. Fukumizu, A. Gretton, G. R. G. Lanckriet and B. Schölkopf (2009). Kernel Choice and Classifiability for RKHS Embeddings of Probability Distributions. In *Advances in Neural Information Processing Systems 22*. (Accepted for plenary oral: 22/1105, 2%; Overall: 263/1105, 24%)  
**Honorable Mention for the Outstanding Student Paper Award**
23. Sriperumbudur, B. K. and G. R. G. Lanckriet (2009). On the Convergence of the Concave-Convex Procedure. In *Advances in Neural Information Processing Systems 22*. (Accepted: 263/1105, 24%)
24. Gretton, A., K. Fukumizu and Z. Harchaoui, B. K. Sriperumbudur (2009). A Fast, Consistent Kernel Two-sample Test. In *Advances in Neural Information Processing Systems 22*. (Accepted for poster spotlight: 64/1105, 6%; Overall: 263/1105, 24%)
25. Fukumizu, K., B. K. Sriperumbudur, A. Gretton and B. Schölkopf (2008). Characteristic Kernels on Groups and Semigroups. In *Advances in Neural Information Processing Systems 21*. (Accepted for plenary oral: 32/1022, 3%; Overall: 250/1022, 24%)
26. Schölkopf, B., B. K. Sriperumbudur, A. Gretton and K. Fukumizu (2008). RKHS Representation of Measures applied to Homogeneity, Independence and Fourier Optics. In *Oberwolfach Report 30*, Mathematisches Forschungsinstitut, Oberwolfach-Walke, Germany.
27. Sriperumbudur, B. K., A. Gretton, K. Fukumizu, G. R. G. Lanckriet and B. Schölkopf (2008). Injective Hilbert Space Embeddings of Probability Measures. In *Proceedings of the 21st Annual Conference on Learning Theory*, 111–122, Helsinki, Finland. (Accepted: 44/126, 35%)
28. Sriperumbudur, B. K., O. A. Lang and G. R. G. Lanckriet (2008). Metric Embedding for Kernel Classification Rules. In *Proceedings of the 25th International Conference on Machine Learning*, 1008–1015, Helsinki, Finland. (Accepted: 158/583, 27%)
29. Sriperumbudur, B. K., D. A. Torres and G. R.G. Lanckriet (2007). Sparse Eigen Methods by D.C. Programming. In *Proceedings of the 24th International Conference on Machine Learning*, 831–838, Corvallis, Oregon, USA. (Accepted: 152/522, 29%)
30. Bharath Kumar, S. V., S. Umesh and R. Sinha (2006). Study of Non-Linear Frequency Warping Functions for Speaker Normalization. In *Proceedings of the 2006 IEEE International Conference on Acoustics, Speech and Signal Processing*, I, 14–17, Toulouse, France.
31. Gopalakrishnan, G., S. V. Bharath Kumar, R. Mullick, A. Narayanan and S. Suryanarayanan (2006). A Framework for Parameter Optimization in Mutual Information (MI)-based Registration Algorithms. In *Proceedings of the 2006 SPIE Medical Imaging*, 6144, 880–887, San Diego, California, USA.
32. Bharath Kumar, S. V., R. Mullick and U. Patil (2005). Textural Content in 3T MR: An Image-Based Marker for Alzheimer’s Disease. In *Proceedings of the 2005 SPIE Medical Imaging*, 5747, 1366–1376, San Diego, California, USA.

33. Bharath Kumar, S. V. and S. Umesh (2004). Non-Uniform Speaker Normalization Using Frequency-Dependent Scaling Function. In *Proceedings of the 2004 International Conference on Signal Processing and Communications*, 305–309, Bangalore, India.
34. Bharath Kumar, S. V. and S. Ramaswamy (2004). A Texture Analysis Approach for Automatic Flaw Detection in Pipelines. In *Proceedings of the 2004 International Conference on Signal Processing and Communications*, 320–323, Bangalore, India.
35. Bharath Kumar, S. V., S. Mukhopadhyay and V. Nandedkar (2004). A Novel Progressive Thick Slab Paradigm for Volumetric Medical Image Compression. In *Proceedings of the 2004 IEEE International Conference on Image Processing*, 3, 1899–1902, Singapore.
36. Bharath Kumar, S. V., S. Umesh and R. Sinha (2004). Non-Uniform Speaker Normalization Using Affine Transformation. In *Proceedings of 2004 IEEE International Conference on Acoustics, Speech and Signal Processing*, I, 121–124, Montréal, Canada.
37. Umesh, S., R. Sinha and S. V. Bharath Kumar (2004). An Investigation into Front-end Signal Processing for Speaker Normalization. In *Proceedings of the 2004 IEEE International Conference on Acoustics, Speech and Signal Processing*, I, 345–348, Montréal, Canada.
38. Bharath Kumar, S. V., N. Nagaraj, S. Mukhopadhyay and X. Xu (2003). Block-Based Conditional Entropy Coding for Medical Image Compression. In *Proceedings of the 2003 SPIE Medical Imaging*, 5033, 375–381, San Diego, California.
39. Umesh, S., S. V. Bharath Kumar, M. K. Vinay, R. Sharma and R. Sinha (2002). A Simple Approach to Non-Uniform Vowel Normalization. In *Proceedings of the 2002 IEEE International Conference on Acoustics, Speech and Signal Processing*, I, 517–520, Orlando, Florida, USA.

## Invited & Contributed Talks

### *Spectral Regularized Kernel Two-Sample Tests*

Session on Statistical Learning and Inference Using Kernel, Distance, and Rank, ICSA Applied Statistics Symposium, Michigan, June 13, 2023

Department of Mathematics, State University of New York, Albany, April 3, 2023

Session on Advances in Statistical Learning Theory, IISA Conference, Bengaluru, India, December 27, 2022

Workshop on Measure-theoretic Approaches and Optimal Transportation in Statistics, November 24, 2022

### *Regularized Stein Variational Gradient Flow*

MaD Seminar, New York University, November 17, 2022

### *Kernel Measures of Dependence and Conditional Dependence*

The 34th New England Statistics Symposium, Providence, RI, October 2, 2021

### *Robust Persistence Diagrams Using Reproducing Kernels*

Fourth International Conference on Econometrics and Statistics, June 25, 2021

SIAM Conference on Computational Science and Engineering, March 4, 2021

### *Johnson & Lindenstrauss Meet Hilbert at a Kernel*

International Conference on Analysis, Inverse Problems and Applications, July 18, 2022

Fifth International Conference on Econometrics and Statistics, June 5, 2022

IBM T. J. Watson Research Center, New York, July 15, 2021

52<sup>èmes</sup> Journées de Statistique de la Société Française de Statistique, Semi-Plenary Session, June 8, 2021

Statistics Seminar, CREST-CMAP, University of Paris-Saclay, April 19, 2021

*Gain with No Pain: Efficient Kernel PCA by Nyström Sampling*

Third International Conference on Econometrics and Statistics, Taichung, June 25, 2019

Approximation Theory 16, Nashville, TN, May 20, 2019

The 33rd New England Statistics Symposium, Hartford, CT, May 17, 2019

*Distribution Regression: Computational vs. Statistical Trade-off*

Department of Mathematics, Pennsylvania State University, University Park, September 30, 2019

Third International Conference on Mathematics of Data Science, Hong Kong, June 21, 2019

Inverse Problems and Machine Learning Workshop, University of Montréal, May 29, 2019

Rao Prize Conference, Pennsylvania State University, May 6, 2019

Functional Inference and Machine Intelligence Workshop, The Institute of Statistical Mathematics, Tokyo, March 28, 2019

*Minimax Estimation of Quadratic Fourier Functionals*

Data, Learning and Inference (DALI) Workshop, George, January 5, 2019

*Measures of (In)dependence Using Positive Definite Kernels*

Theoretical Statistics and Mathematics Unit, Indian Statistical Institute, Bangalore, August 24, 2018

Recent Developments in Dependence Metrics and their Applications, 4th ISNPS Conference, June 13, 2018

*Approximate Kernel PCA: Computational vs. Statistical Trade-off*

Department of Mathematics, Indian Institute of Technology, New Delhi, July 28, 2022

Department of Mathematics, State University of New York, Albany, October 12, 2020

Stochastic Seminar, Department of Mathematics, Georgia Tech, October 8, 2020

Department of Statistics, University of Georgia, September 24, 2020

International Conference on Statistical Distributions and Applications, Grand Rapids, MI, October 12, 2019

Department of Industrial and Manufacturing Engineering, Pennsylvania State University, University Park, October 10, 2019

Department of Statistics, University of Kentucky, Lexington, September 20, 2019

Microsoft Research, Bangalore, August 30, 2018

Department of Computer Science and Automation, Indian Institute of Science, Bangalore, August 21, 2018

IBM India Research Lab, Bangalore, August 14, 2018

9th International Purdue Symposium on Statistics, June 8, 2018

50<sup>èmes</sup> Journées de Statistique, Semi-Plenary Session, Paris-Saclay, May 29, 2018

Functional Inference and Machine Intelligence Workshop, The Institute of Statistical Mathematics, Tokyo, February 20, 2018

Inverse Problems and Machine Learning Workshop, Caltech, February 11, 2018

*Statistical Consistency of Kernel PCA with Random Features*

Session on Nonparametrics, 55th Annual Allerton Conference on Communication, Control and Computing, October 6, 2017

Center for Applied Mathematics, École Polytechnique, July 6, 2017

Department of Mathematics, University of Stuttgart, June 29, 2017



*Shrinkage Estimation in Reproducing Kernel Hilbert Spaces*

BLISS Seminar, Department of EECS, University of California, Berkeley, November 15, 2017  
 Center for Applied Mathematics, École Polytechnique, July 4, 2017  
 Machine Learning Seminar, Carnegie Mellon University, February 7, 2017

*Random Fourier Features and Beyond*

New Directions for Learning with Kernels and Gaussian Processes, Dagstuhl Seminar 16481, December 1, 2016

*On the Kernel Choice in RKHS-based Two Sample Tests*

Third Conference of International Society for Nonparametric Statistics, Avignon, June 12, 2016

*Minimax Estimation of Kernel Mean Embeddings*

Gatsby Unit, University College London, May 4, 2016  
 Department of Statistics, University of Oxford, May 3, 2016

*Density Estimation in Infinite Dimensional Exponential Families*

Department of Statistics, George Mason University, March 23, 2018  
 Flexible Modeling Workshop, The 10th ICSA International Conference, December 22, 2016  
 Department of Statistics, London School of Economics & Political Science, April 29, 2016  
 Department of Mathematics, University of Delaware, April 6, 2016  
 Department of Operations Research and Financial Engineering, Princeton University, April 4, 2016  
 Department of Statistics, Pennsylvania State University, September 18, 2015  
 Department of Statistics, University of Wisconsin-Madison, April 29, 2015  
 Data, Learning and Inference (DALI) Workshop, La Palma, April 12, 2015  
 Modern Non-parametrics Workshop, NIPS 2014, December 13, 2014  
 Department of Statistical Science, University College London, June 19, 2014  
 Department of Engineering, University of Cambridge, May 14, 2014  
 Department of Statistics, University of Oxford, May 9, 2014  
 Department of Statistics, Columbia University, May 2, 2014  
 Sixth International Conference of the ERCIM WG on Computational and Methodological Statistics (ERCIM 2013), December 14, 2013  
 Max Planck Institute for Intelligent Systems, October 9, 2013

*Kernel Mean Shrinkage Estimators*

Department of Statistics, University of Wisconsin-Madison, April 29, 2015

*RKHS Induced Infinite Dimensional Exponential Families: Density Estimation and Beyond*

Weierstrass Institute for Applied Analysis and Stochastics, July 10, 2013

*Mixture Sieve Density Estimation and Hilbert Space Embedding of Measures*

School of Computing, National University of Singapore, October 31, 2011  
 National ICT Australia, Canberra, October 27, 2011  
 Faculty of Mathematical Sciences, Queensland University of Technology, Brisbane, Australia, October 20, 2011

*Hilbert Space Embeddings and Metrics on Probability Measures*

Statistische Woche 2013 (German Statistical Week), Freie Universität Berlin, September 20, 2013  
 School of Engineering, Computing and Mathematics, University of Exeter, December 10, 2012  
 Eighth World Congress in Probability and Statistics, Istanbul, Turkey, July 9, 2012

Department of Pure Mathematics and Mathematical Statistics, University of Cambridge, UK, March 9, 2012

Department of Computer Science and Engineering, Pennsylvania State University, State College, February 24, 2012

Department of Statistics, Pennsylvania State University, State College, February 23, 2012

Department of Mathematics, London School of Economics and Political Science, UK, February 9, 2012

Toyota Technological Institute, Chicago, Illinois, March 3, 2011

Department of Statistics, University of Warwick, Coventry, UK, February 25, 2011

Gatsby Computational Neuroscience Unit, University College London, June 8, 2010

Machine Learning Group, University of Tokyo, Japan, November 18, 2009

Workshop on Machine Learning Methods in Statistical Science, The Institute of Statistical Mathematics, Tokyo, October 23, 2009

Department of Electrical Communication Engineering, Indian Institute of Science, Bangalore, India, December 16, 2008

#### *Non-Parametric Estimation of Integral Probability Metrics*

IEEE International Symposium on Information Theory, Austin, Texas, June 15, 2010

#### *On the Relation Between Universality, Characteristic Kernels and RKHS Embedding of Measures*

Thirteenth International Conference on Artificial Intelligence and Statistics, Sardinia, Italy, May 15, 2010

#### *On the Convergence of the Concave-Convex Procedure*

Workshop on Optimization for Machine Learning, Whistler, Canada, December 12, 2009

#### *Kernel Choice and Classifiability for RKHS Embeddings of Probability Distributions*

Twenty-Third Annual Conference on Neural Information Processing Systems, Vancouver, Canada, December 9, 2009

#### *The Sparse Eigenvalue Problem*

Department of Computer Science and Automation, Indian Institute of Science, Bangalore, India, December 10, 2008

#### *Injective Hilbert Space Embeddings of Probability Measures*

Twenty-First Annual Conference on Learning Theory, Helsinki, Finland, July 10, 2008

Max Planck Institute for Biological Cybernetics, Tübingen, Germany, July 1, 2008

#### *Metric Embedding for Kernel Classification Rules*

Twenty-Fifth International Conference on Machine Learning, Helsinki, Finland, July 8, 2008

#### *Finding Musically Meaningful Words Using Sparse CCA*

Music, Brain and Cognition Workshop, Whistler, Canada, December 7, 2007

#### *Sparse Eigen Methods by D.C. Programming*

Max Planck Institute for Biological Cybernetics, Tübingen, Germany, July 11, 2007

Twenty-Fourth International Conference on Machine Learning, Corvallis, Oregon, June 23, 2007

## Conference/Workshop/Session Organization

Organizer, Invited Session on *Recent Advances in Machine Learning* at EcoSta Conference, Kyoto, Japan, June 2022

*Organizer, Invited Session on Approximation, Learning and Inference with Positive-Definite Kernels at ISNPS Conference, Salerno, Italy, June 2018*

*Co-organizer, NIPS Workshop on Learning on Distributions, Functions, Graphs and Groups, Long Beach, California, USA, December 8, 2017*

*Co-organizer, NIPS Workshop on Adaptive and Scalable Nonparametric Methods in Machine Learning, Barcelona, Spain, December 10, 2016*

*Co-organizer, ICML Workshop on RKHS and Kernel-based Methods: Theoretical Topics and Recent Advances, Edinburgh, UK, July 1, 2012*

## Grants

Reproducing Kernel Hilbert Space Embedding of Measures: Theory and Applications to Statistical Learning. NSF DMS 1713011. 2017-2020

Statistical Learning, Inference and Approximation with Reproducing Kernels. NSF DMS CAREER 1945396. 2020-2025

## Professional Activities

Action Editor, Journal of Machine Learning Research (2021–present)

Associate Editor, Mathematical Foundations of Computing (2020–present)

Editorial Board, Journal of Machine Learning Research (2015–2021)

Scientific Committee, Workshop on Lifting Inference with Kernel Embeddings (2022, 2023)

Senior Program Committee Member, International Conference on Machine Learning (2018)

Senior Program Committee Member, Neural Information Processing Systems (2013, 2015, 2016, 2017, 2018, 2019)

Senior Program Committee Member, Artificial Intelligence and Statistics (2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023)

Senior Program Committee Member, Conference on Learning Theory (2021, 2022, 2023)

Senior Program Committee Member, Algorithmic Learning Theory (2020)

*Journal Reviewing:* Annals of Statistics, Annals of the Institute of Statistical Mathematics, Analysis Mathematica, Applied and Computational Harmonic Analysis, Bernoulli, Biometrika, Electronic Journal of Statistics, Foundations of Computational Mathematics, IEEE Transactions on Information Theory, IEEE Transactions on Pattern Recognition and Machine Intelligence, Memoirs of the American Mathematical Society, IEEE Transactions on Signal Processing, Journal of Machine Learning Research, Journal of Royal Statistical Society (Series B), Machine Learning, Neural Computation, Scandinavian Journal of Statistics, Signal Processing Magazine, Statistics and Computing, Statistical Science

*Conference Reviewing:* International Conference on Machine Learning (ICML), International Conference on Artificial Intelligence and Statistics (AISTATS), Advances in Neural Information Processing Systems (NIPS), Conference on Learning Theory (COLT), International Symposium on Information Theory (ISIT), International Conference on Acoustics, Speech and Signal Processing (ICASSP), International Joint Conference on Artificial Intelligence (IJCAI)

NSF DMS Statistics Panelist (2019, 2021)

## Teaching

Instructor, Research School: Statistical and Geometric Divergences for Machine Learning, University of Rennes 2, Rennes 06/2022

*Kernel Based Distances and Applications in Statistics and Machine Learning*

Instructor, Data Science Summer School, École Polytechnique, Paris <i>Learning with Positive Definite Kernels: Theory and Applications</i>	06/2019
Instructor, Machine Learning Summer School, MPI for Intelligent Systems, Tübingen <i>Introduction to Kernel Methods</i>	06/2017
Instructor, Pennsylvania State University STAT 508 <i>Applied Data Mining</i>	01-05/2023
STAT 597 <i>Nonparametric Methods and Learning Theory</i>	08-12/2022
STAT 515 <i>Stochastic Processes and Monte-Carlo Methods</i>	01-05/2022
STAT 508 <i>Applied Data Mining</i>	01-05/2022
MATH/STAT 415 <i>Mathematical Statistics</i>	08-12/2021
STAT 515 <i>Stochastic Processes and Monte-Carlo Methods</i>	01-05/2021
MATH/STAT 415 <i>Mathematical Statistics</i>	01-05/2021
STAT 597 <i>Nonparametric Methods and Learning Theory</i>	08-12/2020
STAT 515 <i>Stochastic Processes and Monte-Carlo Methods</i>	01-05/2020
MATH/STAT 415 <i>Mathematical Statistics</i>	08-12/2019
STAT 514 <i>Theory of Statistics II</i>	08-12/2019
STAT 515 <i>Stochastic Processes and Monte-Carlo Methods</i>	01-05/2019
MATH/STAT 415 <i>Mathematical Statistics</i> (2 sections)	01-05/2019
STAT 597 <i>Nonparametric Methods and Learning Theory</i>	01-05/2018
MATH/STAT 415 <i>Mathematical Statistics</i>	01-05/2018
STAT 514 <i>Theory of Statistics II</i>	08-12/2017
STAT 514 <i>Theory of Statistics II</i>	08-12/2016
MATH/STAT 415 <i>Mathematical Statistics</i> (2 sections)	08-12/2016
STAT 514 <i>Theory of Statistics II</i>	08-12/2015
MATH/STAT 415 <i>Mathematical Statistics</i>	08-12/2015
MATH/STAT 415 <i>Mathematical Statistics</i>	01-05/2015
STAT 401 <i>Experimental Methods</i>	01-05/2015
Supervisor (King's College), University of Cambridge 1B <i>Statistics</i>	01-06/2013
Lecturer, University of Cambridge IIC <i>Statistical Modelling</i>	01-03/2013
Co-Instructor, University College London COMPG113 <i>Advanced Topics in Machine Learning</i> <i>Adaptive Modelling of Complex Data</i>	01-04/2012
Teaching Assistant, University of California San Diego ECE 273 <i>Convex Optimization and Applications</i>	04-06/2010
Instructor, Edison Engineer Development Program, General Electric Global Research <i>Signals &amp; Systems</i>	2004-2005
Teaching Assistant, Indian Institute of Technology Kanpur EE 380 <i>Electrical Engineering Lab</i>	08-12/2001
EE 370 <i>Digital Electronics and Microprocessor Technology</i>	01-05/2001

## Advising

*Postdoctoral Mentor:*

Sakshi Arya (08/2021-07/2023) [Tenure-Track Assistant Professor, Department of Mathematics, Applied Mathematics, and Statistics, Case Western Reserve University]

*PhD Thesis Advisor:*Nicholas Sterge (08/2016–10/2021) [*Flow Traders, New York*]Siddharth Viswanath (08/2018–06/2023) [*SEW Visiting Assistant Professor, Department of Mathematics, UC San Diego*]

Sowmya Mukherjee (06/2022–present)

Aratrika Mustafi (06/2022–present)

*PhD Thesis Co-advisor:*

Omar Hagrass (08/2019–present)

Nikolas Siapoutis (08/2018–05/2022) [*Teaching Assistant Professor, Department of Statistics, University of Pittsburgh*]Tianhong Sheng (08/2018–07/2022) [*Data Scientist, Pinterest, San Francisco*]*MS Thesis Advisor:*Benjamin Straub (08/2017–05/2018) [*Principal Programmer, GSK, Philadelphia*]Aniruddha Rajendra Rao (08/2017–06/2019) [*Machine Learning Researcher, Hitachi America, Santa Clara*],Nikolas Siapoutis (08/2018–06/2019) [*Teaching Assistant Professor, Department of Statistics, University of Pittsburgh*]*PhD Academic Advisor:*Jordan Awan, Aniruddha Rajendra Rao, Roopali Singh and Alex Zhao, Department of Statistics,  
Pennsylvania State University 08/2016–05/2018*Undergraduate Honor's Thesis Advisor:*Zhenyuan Yuan (12/2016–05/2018) [*PhD Candidate, Department of EECS, Pennsylvania State University*]

## PhD Committees

*Chair*

Elena Hadjicosta, Department of Statistics, Pennsylvania State University 2017–19

*Member*

Chaegeun Song, Department of Statistics, Pennsylvania State University 07/2023–present

Yin Tang, Department of Statistics, Pennsylvania State University 04/2023–present

Anping Pan, Department of Mathematics, Pennsylvania State University 03/2023–present

Wilson Peoples, Department of Mathematics, Pennsylvania State University 01/2022–present

Bokgyeong Kang, Department of Statistics, Pennsylvania State University 2021–23

Seong-ho Lee, Department of Statistics, Pennsylvania State University 2021–23

Mihir Mehta, Department of Industrial Engineering, Pennsylvania State University 2021–23

Huy Dang, Department of Statistics, Pennsylvania State University 2021–23

Jeremy Seeman, Department of Statistics, Pennsylvania State University 2021–23

Stephen White, Department of Mathematics, Pennsylvania State University 2021–23

Harris Quach, Department of Statistics, Pennsylvania State University 2021–22

Ilias Moysidis, Department of Statistics, Pennsylvania State University 2019–21

Faheem Gilani, Department of Mathematics, Pennsylvania State University 2019–21

Zhanrui Cai, Department of Statistics, Pennsylvania State University 2019–21

Peng Cheng, Department of Industrial and Manufacturing Engineering, Pennsylvania State University 2018–20

Jordan Awan, Department of Statistics, Pennsylvania State University 2018–20

Kyongwon Kim, Department of Statistics, Pennsylvania State University 2018–20

Patrick Godwin, Department of Physics, Pennsylvania State University	2017–20
Cheng-Bang Chen, Department of Industrial and Manufacturing Engineering, Pennsylvania State University	2017–19
Sanghack Lee, Information Sciences and Technology, Pennsylvania State University	2016–18
Junli Lin, Department of Statistics, Pennsylvania State University	2017
Hyunphil Choi, Department of Statistics, Pennsylvania State University	2016–17
Zachary Jones, Department of Political Science, Pennsylvania State University	2016–17
Adrian Maler, Department of Mathematics, Pennsylvania State University	2015

#### *External Examiner*

Wojciech Reise, Université Paris-Saclay and INRIA, France	06/2023–present
Luc Brogat-Motte, Télécom Paris, Institut Polytechnique de Paris, France	2023
Tamim El Ahmad, LTCI, Télécom Paris, Institut Polytechnique de Paris, France	12/2022–present
Ülker Okur, Department of Mathematics, University of Stuttgart, Germany	11/2016–present
Shashank Singh, Machine Learning Department, Carnegie Mellon University, USA	2018–19
Damien Garreau, École Normale Supérieure, France	2017
Aurélien Guetsop Nangue, Department of Statistics, University of Montréal, Canada	2016
K. Balasubramanian, Department of Electronics and Communication Engineering, Amrita School of Engineering, India	2016

## Department/University Activities

<i>Chair</i> , Graduate Admissions Committee, Pennsylvania State University	2022–present
<i>Chair</i> , Graduate Curriculum Committee, Pennsylvania State University	2021–present
<i>Member</i> , Data Science Working Group, Pennsylvania State University	2021–present
<i>Member</i> , Eberly Fellow Hiring Committee, Pennsylvania State University	2021
<i>Sub-committee Chair</i> , Strategic Planning Committee, Pennsylvania State University	2020–21
<i>Chair</i> , Ph.D. Qualifying Exam Committee, Pennsylvania State University	2020–21
<i>Member</i> , Graduate Admission Committee, Pennsylvania State University	2019–22
<i>Committee Member</i> , 2019 Rao Prize Conference, Pennsylvania State University	2018–19
<i>Member</i> , Faculty Hiring Committee, Pennsylvania State University	2018–19
<i>Committee Member</i> , 2018 Chemerda Lecture, Pennsylvania State University	2017–18
<i>Committee Member</i> , 2017 Marker Lecture, Pennsylvania State University	2017
<i>Committee Member</i> , 2017 Rao Prize Conference, Pennsylvania State University	2017
<i>Interviewer</i> , Millenium Scholars Program, Pennsylvania State University	2017
<i>Committee Member</i> , 2017 Clifford Clogg Lecture, Pennsylvania State University	2017
<i>Committee Member</i> , 2016 Clifford Clogg Lecture, Pennsylvania State University	2016
<i>Committee Member</i> , 2016 Marker Lecture, Pennsylvania State University	2016
<i>Co-organizer</i> , Statistics Colloquium, Pennsylvania State University	2015–16
<i>Member</i> , Ph.D. Qualifying Exam Committee, Pennsylvania State University	2014–15