

Anima Anandkumar

University of California, Irvine

Electrical Engineering & Computer Science

4408, Engineering Hall

Irvine, CA, USA 92697-2625.

Phone:

+1-(949)-824-9072.

Email:

a.anandkumar@uci.edu

Homepage:

<http://newport.eecs.uci.edu/anandkumar>

Current Research Interests

High-dimensional statistics and large-scale machine learning with a focus on learning probabilistic latent variable models and analysis of non-convex algorithms.

Current Appointment

Assistant Professor at Electrical Engineering and Computer Science

Since August 2010

University of California, Irvine, CA, USA.

Education

Doctor of Philosophy in Electrical Engineering with minor in Applied Mathematics

July 2009

advised by Prof. Lang Tong, Electrical & Computer Engr, Cornell University, Ithaca, NY, USA.

Bachelor of Technology in Electrical Engineering with minor in Theoretical Comp. Science

May 2004

Indian Institute of Technology Madras, Department of Electrical Engineering, Chennai, India.

Awards and Honors

1. **Air Force Office of Sponsored Research (AFOSR) Young Investigator Award (YIP) 2015**
2. **Alfred P. Sloan Research Fellowship 2014**
3. **Microsoft Faculty Fellowship 2013**
4. **ARO Young Investigator Award (YIP) 2013**
5. **NSF CAREER Award 2013.**
6. **ACM SIGMETRICS 2011 Best Paper Award.**
7. **Best Thesis Award 2009** by ACM SIGMETRICS Society.
8. **IEEE Signal Processing Society Young Author Best Paper Award 2008.**
9. **Fran Allen IBM PhD Fellowship 2008-09.**
10. **Best Paper Award**, International Conference on Acoustic, Speech & Signal Processing 2006.

Previous Appointments

Visiting Researcher at Microsoft Research New England

April-Dec. 2012

Cambridge, MA, USA.

Post-doctoral Associate at the Laboratory of Information & Decision Systems

July 2009-July 2010

with Prof. Alan Willsky, MIT, Cambridge, MA, USA.

Graduate Research Intern at IBM Watson Research

Summer 2007 and 2008

with Dr. Chatschik Bisdikian and Dr. Dakshi Agrawal, Hawthorne, NY, USA.

Principal Research: High Dimensional Learning

Preprints (Available on Webpage)

- [1] Majid Janzamin, Hanie Sedghi, and Anima Anandkumar. Generalization bounds for neural networks through tensor factorization. *arXiv preprint arXiv:1506.08473*, 2015.
- [2] Yining Wang, Hsiao-Yu Tung, Alexander Smola, and Animashree Anandkumar. Fast and guaranteed tensor decomposition via sketching. *arXiv preprint arXiv:1506.04448*, 2015.
- [3] Furong Huang and Animashree Anandkumar. Convolutional dictionary learning through tensor factorization. *arXiv preprint arXiv:1506.03509*, 2015.
- [4] Anima Anandkumar and Hanie Sedghi. Learning mixed membership community models in social tagging networks through tensor methods. *ArXiv 1503.04567*, 2015.
- [5] H. Sedghi and A. Anandkumar. Provable Tensor Methods for Learning Mixtures of Classifiers. *Preprint.*, Dec. 2014.
- [6] M. Janzamin, H. Sedghi, and A. Anandkumar. Score Function Features for Discriminative Learning: Matrix and Tensor Frameworks. *Preprint.*, Dec. 2014.
- [7] Forough Arabshahi, Furong Huang, Animashree Anandkumar, and Carter T Butts. Are you going to the party: depends, who else is coming? Learning hidden group dynamics via conditional latent tree models. *arXiv preprint arXiv:1411.1132*, 2014.
- [8] Anima Anandkumar, Rong Ge, and Majid Janzamin. Analyzing tensor power method dynamics: Applications to learning overcomplete latent variable models. *arXiv preprint arXiv:1411.1488*, 2014.
- [9] A. Anandkumar, R. Ge, and M. Janzamin. Provable Learning of Overcomplete Latent Variable Models: Semi-supervised and Unsupervised Settings. *Preprint.*, June 2014.
- [10] F. Huang, U.N. Niranjan, J. Perros, R. Chen, J. Sun, and A. Anandkumar. Scalable Latent Tree Model and its Application to Health Analytics. *Preprint*, Feb. 2015.
- [11] A. Anandkumar, R. Ge, and M. Janzamin. Guaranteed Non-Orthogonal Tensor Decomposition via Alternating Rank-1 Updates. *Preprint.*, Feb. 2014.
- [12] A. Agarwal, A. Anandkumar, P. Jain, P. Netrapalli, and R. Tandon. Learning Sparsely Used Overcomplete Dictionaries via Alternating Minimization. *ArXiv 1310.7991*, Oct. 2013.
- [13] A. Agarwal, A. Anandkumar, and P. Netrapalli. Exact Recovery of Sparsely Used Overcomplete Dictionaries. *ArXiv 1309.1952*, Sept. 2013.
- [14] A. Anandkumar, D. Hsu, F. Huang, and S.M. Kakade. Learning High-Dimensional Mixtures of Graphical Models. *ArXiv 1203.0697*, Feb. 2013.
- [15] A. Anandkumar, D. Hsu, and A. Javanmard S. M. Kakade. Learning Topic Models and Latent Bayesian Networks Under Expansion Constraints. *Preprint. ArXiv:1209.5350*, Sept. 2012.

Journal Publications

- [16] F. Huang, U.N. Niranjan, M. Hakeem, and A. Anandkumar. Furong Huang, U. N. Niranjan, Mohammad Umar Hakeem, Animashree Anandkumar. *ArXiv 1309.0787, accepted to JMLR*, Sept. 2013.
- [17] A. Anandkumar, D. Hsu, M. Janzamin, and S. M. Kakade. When are Overcomplete Topic Models Identifiable? Uniqueness of Tensor Tucker Decompositions with Structured Sparsity. *ArXiv 1308.2853, accepted to JMLR*, Aug. 2013.

- [18] A. Anandkumar, R. Ge, D. Hsu, S. M. Kakade, and M. Telgarsky. Tensor Methods for Learning Latent Variable Models. *J. of Machine Learning Research*, 15:2773–2832, 2014.
- [19] M. Janzamin and A. Anandkumar. High-Dimensional Covariance Decomposition into Sparse Markov and Independence Domains. *To appear, JMLR*, 2014.
- [20] A. Anandkumar, R. Ge, D. Hsu, and S. M. Kakade. A Tensor Approach to Learning Mixed Membership Community Models. *J. of Machine Learning Research*, (15):2239–2312, June 2014.
- [21] A. Anandkumar, D. P. Foster, D. Hsu, S. M. Kakade, and Y. K. Liu. Two SVDs Suffice: Spectral Decompositions for Probabilistic Topic Modeling and Latent Dirichlet Allocation. *to appear in the special issue of Algorithmica on New Theoretical Challenges in Machine Learning*, July 2013.
- [22] A. Anandkumar and R. Valluvan. Learning Loopy Graphical Models with Latent Variables: Efficient Methods and Guarantees. *Annals of Statistics*, 41(2):401–435, 2013.
- [23] A. Anandkumar, V. Y. F. Tan, F. Huang, and A. S. Willsky. High-dimensional structure learning of Ising models: local separation criterion. *The Annals of Statistics*, 40(3):1346–1375, 2012.
- [24] A. Anandkumar, V. Y. F. Tan, F. Huang, and A. S. Willsky. High-Dimensional Gaussian Graphical Model Selection: Walk-Summability and Local Separation Criterion. *J. Machine Learning Research*, 13:2293–2337, Aug. 2012.
- [25] A. Anandkumar, A. Hassidim, and J. Kelner. Topology discovery of sparse random graphs with few participants. *J. of Random Structures and Algorithms*, 43, June 2013.
- [26] Y. Liu, V. Chandrasekaran, A. Anandkumar, and A. Willsky. Feedback Message Passing for Inference in Gaussian Graphical Models. *IEEE Tran. on Signal Processing*, 60(8):4135–4150, Aug. 2012.
- [27] M.J. Choi, V.Y.F. Tan, A. Anandkumar, and A. Willsky. Learning latent tree graphical models. *J. of Machine Learning Research*, 12:1771–1812, May 2011.
- [28] V.Y.F. Tan, A. Anandkumar, and A. Willsky. Learning Markov forest models: analysis of error rates. *J. of Machine Learning Research*, 12:1617–1653, May 2011.
- [29] V.Y.F. Tan, A. Anandkumar, and A. Willsky. A large-deviation analysis for the maximum likelihood learning of tree structures. *IEEE Tran. on Information Theory*, 57(3):1714–1735, March 2011.
- [30] V.Y.F. Tan, A. Anandkumar, and A. Willsky. Learning Gaussian tree models: analysis of error exponents and extremal structures. *IEEE Tran. on Signal Processing*, 58(5):2701–2714, May 2010.

Conference Publications (Limited List)

- [31] P. Netrapalli, Niranjan U. N., S. Sanghavi, A. Anandkumar, and P. Jain. Provable Non-convex Robust PCA. In *Proc. of Neural Information Processing (NIPS)*, Dec. 2014.
- [32] H. Sedghi, A. Anandkumar, and E. Jonckheere. Guarantees for Stochastic ADMM in High Dimensions. In *Proc. of Neural Information Processing (NIPS)*, Dec. 2014.
- [33] Hanie Sedghi and Anima Anandkumar. Provable methods for training neural networks with sparse connectivity. In *NIPS Deep Learning Workshop*, 2014.
- [34] L. Song, A. Anandkumar, B. Dai, and B. Xie. Nonparametric Estimation of Multi-View Latent Variable Models. In *Proc. of ICML*, June 2014.
- [35] A. Agarwal, A. Anandkumar, P. Jain, P. Netrapalli, and R. Tandon. Learning Sparsely Used Overcomplete Dictionaries. In *Conference on Learning Theory (COLT)*, June 2014.

- [36] A. Anandkumar, D. Hsu, M. Janzamin, and S. M. Kakade. When are Overcomplete Topic Models Identifiable? Uniqueness of Tensor Tucker Decompositions with Structured Sparsity. In *Neural Information Processing (NIPS)*, Dec. 2013.
- [37] A. Anandkumar, R. Ge, D. Hsu, and S. M. Kakade. A Tensor Spectral Approach to Learning Mixed Membership Community Models. In *Conference on Learning Theory (COLT)*, June 2013.
- [38] A. Anandkumar, D. Hsu, A. Javanmard, and S. M. Kakade. Learning Bayesian Networks with Latent Variables. In *Proc. of Intl. Conf. on Machine Learning*, June 2013.
- [39] A. Anandkumar and R. Valluvan. Learning Loopy Graphical Models with Latent Variables: Efficient Methods and Guarantees. In *Proc. of Neural Information Processing (NIPS)*, Dec. 2012.
- [40] A. Anandkumar, D. P. Foster, D. Hsu, S. M. Kakade, and Y. K. Liu. A Spectral Algorithm for Latent Dirichlet Allocation. In *Proc. of Neural Information Processing (NIPS)*, Dec. 2012.
- [41] A. Anandkumar, D. Hsu, F. Huang, and S.M. Kakade. Learning Mixtures of Tree Graphical Models. In *Proc. of Neural Information Processing (NIPS)*, Dec. 2012.
- [42] M. Janzamin and A. Anandkumar. High-Dimensional Covariance Decomposition into Sparse Markov and Independence Domains. In *Proc. of International Conf. on Machine Learning*, June 2012.
- [43] A. Anandkumar, D. Hsu, and S.M. Kakade. A Method of Moments for Mixture Models and Hidden Markov Models. In *Proc. of Conf. on Learning Theory*, June 2012.
- [44] A. Anandkumar, V. Y. F. Tan, and A. S. Willsky. High-Dimensional Graphical Model Selection: Tractable Graph Families and Necessary Conditions. In *Proc. of Neural Information Processing (NIPS)*, Dec. 2011. *Oral Presentation, AR 1%*.
- [45] A. Anandkumar, K. Chaudhuri, D. Hsu, S.M. Kakade, L. Song, and T. Zhang. Spectral Methods for Learning Multivariate Latent Tree Structure. In *Proc. of Neural Information Processing (NIPS)*, Dec. 2011.
- [46] A. Anandkumar, A. Hassidim, and J. Kelner. Topology Discovery of Sparse Random Graphs With Few Participants. In *Proc. of ACM SIGMETRICS*, June 2011. **Winner of Best Paper Award**.
- [47] M. A. Khajehnejad, J. Yoo, A. Anandkumar, and B. Hassibi. Summary Based Structures with Improved Sublinear Recovery for Compressed Sensing. In *Proc. of IEEE ISIT*, July 2011.

Other Research: Signal Processing, Networks & Info. Theory

Journal Publications (Limited List)

- [48] Amod JG Anandkumar, Animashree Anandkumar, Sangarapillai Lambotharan, and Jonathon A Chambers. Robust rate maximization game under bounded channel uncertainty. *Vehicular Technology, IEEE Transactions on*, 60(9):4471–4486, 2011.
- [49] A. Anandkumar, J.E. Yukich, L. Tong, and A. Swami. Energy Scaling Laws for Distributed Inference in Random Networks. *IEEE J. Selec. Area Comm.*, 27(7):1203–1217, Sept. 2009.
- [50] A. Anandkumar, L. Tong, and A. Swami. Detection of Gauss-Markov Random Fields with Nearest-neighbor Dependency. *IEEE Tran. Information Theory*, 55(2):816–827, Feb. 2009.
- [51] A. Anandkumar, N. Michael, A.K. Tang, and A. Swami. Distributed algorithms for learning and cognitive medium access with logarithmic regret. *Selected Areas in Communications, IEEE Journal on*, 29(4):731–745, 2011. **Best Readings on Cognitive Radio by IEEE Comsoc society**.

- [52] A. Anandkumar, L. Tong, and A. Swami. Distributed Estimation Via Random Access. *IEEE Tran. Information Theory*, 54(7):3175–3181, July 2008.
- [53] A. Anandkumar and L. Tong. Type-Based Random Access for Distributed Detection over Multiaccess Fading Channels. *IEEE Tran. Signal Proc.*, 55(10):5032–5043, Oct. 2007. **IEEE Signal Processing Society 2008 Young Author Best Paper Award.**

Conference Publications (Limited List)

- [54] F. Huang and A. Anandkumar. Fast, Concurrent and Distributed Load Balancing under Switching Costs and Imperfect Observations. In *Proc. of IEEE INFOCOM*, Apr. 2013.
- [55] T. He, A. Anandkumar, and D. Agrawal. Index-based sampling policies for tracking dynamic networks under sampling constraints. In *Proc. of IEEE INFOCOM*, May 2011. *AR 15.96%*.
- [56] P. Balister, B. Bollobas, A. Anandkumar, and A.S. Willsky. Energy-latency tradeoff for in-network function computation in random networks. In *Proc. of IEEE INFOCOM*, May 2011. *AR 15.96%*.
- [57] A. Anandkumar, N. Michael, and A.K. Tang. Opportunistic Spectrum Access with Multiple Users: Learning under Competition. In *Proc. of IEEE INFOCOM*, San Deigo, USA, March 2010. *AR 17%*.
- [58] A. Anandkumar, M. Wang, L. Tong, and A. Swami. Prize-Collecting Data Fusion for Cost-Performance Tradeoff in Distributed Inference. In *Proc. of IEEE INFOCOM*, Rio De Janeiro, Brazil, April 2009. *AR 20%*.
- [59] A. Anandkumar, C. Bisdikian, and D. Agrawal. Tracking in a Spaghetti Bowl: Monitoring Transactions Using Footprints. In *Proc. ACM Intl. Conf. on Measurement & Modeling of Computer Systems (Sigmetrics)*, Annapolis, Maryland, USA, June 2008. *AR 18%*.
- [60] A. Anandkumar, L. Tong, A. Swami, and A. Ephremides. Minimum Cost Data Aggregation with Localized Processing for Statistical Inference. In *Proc. of INFOCOM*, pages 780–788, Phoenix, USA, April 2008. *AR 20%*.
- [61] A. Anandkumar and L. Tong. A Large Deviation Analysis of Detection over Multi-Access Channels with Random Number of Sensors. In *Proc. of ICASSP'06*, volume IV, pages 1097–1101, Toulouse, France, May 2006. **Best Paper Award.**

Book Chapters

- [62] A. Anandkumar, A. Ephremides, A. Swami, and L. Tong. Routing for Statistical Inference in Sensor Networks. In S. Haykin and R. Liu, editors, *Handbook on Array Processing and Sensor Networks*, chapter 23. John Wiley & Sons, 2009.

Invention Disclosures

- [63] A. Anandkumar and D. Agrawal and C. Bisdikian and T. He, and S. Perelman. Selective Instrumentation For Distributed Applications For Transaction Monitoring. *US 8433786 B2*, April 2013.

Teaching

Large-scale ML (2014), Stat. Learning Theory (2014), Signals & Systems (2012-15), Random Processes (2010-11), Estimation Theory (2011-13), Special Topics in Learning (2013).

Funding

AFOSR YIP, ONR (PI), Sloan fellowship, Microsoft faculty fellowship, Microsoft Azure for research, NSF BigData (PI), ARO Young Investigator Award (YIP), NSF Career (PI), NSF CCF-1219234 (PI).

Service

TPC for ICML 2012-16, AISTATS 2016, NIPS 2014, UAI 2013-14, SIGMETRICS 2014-16, ISIT 2014-15, AAAI 2013, SPCOM 2012, ACM MOBIHOC 2011-2013, IEEE INFOCOM 2011-2012, Intl. Symposium of Information Theory and its App. 2012.

Assoc. Editor for IEEE Tran. on Signal Processing, Reviewer for JMLR, Annals of Statistics, IEEE Tran. on Information Theory.

Organizer of the workshop on optimization and matrix methods.

Recipient of IBM grant of \$30,000 as part of Fran Allen award to mentor female students. University.

In the News

Announcement of AFOSR YIP, Feb. 2015.

<http://www.wpafb.af.mil/news/story.asp?id=123436763>

Announcement of the Sloan fellowship, Feb. 2014

<http://www.eng.uci.edu/news/2014/2/anandkumar-receives-early-career-sloan-research-fellowship-her-work-machine-learning>
<http://www.sloan.org/sloan-research-fellowships/2014-sloan-research-fellows/>

Announcement of Microsoft faculty award, July 2013.

http://research.microsoft.com/en-us/collaboration/awards/msrff_all.aspx#2013

<http://www.eng.uci.edu/news/2013/6/microsoft-research-names-anima-anandkumar-faculty-fellow>.

Interview at faculty summit: <http://research.microsoft.com/apps/video/?id=200507>.

Announcement of Windows Azure for Research Award winners, (Oct. 2013)

http://blogs.msdn.com/b/msr_er/archive/2013/11/05/october-2013-windows-azure-for-research-award-winners.aspx#!

Article on Sizing Samples in ACM Technews and MIT news September 2010.

<http://technews.acm.org/archives.cfm?fo=2010-09-sep/sep-01-2010.html>

<http://web.mit.edu/newsoffice/2010/sizing-samples-0825.html>

Article on Fran Allen Fellowship in Cornell News December 2008.

<http://www.news.cornell.edu/stories/Dec08/AnandkumarAward.html>

Article on Anita Borg Scholars in Google Press Release March 2007.

<http://www.google.com/intl/en/press/pressrel/anitaborg07.html>

Invited Talks (Limited List)

Invited talk at Strata+Hadoop conference, Feb. 2015.

Tutorials at ML Summer school July 2014, AAAI July 2014, and ICML 2013.

Invited talks at Simons Workshop on Spectral Methods, Fall 2014.

What's hot in Machine Learning? Invited Talk at AAAI 2014.

Invited talk, Deep Learning Models for Emerging Big Data Applications Workshop at ICML 2014.

Invited talk, Learning Tractable Probabilistic Models, ICML workshop.

Invited talk, Spectral learning Workshop, ICML 2014.

Invited talk, Network Science and Graph Algorithms, ICERM, Brown University, April 2014.

Invited talk, MLConf, NYC, April 2014

Invited Talk, ITA, Feb. 2014

Invited talk at NIPS workshop on Topic Modeling, Dec. 2013.

AI/ML Talk at U.C. San Diego, CA, Nov. 2013.

Talk at MIT, Cambridge, MA, Oct. 2013.

Invited talk at INI, Cambridge, UK, August, 2013.

Last updated: August 4, 2015

<http://newport.eecs.uci.edu/anandkumar/Resume/CV.pdf>