

Arvind Krishna Saibaba

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Research Interests

Inverse Problems and Imaging, Numerical Linear Algebra, Uncertainty Quantification, Applications to Medical Imaging and Geosciences.

Employment History

Assistant Professor (August 2015 -)

North Carolina State University, Department of Mathematics.

Postdoctoral Scholar (September 2013 - June 2015)

Tufts University, Department of Electrical & Computer Engineering.

Supervisors: Misha Kilmer (Math) and Eric Miller (ECE).

Education

Doctor of Philosophy (2010 - 2013)

Stanford University, Institute for Computational and Mathematical Engineering.

Advisor: Peter Kitanidis

Master Of Science (2007 - 2010)

Stanford University, Institute for Computational and Mathematical Engineering.

Bachelor of Technology (2003-2007)

National Institute of Technology Karnataka, Department of Chemical Engineering.

Awards

2017-2020: NSF Award DMS-1720398, Principal Investigator, Amount to NC State: \$104, 942.

2017: Travel Award for Householder Symposium XX, Virginia Tech.

2015-2016: Faculty Fellow, Statistical and Mathematical Sciences Institute (SAMSI).

Program: Computational Challenges in Neuroscience.

2015: Featured article on Inverse Problems website and Highlights of 2015 collection.

◦ <http://iopscience.iop.org/0266-5611/labtalk-article/60667>

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2015: SIAM Early career travel award to attend SIAM Geosciences 2015.

2013: WRR Editor's Choice Award (awarded to 1% of all papers published in WRR, 2012).

2006: JNCASR Summer research fellowship.

Publications

[Under review/revision](#).....

1. **A.K. Saibaba**. Randomized subspace iteration: Analysis of canonical angles and unitarily invariant norms. arXiv preprint arXiv:1804.02614, (2018).
2. A. Attia, A. Alexanderian, **A.K. Saibaba**. Goal-Oriented Optimal Design of Experiments for Large-Scale Bayesian Linear Inverse Problems. arXiv preprint arXiv:1802.06517, (2018).
3. A. Alexanderian, **A.K. Saibaba**. Efficient D-optimal design of experiments for infinite-dimensional

Bayesian linear inverse problems. Under revision, SIAM Journal on Scientific Computing. arXiv preprint arXiv:1711.05878, (2017).

4. A. Brown, **A.K. Saibaba**, S. Vallélian, Low-Rank Independence Samplers for Bayesian Inverse Problems. Under revision, SIAM/ASA Journal on Uncertainty Quantification. arXiv preprint arXiv:1609.07180, (2016).
5. E.C. Chi, L. Hu, **A.K. Saibaba**, A.U.K. Rao, Going off the Grid: Iterative Model Selection for Biclustered Matrix Completion. Under revision, Journal of Computational and Graphical Statistics. arXiv preprint arXiv:1610.05400, (2016).

Accepted.....

1. J. Zhang, **A.K. Saibaba**, M.E. Kilmer, S. Aeron, A Randomized Tensor Singular Value Decomposition based on the t-product. To appear, Numerical Linear Algebra with Applications. arXiv preprint arXiv:1609.07086. (2018).
2. Z. Drmac, **A.K. Saibaba**, The Discrete Empirical Interpolation Method: Canonical Structure and Formulation in Weighted Inner Product Spaces. To appear, SIAM Journal on Matrix Analysis and Applications. arXiv preprint arXiv:1704.06606, (2018).

Journal Publications.....

1. J. Chung, **A. K. Saibaba**, M. Brown, E. Westman, Efficient generalized Golub-Kahan based methods for dynamic inverse problems. *Inverse Problems* 34, no. 2: 024005, (2018).
2. J. Chung, **A.K. Saibaba**, Generalized Hybrid Iterative Methods for Large-Scale Bayesian Inverse Problems. *SIAM Journal on Scientific Computing* 39.5, (2017).
3. **A.K. Saibaba**, A. Alexanderian, I.C.F. Ipsen, Randomized matrix-free estimators for trace and determinant. *Numerische Mathematik* 137.2: 353-395, (2017).
4. T. Bakhos, S. Ladenheim, P. K. Kitanidis, **A.K. Saibaba**, D. Szyld, Multiple Preconditioned GMRES for Shifted Systems. *SIAM Journal on Scientific Computing* 39.5, (2017).
5. **A.K. Saibaba**, HOID: Higher Order Interpolatory Decomposition for tensors based on Tucker representation, *SIAM Journal on Matrix Analysis and Applications* 37(3), 1223–1249, (2016).
6. **A.K. Saibaba** and P.K. Kitanidis, Randomized algorithms for generalized Hermitian eigenvalue problems with application to computing Karhunen-Loève expansion. *Numerical Linear Algebra with Applications*, 23: 314-339, (2015).
7. **A.K. Saibaba**, M. Kilmer, E. Miller, S. Fantini, Fast algorithms for Hyperspectral Diffuse Optical Tomography, *SIAM Journal on Scientific Computing*. 37(5), B712–B743, (2015).
8. T. Bakhos, **A.K. Saibaba** and P.K. Kitanidis, Fast solvers for inverse problems based on parabolic PDEs using Laplace transforms and flexible Krylov solvers, *Journal of Computational Physics*, vol. 299, 940–954. (2015).
9. **A.K. Saibaba** and P.K. Kitanidis, Fast computation of uncertainty quantification measures in geostatistical approach to inverse problems, *Advances in Water Resources* 82 : 124-138, (2015).
10. **A.K. Saibaba**, E. Miller, and P.K. Kitanidis, Fast Kalman Filter using Hierarchical matrices and a low-rank perturbative approach, *Inverse Problems* 31 015009, (2015).
 - Featured on the **magazine cover** for issue January 2015.
 - Featured article on Inverse Problems website and Highlights of 2015. <http://iopscience.iop.org/0266-5611/labtalk-article/60667>
11. **A.K. Saibaba**, T. Bakhos, and P.K. Kitanidis, A flexible Krylov solver for shifted systems with application to oscillatory hydraulic tomography, *SIAM Journal on Scientific Computing*, 35 (6), A3001-A3023, (2013).
12. **A.K. Saibaba**, S. Ambikasaran, J.L. Li, P.K. Kitanidis, and E.F. Darve, Application of Hierarchical Matrices to Linear Inverse problems for Geostatistical Applications. *OGST Revue d'IFP Energies Nouvelles*, 67 (5), (2012).
13. **A.K. Saibaba** and P.K. Kitanidis, Efficient methods for large-scale linear inversion using a Geostatistical approach, *Water Resources Research* 48 (5), W05522, (2012). *Appeared as a Featured publication.*

Book Chapters.....

1. S. Ambikasaran, **A.K. Saibaba**, E.F. Darve, P.K. Kitanidis, Fast Algorithms for Bayesian Inverse Problems. IMA Computational Challenges in the Geosciences Vol. 156 101-142. (2013).

Conference Proceedings.....

1. **A.K. Saibaba**, N. Krishnamurthy, P. Anderson, J. Kainerstorfer, A. Sassaroli, E. Miller, S. Fantini, M. Kilmer. 3D Parameter reconstruction in Hyperspectral Diffuse Optical Tomography, Proceeding of SPIE conference on Optical Tomography and Spectroscopy of Tissue XI, San Francisco, February 2015.
2. **A.K. Saibaba**, E.L. Miller and P.K. Kitanidis, A Fast Kalman Filter for Time-Lapse Electrical Resistivity Tomography. Proceedings of IGARSS 2014, Montreal, Canada 2014.
3. **A.K. Saibaba** and P.K. Kitanidis, Dimensionality reduction in the Geostatistical approach for Hydraulic Tomography. Proceedings of Computational Methods in Water Resources 2012, Urbana-Champaign, Illinois, June 2012.

Advising

Research Mentoring.....

2017-: Elizabeth Herman (Joint with Alen Alexanderian), PhD Candidate, NC State.

2017-: Rachel Minster, PhD Candidate, NC State.

2016-: Katrina Petroske, PhD Candidate, NC State.

2017-2018: Valerie Taylor, Masters

2015-2017: Dr. Ahmed Attia (Joint with Alen Alexanderian), SAMSI Postdoctoral researcher.

2015-2017: Dr. Sarah Vallélian, SAMSI Postdoctoral researcher.

2015-2016: Dr. Duy Thai, SAMSI Postdoctoral researcher.

2012: Jan D. Stepinski, Visiting Summer Intern, Stanford University.

PhD Committee Member.....

- o Melissa Gaddy, Mathematics, NC State.
- o Meng Yang, Statistics, NC State.
- o Danny Smyl, Civil, Construction and Environmental Engineering, NC State. (PhD: 2017).

Talks

Departmental Seminars and Colloquia.....

- o Department Colloquium, University of Montana, November 2017.
- o Scientific Computing Seminar, Emory University, October 2017.
- o Environmental Statistics Seminar, NC State University, March 2017.
- o Colloquium, TIFR - Center for Applicable Mathematics, Bangalore, June 2016.
- o Colloquium, International Center for Theoretical Sciences, Bangalore, June 2016.
- o Matrix Computation Seminar, Virginia Tech, April 2016.
- o Applied Mathematics Seminar, Duke University, September 2015.
- o Applied Mathematics Seminar, Tufts University, March 2015.
- o Department of Mathematics, North Carolina State University, January 2015.
- o Applied and Computational Mathematics Seminar, Dartmouth College, November 2014.
- o Applied Mathematics and Scientific Computing Seminar, Temple University, October 2014.
- o Department of Mathematics, Tufts University, March 2014.
- o ICME Departmental Seminar, Stanford University, March 2013.

- MCS Division, Argonne National Laboratories, March 2013.
- ACDL Seminar, MIT, March 2013.
- Linear Algebra and Optimization Seminar, Stanford University, Nov 2012
- SIAM SCREAM Seminar, Stanford University, March 2012.

Invited Conference Presentations.....

- SIAM Conference on Uncertainty Quantification, Long Beach, April 2018.
- SIAM Conference on Computational Science and Engineering, Atlanta, March 2017.
- AMS Sectional Meeting, Raleigh, November 2016.
- SIAM Annual Meeting, Boston, July 2016.
- SIAM Conference on Computational Science and Engineering, March 2015.

Contributed Talks.....

- Copper Mountain Conference on Iterative Methods, March 2018.
- SIAM South Eastern Atlantic Sectional Conference, March 2018.
- Joint Mathematics Meeting, San Diego, January 2018.
- American Geophysical Union: Fall Meeting, San Francisco, December 2016.
- SIAM Conference on Imaging Sciences, Albuquerque, May 2016.
- Copper Mountain Conference on Iterative Methods, March 2016.
- SPIE conference on Optical Tomography and Spectroscopy of Tissue XI, February 2015.
- Copper Mountain conference on Iterative Methods, April 2014.
- SIAM conference on Uncertainty Quantification, April 2014.
- SIAM Conference on Computational Science and Engineering, Boston, MA, March 2013.
- American Geophysical Union: Fall Meeting, December 2012.
- Computational Methods in Water Resources 2012, Illinois, June 2012.
- Copper Mountain Conference on Iterative Methods, March 2012.
- The International Council for Industrial and Applied Mathematics meeting, Vancouver, July 2011.
- American Physical Society Division of Fluid Dynamics Meeting, November 2009.
- National Conference for Aerospace Engineers, Trivandrum, India, October 2006.

Posters.....

- Householder Symposium XX, June 2017. (Invited).
- American Geophysical Union, Fall Meeting, December 2010 and 2013.

Summer School/Workshops.....

- NSF CISE CAREER Workshop, 2018.
- SAMSI Transition Workshop, 2015 and 2016.
- USC Workshop on Uncertainty Quantification, 2012.
- Gene Golub summer school (G2S3) University of British Columbia, 2010.

Expository Talks.....

- SIAM Student Chapter, NC State, February 2017.
- SUM Series, NC State, March 2016.

Service

- **Co-organizer** of Numerical Analysis seminar at NC State 2016-Present.

- **Co-organizer** of SIAM minisymposia
 - SIAM conference on Uncertainty Quantification, in Savannah, Georgia, April 2014 (8 talks).
With Siva Ambikasaran, Kenneth Ho
Title: *Fast linear algebra for UQ in Inverse Problems and Data Assimilation*.
 - SIAM conference on Computational Science and Engineering, in Utah, March 2015 (8 talks).
With Misha Kilmer and Eric Miller
Title: *State-of-the-art linear solvers for Inverse Problems*.
 - SIAM conference on mathematical and computational issues in the Geosciences, Stanford, June 2015 (6 talks). With Tania Bakhos and Peter Kitanidis
Title: *Recent advances in Geophysical Inverse Problems*.
 - SIAM conference on Imaging Sciences, May 2016.
Title: *Big Data for Inverse Problems in Imaging* (8 talks) with Eric Miller and Misha Kilmer.
Title: *Inverse Problems in Neuroscience*. (4 talks) with Sarah Vallélian.
 - Joint Math Meeting 2018 (6 talks) with Eric Miller, Misha Kilmer, Eric de Sturler .
Title: *Randomization and Uncertainty Quantification in Bayesian Inverse Problems*
 - SIAM South Eastern Atlantic Sectional Conference, March 2018. With Julianne Chung
Title: *Computational Methods and Tools for Large Scale Inverse Problems* (4 talks).
- **Co-organizer** of SAMSI workshop on 'Statistical Inverse Problems' January 2017.
 - 20 participants, 9 speakers, 2 plenary talks.
- **Working group co-leader** (with Alen Alexanderian) SAMSI Program on Optimization 2016-2017.
- **Local Scientific Coordinator** for SAMSI Program on Optimization 2016-2017.
- **SAMSI Faculty Fellow** (2015-2016)
 - Part of Computational Challenges in Neurosciences program (CCNS)
 - Led year-long working group on Computational Inverse Problems in Neuroscience
- **Mentor**: Participated as mentor in the SIAM Broader Engagements program, part of SIAM CSE 2015, 2017.
 - Jiahua Jiang (2015), Conrad Czejdo (2017).
- **Co-Organizer** of ICME MATLAB summit, Stanford University, 2011
A forum for discussion of current and future state of MATLAB, involving Mathworks Engineers, Toolbox developers and users.
- **Student Consultant** for Computational Consulting (2010-2013)
A student run initiative, where researchers from academia and industry can consult regarding formulating mathematical problems, applying state-of-the-art computational techniques or implementations.
- **Organizer** of ICME Refresher course, Stanford University, 2011
A week long course that helps incoming graduate students in several Engineering departments refresh their mathematics skills. **Taught**: 2010-2011, **Organized**: 2011
- **Reviewer** for Water Resources Research, Journal of Hydrology, SIAM Journal on Matrix Analysis and Applications, SIAM Review, SIAM Journal on Scientific computing, Journal of Optical Society of America A, IEEE Transactions on Geosciences & Remote Sensing, IEEE Transactions on Image Processing, Advances in Water Research, Computers and Geosciences, Geoscientific Model Development, Pattern Recognition Letters, Geophysical Research Letters.

Teaching Experience

Instructor.....

MA 723: Theory of Matrices with Applications, Spring 2017 and 2018, NC State.

MA 523: Linear Transformations and Matrix Theory, Fall 2016 and 2017, NC State.

MA 405: Introduction to Linear Algebra, Fall 2015 and Spring 2016, NC State.

CME 108: Introduction to Scientific Computing, Summer 2013, Stanford University.

Guest Lecturer

MATH 250: Graduate special topics, Spring 2014, Tufts University. (3 weeks)

CEE 365B: Advanced Topics in Environmental Fluid Mechanics and Hydrology, Stanford University. (5 weeks)

CEE 362G: Stochastic Inverse Problems and Data Assimilation methods. Spring 2012, Stanford University. (2 weeks)

Teaching Assistant

CME 204/ ME 300B: Partial Differential Equations for Engineering, Winter 2007, 2012

CME 306/ MATH 224: Numerical Methods for Partial Differential Equations, Spring 2010

CME 330: Applied Mathematics in the Chemical and Biological Sciences, Fall 2008

CME 108: Introduction to Scientific Computing, Winter 2010 and Summer 2010

CME 104: Linear Algebra and Partial Differential Equations, Spring 2012

Computer Skills

Languages: PYTHON, C/C++, MATLAB.

Software: PETSc/SLEPc, FEniCS

Publicly available codes: <https://github.com/arvindks>