Anima Anandkumar

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Current Research Interests

Focus on high-dimensional learning of probabilistic graphical models and latent variable models. Broad interests in high dimensional statistics and large-scale machine learning, tensor methods, signal processing, information theory and statistical physics.

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. **Alfred P. Sloan Research Fellowship 2014**
2. **Microsoft Faculty Fellowship 2013**
3. **ARO Young Investigator Award (YIP) 2013**
4. **NSF CAREER Award 2013.**
5. **ACM SIGMETRICS 2011 Best Paper Award.**
6. **Best Thesis Award 2009** by ACM SIGMETRICS Society.
7. **IEEE Signal Processing Society Young Author Best Paper Award 2008**.
8. **Fran Allen IBM PhD Fellowship 2008-09**.
9. **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] A. Anandkumar, R. Ge, and M. Janzamin. Provable Learning of Overcomplete Latent Variable Models: Semi-supervised and Unsupervised Settings. *Preprint.*, June 2014.

[2] F. Huang, U.N. Niranjan, and A. Anandkumar. Integrated Structure and Parameter Learning in Latent Tree Graphical Models. *Preprint*, June 2014.

[3] A. Anandkumar, R. Ge, and M. Janzamin. Provable Learning Overcomplete Latent Variable Models: Unsupervised and Semi-supervised Settings. *Preprint*, Feb. 2014.

[4] A. Agarwal, A. Anandkumar, P. Jain, P. Netrapalli, and R. Tandon. Learning Sparsely Used Overcomplete Dictionaries via Alternating Minimization. *ArXiv 1310.7991*, Oct. 2013.

[5] A. Agarwal, A. Anandkumar, and P. Netrapalli. Exact Recovery of Sparsely Used Overcomplete Dictionaries. *ArXiv 1309.1952*, Sept. 2013.

[6] F. Huang, U.N. Niranjan, M. Hakeem, and A. Anandkumar. Fast Detection of Overlapping Communities via Online Tensor Methods. *ArXiv 1309.0787*, Sept. 2013.

[7] 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*, Aug. 2013.

[8] A. Anandkumar, D. Hsu, F. Huang, and S.M. Kakade. Learning High-Dimensional Mixtures of Graphical Models. *ArXiv 1203.0697*, Feb. 2013.

[9] 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

[10] 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.

[11] M. Janzamin and A. Anandkumar. High-Dimensional Covariance Decomposition into Sparse Markov and Independence Domains. *To appear, JMLR*, 2014.

[12] A. Anandkumar, R. Ge, D. Hsu, and S. M. Kakade. A Tensor Approach to Learning Mixed Membership Community Models. *JMLR*, (15):2239–2312, June 2014.

[13] 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.

[14] A. Anandkumar and R. Valluvan. Learning Loopy Graphical Models with Latent Variables: Efficient Methods and Guarantees. *Annals of Statistics*, 41(2):401–435, 2013.

[15] 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.

[16] 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.

[17] 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.

[18] 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.

[19] 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.

[20] 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.

[21] 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.

[22] 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)

[23] 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.

[24] H. Sedghi, A. Anandkumar, and E. Jonckheere. Guarantees for Stochastic ADMM in High Dimensions. In *Proc. of Neural Information Processing (NIPS)*, Dec. 2014.

[25] L. Song, A. Anandkumar, B. Dai, and B. Xie. Nonparametric Estimation of Multi-View Latent Variable Models. In *Proc. of ICML*, June 2014.

[26] A. Agarwal, A. Anandkumar, P. Jain, P. Netrapalli, and R. Tandon. Learning Sparsely Used Overcomplete Dictionaries. In *Conference on Learning Theory (COLT)*, June 2014.

[27] 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.

[28] 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.

[29] 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.

[30] 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.

[31] 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.

[32] 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.

[33] 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.

[34] 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.

[35] 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%.*

[36] 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.

[37] 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**.

[38] 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)

[39] 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.

[40] 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.

[41] 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.

[42] 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**.

[43] A. Anandkumar, L. Tong, and A. Swami. Distributed Estimation Via Random Access. *IEEE Tran. Information Theory*, 54(7):3175–3181, July 2008.

[44] 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)

[45] F. Huang and A. Anandkumar. Fast, Concurrent and Distributed Load Balancing under Switching Costs and Imperfect Observations. In *Proc. of IEEE INFOCOM*, Apr. 2013.

[46] 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%.*

[47] 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%.*

[48] 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%.*

[49] 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%.*

[50] 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%*.

[51] 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%*.

[52] 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

[53] 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

[54] 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

Signals & Systems (2012-13) Random Processes (2010-11) Estimation Theory (2011-13) Special Topics in Learning (2013).

Funding

ONR, 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 NIPS 2014, UAI 2014, ICML 2014, SIGMETRICS 2014, ISIT 2014, UAI 2013, AAAI 2013, ICML 2013, SPCOM 2012, ACM MOBIHOC 2011-2013, IEEE INFOCOM 2011-2012, Intl. Symposium of Information Theory and its App. 2012.

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

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

In the News

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)

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

Invited talk at Simons Workshop on "Semidefinite Optimization, Approximation, and Applications", Sept. 2014.

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

Invited talk, Spectral learning Workshop, ICML 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, 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.