

# Shashanka Ubaru

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## Research Interests

Machine learning, numerical linear algebra, coding theory applications, approximation theory and algorithms, eigenvalue problems, and material informatics.

## Current Position

Aug. 2018 **IBM T.J. Watson Research Center**, Yorktown Heights, NY, USA.  
*Goldstine Postdoctoral Fellow*

## Education

- 2012-18 **University of Minnesota**, Minneapolis, MN, USA.  
*Ph.D. Computer Science* May 2018  
Advisor: Yousef Saad  
Thesis: *Algorithmic advances in learning from large dimensional matrices and scientific data*
- M.S. Computer Science* October 2015  
*M.S. Electrical Engineering* November 2014  
Advisors: Yousef Saad and Arya Mazumdar  
Thesis: *Randomized techniques for matrix decomposition and estimating the approximate rank of a matrix*
- 2008-12 **M.S. Ramaiah Institute of Technology**, Bangalore, India.  
*B.Eng. Electronics and Communication*  
Final Project: *RADARS: Determining Doppler, Ranging and Imaging*

## Publications

### Journal articles

- 2017 *Fast estimation of  $\text{tr}(f(A))$  via Stochastic Lanczos Quadrature.*  
**S. Ubaru**, J. Chen, and Y. Saad  
SIAM Journal on Matrix Analysis and Applications (SIMAX), 38(4), 1075–1099.
- 2017 *Low rank approximation and decomposition of large matrices using error correcting codes.*  
**S. Ubaru**, A. Mazumdar, and Y. Saad  
IEEE Transactions on Information Theory, 63(9), 5544–5558.
- 2017 *Formation enthalpies for transition metal alloys using machine learning.*  
**S. Ubaru**, A. Miedlar, Y. Saad, and J. R. Chelikowsky  
Physical Review B, (Vol.95, No.21).
- 2017 *Fast estimation of approximate matrix ranks using spectral densities.*  
**S. Ubaru**, Y. Saad, and A.-K. Seghouane  
Neural Computation, 29(5):1317–1351.
- 2017 *Improving the Incoherence of a Learned Dictionary via Rank Shrinkage.*  
**S. Ubaru**, A.-K. Seghouane, and Y. Saad  
Neural Computation, 29(1):263–285.
- 2012 *Displaying gray scales by cross pairing select and data voltages in multi-line addressed LCD.*  
**S. Ubaru** and T.N. Ruckmongathan  
IEEE Journal of Display Technology, 8(11), 669–677.

### Conference proceedings

- 2018 *Spectral Sums Beyond Fast Matrix Multiplication: Algorithms and Hardness.*  
C. Musco, P. Netrapalli, A. Sifford, **S. Ubaru**, and D. P. Woodruff  
Innovations in Theoretical Computer Science (ITCS).

- 2017 *UoI-NMF<sub>cluster</sub>: A Robust Nonnegative Matrix Factorization Algorithm for Improved Parts-Based Decomposition and Reconstruction of Noisy Data.*  
**S. Ubaru**, K. Wu, and K. E. Bouchard  
 IEEE International Conference on Machine Learning and Applications (ICMLA).  
**\*Best Paper Award.\***
- 2017 *Union of Intersections (UoI) for Interpretable Data Driven Discovery and Prediction.*  
 K. E. Bouchard, A. F. Bujan, F. Roosta-Khorasani, **S. Ubaru**, Prabhat, A. M. Snijders, J.-H. Mao, E. F. Chang, M. W. Mahoney, and S. Bhattacharyya  
 Neural Information Processing Systems (NIPS).
- 2017 *Multilabel Classification with Group Testing and Codes.*  
**S. Ubaru** and A. Mazumdar  
 International Conference on Machine Learning (ICML).
- 2016 *Fast methods for estimating the Numerical rank of large matrices.*  
**S. Ubaru** and Y. Saad  
 International Conference on Machine Learning (ICML).
- 2016 *Group testing schemes from low-weight codewords of BCH codes.*  
**S. Ubaru**, A. Mazumdar, and A. Barg  
 IEEE International Symposium on Information Theory (ISIT).
- 2015 *Low rank approximation using error correcting coding matrices.*  
**S. Ubaru**, A. Mazumdar, and Y. Saad  
 International Conference on Machine Learning (ICML).

#### Book Chapter

- 2018 *Applications of trace estimation techniques.*  
**S. Ubaru** and Y. Saad  
 High Performance Computing in Science and Engineering, LNCS book series, vol. 11087, ch. 2, pp 19–33.

#### Submissions

- 2018 *Find the dimension that counts: Fast dimension estimation and Krylov PCA.*  
**S. Ubaru**, A.-K. Seghouane, and Y. Saad.
- 2018 *Spectrum-Adapted Polynomial Approximation for Matrix Functions.*  
 L. Fan, D. Shuman, **S. Ubaru**, and Y. Saad.
- 2018 *Run Procrustes, Run! On the convergence of accelerated Procrustes flow.*  
 A. Krylidis, **S. Ubaru**, G. Kollias, and K. E. Bouchard.
- 2017 *Sampling and multilevel coarsening algorithms for fast matrix approximations.*  
**S. Ubaru** and Y. Saad. (Journal submission revised.)

## Presentations and Visits

- 2018 *Error Correcting Codes for Machine Learning.*  
 - Theory Seminar, University of Massachusetts, Amherst, MA.  
 - IP Seminar, IBM T.J. Watson Research Center, NY.  
 Lawrence Berkeley National Laboratory, CA (Two weeks visit in June).
- 2017 *UoI-NMF<sub>cluster</sub>: A Robust Nonnegative Matrix Factorization Algorithm for Noisy Data*  
 - International Conference on Machine Learning and Applications (ICMLA), Cancun, Mexico.
- Multilabel Classification with Group Testing and Codes*  
 - Neural Systems and Engineering Labs, Lawrence Berkeley National Laboratory, CA.  
 - International Conference on Machine Learning (ICML), Sydney, Australia.
- Error Correcting Codes for Machine Learning.*  
 - The University of Melbourne, Melbourne, Australia (Two weeks visit in August).
- UoI-NMF<sub>cluster</sub> and UoI-CUR: Union of Intersections methods for matrix approximations*  
 - Neural Systems and Engineering Labs, Lawrence Berkeley National Laboratory, CA.
- Microsoft Research, Bangalore, India (Two days visit in May).

2016 *Error correcting codes for low rank approximation and group testing*  
- BLISS Seminar, University of California, Berkeley, CA.

*Fast methods for estimating the Numerical rank of large matrices*  
- International Conference on Machine Learning (ICML), New York, NY.

2015 *Low rank approximation using error correcting coding matrices.*  
- International Conference on Machine Learning (ICML), Lille, France.

## Awards

2018-20 **Herman Goldstine Fellowship**, IBM Research.  
2017 **Best Paper Award**, International Conference on Machine Learning and Applications (ICMLA).  
2015,16,17 **ICML Travel Scholarship**.  
2015 **CS Department Travel Award**.  
2011 **Visiting Research Student Program**, Raman Research Institute.

## Experience

2013-18 **University of Minnesota**, *Minneapolis*, MN, USA.  
*Research Assistant*, Department of Computer Science.  
Jun-Aug. 17 **Lawrence Berkeley National Laboratory**, *Berkeley*, CA, USA.  
May-Aug. 16 *Research Intern*, Scientific Data Management group.  
May-Aug. 13 **Seagate Technology**, *Shakopee*, MN, USA.  
*Signal Processing Intern*.  
2011-12 **Raman Research Institute**, *Bangalore*, India.  
*Visiting Research Student Program*.

## Teaching

### University of Minnesota

Spring 2018 CSci 2033, Elementary Computational Linear Algebra, *Recitation Instructor*.  
Fall 2017 CSci 5304, Computational Aspects of Matrix Theory, *Teaching Assistant*.  
Spring 2017 CSci 8314, Sparse Matrix Computations, *Temporary Instructor*.

## Service

Reviewer: ICMLA 2018, ISIT 2017, NIPS 2016, PLOS One, SIAM Journal on Matrix Analysis and Applications, Signal Processing Letters, IEEE Transactions on Information Theory, IEEE Transactions on Signal and Information Processing over Networks, Mathematical Modelling and Analysis.  
Organizer: ICMLA Challenge 2018 - Parts based decomposition of noisy data.  
MSRIT ROBONXG-2012, a week long robotics festival.

## Graduate courses

Random matrices and high dimensional statistics, Sparse matrix computations, Optimization theory, Machine learning, Methods of applied mathematics, Computational aspects of matrix theory, Advanced algorithms and data-structures, Pattern recognition, Data compression, Adaptive digital signal processing, Detection and estimation theory, Digital communications, Probability and stochastic processes.

## References

### **Yousef Saad**

CSE Distinguished Professor,  
Computer Science and Engineering,  
University of Minnesota- Twin Cities, MN, USA.

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### **Arya Mazumdar**

Assistant Professor,  
College of Information and Computer Sciences,  
University of Massachusetts at Amherst, MA, USA.

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### **Kristofer E. Bouchard**

Research Scientist  
Neural Systems and Engineering  
Lawrence Berkeley National Laboratory, CA, USA.

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