

# Greg Ver Steeg

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## Biographical sketch

Dr. Ver Steeg's research explores *practical methods for inferring meaningful structure in complex systems*. This work draws on a diverse set of connections between information theory, machine learning, causal inference, and physics. His recent work has applied these novel tools to solving outstanding problems in diverse domains including biology, natural language, human behavior, and social networks.

## Education

Ph.D., California Institute of Technology	2009
Field: Physics, Area: Quantum Information and Computation	
Advisor: John Preskill, Feynman Professor of Theoretical Physics	
B.S. Drake University	2003
Majors: Physics, Mathematics, Philosophy	

## Experience

Information Sciences Institute, University of Southern California	
Research Lead	2015 - Present
Research Assistant Professor	2013 - Present
Computer scientist	2011 - 2015
Postdoctoral researcher	2009 - 2011
Singapore Management University, Living Analytics Research Center	
Visiting researcher	Aug. 2012
California Institute of Technology	2003-2009
Graduate research	
Summer internships	
Google Inc., Machine translation	2009
Brookhaven National Laboratory, Nuclear physics	2002
Los Alamos National Laboratory, Nuclear physics	2001
Drake University	2001-2003
Computational atomic physics research	

## Grants

James H. Zumberge Research and Innovation Fund Award, \$85k	2017
DARPA Next Generation Social Science, ~ \$500k (PI)	2016-2019
DARPA Social Media in Strategic Communication grant, ~ \$6 million (co-PI) "Situational Awareness for Social Media: Theories, Models and Algorithms"	2012-2016

AFOSR Young Investigator Award, \$360k (PI) “Bell Inequalities for Complex Networks”	2012-2015
Army Research Office, \$645k “Optimization via Open System Quantum Annealing”	2012-2015

## Awards

IJCAI Early Career Spotlight	2017
AFOSR Young Investigator Award	2012-2015
Best paper runner-up at UAI	2011
National Science Foundation Graduate Research Fellowship	2005-2008
California Institute of Technology Richard Feynman Fellowship	2003
Barry Goldwater Scholarship	2002
Drake University Physics Scholarship	1999-2003

## Teaching Experience

CSCI-590: Directed research, USC	2014-2016
CSCI-599: Physics and Computation, USC Designed and taught with A. Galstyan, two class projects led to publications.	Spring 2012
T.A. Physics 2, California Institute of Technology	2008

## Service

### Open source code contributions:

Linear factor models and covariance estimation with Linear CorEx <a href="https://github.com/gregversteeg/linearcorex">https://github.com/gregversteeg/linearcorex</a>	2017
Nonlinear CorEx models optimized for under-sampled, high-d biomedical data. <a href="https://github.com/gregversteeg/bio_corex">https://github.com/gregversteeg/bio_corex</a>	2017
Constructing topic models with CorEx <a href="https://github.com/gregversteeg/corex_topic">https://github.com/gregversteeg/corex_topic</a>	2016
The discrete information sieve <a href="https://github.com/gregversteeg/discrete_sieve">https://github.com/gregversteeg/discrete_sieve</a>	2016
Gaussianizing data <a href="https://github.com/gregversteeg/gaussianize">https://github.com/gregversteeg/gaussianize</a>	2015
Information-theoretic deep learning: <a href="https://github.com/gregversteeg/CorEx">https://github.com/gregversteeg/CorEx</a>	2014
Non-parametric information-theoretic estimation code: <a href="https://github.com/gregversteeg/NPEET">https://github.com/gregversteeg/NPEET</a>	2013
ISI AI Seminar Coordinator	2014
Tutorials: ICWSM (2013), IPAM (2016), IJCAI (2016)	
Program Committees and reviewing: ICWSM, UAI, CSS, AISTATS.	
Reviews: Journal of Causal Inference, NIPS, <i>Entropy</i> , AFOSR proposals, Mitacs, <i>Neural Computation</i> , IEEE Transactions on Knowledge and Data Engineering, WebSci.	

## Recent pre-prints

Greg Ver Steeg and Aram Galstyan. Low Complexity Gaussian Latent Factor Models and a Blessing of Dimensionality. arXiv:1706.03353 [stat.ML], 2017.

R.J. Gallagher, K. Reing, D. Kale, G. Ver Steeg. “Anchored Correlation Explanation: Topic Modeling with Minimal Domain Knowledge.” <http://arxiv.org/abs/1611.10277>

## Peer-reviewed Publications

- [1] David Stück, Haraldur Tómas Hallgrímsson, Greg Ver Steeg, Alessandro Epasto, and Luca Foschini. The spread of physical activity through social networks. In *Proceedings of the 26th International Conference on World Wide Web*, pages 519–528. International World Wide Web Conferences Steering Committee, 2017.
- [2] Greg Ver Steeg, Shuyang Gao, Kyle Reing, and Aram Galstyan. Sifting common information from many variables. *IJCAI*, 2017.
- [3] Shirley Pepke and Greg Ver Steeg. Comprehensive discovery of subsample gene expression components by information explanation: therapeutic implications in cancer. *BMC medical genomics*, 10(1):12, 2017.
- [4] Artemis Zavaliangos-Petropulu, Emily L Dennis, Greg Ver Steeg, Talin Babikian, Richard Mink, Christopher Babbitt, Jeffrey Johnson, Christopher C Giza, Robert F Asarnow, and Paul M Thompson. Variable clustering reveals associations between subcortical brain volume and cognitive changes in pediatric traumatic brain injury. In *12th International Symposium on Medical Information Processing and Analysis*. International Society for Optics and Photonics, 2017.
- [5] Shuyang Gao, Greg Ver Steeg, and Aram Galstyan. Variational information maximization for feature selection. In *Advances In Neural Information Processing Systems*, pages 487–495, 2016.
- [6] Kyle Reing, David C. Kale, Greg Ver Steeg, and Aram Galstyan. Toward interpretable topic discovery via anchored correlation explanation. In *ICML Workshop on Human Interpretability in Machine Learning (WHI 2016)*, 2016.
- [7] Linhong Zhu, Dong Guo, Junming Yin, Greg Ver Steeg, and Aram Galstyan. Scalable temporal latent space inference for link prediction in dynamic social networks. *IEEE Transactions on Knowledge and Data Engineering*, 2016.
- [8] Greg Ver Steeg and Aram Galstyan. The information sieve. In *International Conference on Machine Learning (ICML)*, 2016.
- [9] Sarah Madsen, Greg Ver Steeg, Madelaine Daianu, Adam Mezher, Neda Jahanshad, Talia M. Nir, Xue Hua, Boris A. Gutman, Aram Galstyan, and Paul M. Thompson. Relative value of diverse brain mri and blood-based biomarkers for predicting cognitive decline in the elderly. In *SPIE Medical Imaging*, 2016.
- [10] Yoon-Sik Cho, Greg Ver Steeg, Emilio Ferrara, and Aram Galstyan. Latent space model for multi-modal social data. In *Proceedings of World Wide Web Conference (WWW)*, 2016.
- [11] Armen Allahverdyan, Greg Ver Steeg, and Aram Galstyan. Memory-induced mechanism for self-sustaining cascades in networks. *Physical Review E*, 2015.
- [12] Daniel Moyer, Boris Gutman, Gautam Prasad, , Greg Ver Steeg, and Paul Thompson. Mixed membership stochastic blockmodels for the human connectome. In *Proceedings of Bayesian and Graphical Imaging for Biomedical Imaging (BAMBI)*, 2015.

- [13] Madelaine Daianu, Greg Ver Steeg, Adam Mezher, Neda Jahanshad, Talia M. Nir, Xiaoran Yan, Gautam Prasad, Kristina Lerman, Aram Galstyan, and Paul M. Thompson. Information-theoretic clustering of neuroimaging metrics related to cognitive decline in the elderly. In *Proceedings of the MICCAI Workshop on Medical Computer Vision*, 2015.
- [14] Daniel Moyer, Boris Gutman, Gautam Prasad, Joshua Faskowitz, Greg Ver Steeg, and Paul Thompson. Blockmodels for connectome analysis. In *11th International Symposium on Medical Information Processing and Analysis (SIPAIM 2015)*, 2015.
- [15] Shuyang Gao, Greg Ver Steeg, and Aram Galstyan. Estimating mutual information by local gaussian approximation. In *Uncertainty in Artificial Intelligence (UAI)*, 2015.
- [16] Shuyang Gao, Greg Ver Steeg, and Aram Galstyan. Understanding confounding effects in linguistic coordination: an information-theoretic approach. *PLoS ONE*, 10(6): e0130167, 2015.
- [17] Sarah K. Madsen, Greg Ver Steeg, Adam Mezher, Neda Jahanshad, Talia M. Nir, Xue Hua, Boris A. Gutman, Aram Galstyan, and Paul M. Thompson. Information-theoretic characterization of blood panel predictors for brain atrophy and cognitive decline in the elderly. *IEEE International Symposium on Biomedical Imaging*, 2015.
- [18] Greg Ver Steeg and Aram Galstyan. Maximally informative hierarchical representations of high-dimensional data. In *Proceedings of the Sixteenth International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2015.
- [19] Shuyang Gao, Greg Ver Steeg, and Aram Galstyan. Efficient estimation of mutual information for strongly dependent variables. In *Proceedings of the Sixteenth International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2015.
- [20] Nathan Hodas, Greg Ver Steeg, Joshua Harrison, Satish Chikkagoudar, Eric Bell, and Courtney Corley. Disentangling the lexicons of disaster response in twitter. In *The 3rd International Workshop on Social Web for Disaster Management (SWDM'15)*, 2015.
- [21] Christoph Adami and Greg L. Ver Steeg. Black holes are almost optimal quantum cloners. *Journal of Physics A*, 58, 2015.
- [22] Greg Ver Steeg and Aram Galstyan. Discovering structure in high-dimensional data through correlation explanation. *Advances in Neural Information Processing Systems (NIPS)*, 2014.
- [23] Greg Ver Steeg, Aram Galstyan, Fei Sha, and Simon DeDeo. Demystifying information-theoretic clustering. In *International Conference on Machine Learning (ICML)*, 2014.
- [24] Yoon Sik Cho, Greg Ver Steeg, and Aram Galstyan. Where and why users “check in”. In *Proc. of the Twenty-Eighth Conference on Artificial Intelligence (AAAI)*, 2014.
- [25] Siddhartha Santra, Greg Quiroz, Greg Ver Steeg, and Daniel Lidar. Max 2-sat with up to 108 qubits. *New J. Phys.*, 16:045006, 2014.
- [26] Yoon-Sik Cho, Greg Ver Steeg, and Aram Galstyan. Mixed membership blockmodels for dynamic networks with feedback. In *Handbook of Mixed Membership Models and Their Applications*. Chapman & Hall/CRC, 2014.
- [27] Greg Ver Steeg, Cristopher Moore, Aram Galstyan, and Armen Allahverdyan. Phase transitions in community detection: A solvable toy model. *EPL (Europhysics Letters)*, 106(4):48004, 2014.
- [28] Christoph Adami and Greg Ver Steeg. Classical information transmission capacity of quantum black holes. *Classical and Quantum Gravity*, 31(7):075015, 2014.

- [29] Vasanthan Raghavan, Greg Ver Steeg, Aram Galstyan, and Alexander G Tartakovsky. Modeling temporal activity patterns in dynamic social networks. *IEEE TCSS*, 2014.
- [30] Greg Ver Steeg and Aram Galstyan. Statistical tests for contagion in observational social network studies. In *Proceedings of the Sixteenth International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2013.
- [31] Greg Ver Steeg and Aram Galstyan. Information-theoretic measures of influence based on content dynamics. In *Proceedings of the 6th International Conference on Web Search and Data Mining (WSDM)*. ACM, 2013.
- [32] Yoon Sik Cho, Greg Ver Steeg, and Aram Galstyan. Socially relevant venue clustering from check-in data. In *MLG'13: Mining and Learning from Graphs*, 2013.
- [33] Greg Ver Steeg and Aram Galstyan. Information transfer in social media. In *Proceedings of World Wide Web Conference (WWW)*, 2012.
- [34] Greg Ver Steeg and Aram Galstyan. A sequence of relaxations constraining hidden variable models. In *Proc. of the Twenty-Seventh Conference on Uncertainty in Artificial Intelligence (UAI)*, 2011. **Best paper runner-up award.**
- [35] Greg Ver Steeg, Rumi Ghosh, and Kristina Lerman. What stops social epidemics? In *Proc. 5th Int. AAAI Conf. on Weblogs and Social Media (ICWSM)*, 2011.
- [36] Yoon Sik Cho, Greg Ver Steeg, and Aram Galstyan. Co-evolution of selection and influence in social networks. In *Proc. of the Twenty-Fifth Conference on Artificial Intelligence (AAAI)*, 2011.
- [37] Aram Galstyan, Greg Ver Steeg, and Armen Allahverdyan. Statistical mechanics of semi-supervised clustering in sparse graphs. *J. Stat. Mech.*, (Po8009), 2011.
- [38] A. E. Allahverdyan, Greg Ver Steeg, and A. Galstyan. Community detection with and without prior information. *EPL (Europhysics Letters)*, 90(1):18002, 2010.
- [39] Greg Ver Steeg. *Foundational aspects of nonlocality*. PhD thesis, California Institute of Technology, 2009.
- [40] Greg Ver Steeg and N. C. Menicucci. Entangling power of an expanding universe. *Physical Review D*, 79(4), February 2009.
- [41] Greg Ver Steeg and S. Wehner. Relaxed uncertainty relations and information processing. *Quantum Information and Computation*, 9:0801–0832, 2009.
- [42] P. L. Bartlett, I. Bray, S. Jones, A. T. Stelbovics, A. S. Kadyrov, K. Bartschat, Greg Ver Steeg, M. P. Scott, and P. G. Burke. Unambiguous ionization amplitudes for electron-hydrogen scattering. *Physical Review A*, 68(2), August 2003.
- [43] K. Bartschat, M. P. Scott, P. G. Burke, T. Stitt, N. S. Scott, A. N. Grum-Grzhimailo, S. Riordan, Greg Ver Steeg, and S. I. Strakhova. Convergence of energy-differential ionization cross sections obtained from a T-matrix approach with R-matrix wave functions. *Physical Review A*, 65(6), June 2002.
- [44] K. Bartschat, S. Riordan, and Greg Ver Steeg. Extraction of energy-differential ionization cross sections in time-dependent calculations. *Physical Review A*, 65(6), June 2002.
- [45] Greg L. Ver Steeg, K. Bartschat, and I. Bray. Time-dependent model calculations for a molecular hydrogen ion in a strong ultra-short laser pulse. *Journal of Physics B Atomic Molecular Physics*, 36:3325–3336, August 2003.

Note: these papers span different disciplines including physics, computer science, and biology. Listed are all peer-reviewed publications including journal articles and conference proceedings. In physics, conferences typically do not have papers (only abstracts, not included here). Peer reviewed conference proceedings in CS and biology are included. In CS, conference proceedings are, depending on the conference, highly selective and considered top venues in the field (e.g., NIPS, ICML, WWW). Journals in CS are typically used for longer version of work appearing originally in conferences. In biology (neuroscience at least), conference papers are peer reviewed, but they are short and generally regarded as second tier publications mainly used for work in progress.

## Recent Invited Talks

\* *Talks with honorarium*

Berkeley DataEDGE conference	2017
Los Alamos National Lab.	2017
IJCAI Early Career Spotlight talk	2017
ITA Workshop	2017
Vicarious	2016
*W.V.T. Rusch Engineering Honors Colloquium	2016
Headspace	2016
Deep learning for health care workshop at MLHC	2016
StatPhys26 Workshop: Statistical physics methods in biology and computer science	2016
IPAM Cultural Analytics workshop	2016
ITA Workshop	2016
UCLA, Soatto group seminar	2016
UC Davis, Crutchfield group seminar	2016
Caltech, IST Seminar	2015
UC San Diego, AI seminar	2015
OpenX	2015
Brain Corporation	2015
*1st Collaborative Data Science Symposium hosted by Ameritrade	2015
Joint Symposium on Neural Computation at USC	2015
Machine Learning LA at eHarmony	2015
Information Theory and Applications Workshop	2015
*AFRL Rome, "Distinguished Speaker Seminar Series in Machine Intelligence and Autonomy"	2014
Santa Fe Institute, workshop on "Statistical Mechanics of Complexity"	2014
IPAM Mathematics of Social Learning Workshop	2014
ISI, Natural Language Seminar	2013
ID Analytics, "Information-Theoretic Tools for Social Media"	2013
Santa Fe Institute, workshop on "Structure, Statistical Inference and Dynamics in Networks"	2013
Sante Fe Institute, "Information-Theoretic Tools for Social Media"	2012
Keynote for "Making Sense of Microposts" workshop at WWW 2012.	2012
SAP Research, Singapore	2012
LARC, Singapore Management University seminar.	2012
UC Irvine, AI-ML seminar.	2012

## Recent Non-Proceedings Workshop and Conference Presentations

(Invited contribution for IJCAI 2017 Early Career Spotlight) Greg Ver Steeg, “Unsupervised Learning via Total Correlation Explanation”, IJCAI 2017.

Jahanshad, Ver Steeg, et al. “Enhancing genetic correlations between blood and brain using latent factors of correlated blood measures”, SPIE 2016.

Kyle Reing, David Kale, Greg Ver Steeg, Aram Galstyan. ICML Workshop on Interpretability in Machine Learning, 2016.

Madsen, Ver Steeg, et al. “Predicting Cognitive Decline with Information-Theoretic Clustering of Brain MRI and Blood Tests.” Society of Biological Psychiatry, 2015.

NIPS workshop on Machine Learning in Computational Biology (MLCB), 2014.

NIPS workshop on Machine Learning and Interpretation in Neuroimaging (MLINI), 2014.

Greg Ver Steeg and Aram Galstyan. “Minimal Assumptions Tests for Observational Social Network Studies”. In *Workshop on Information in Networks*, 2013.

Shuyang Gao, Greg Ver Steeg and Aram Galstyan. “Explaining Away Stylistic Coordination”. In *Workshop on Information in Networks*, 2013.

Greg Ver Steeg “Optimization via Open System Quantum Annealing.” *ARO Quantum Computing Review*, 2013.

Vasanthan Raghavan, Alexander G. Tartakovsky, Aram Galstyan, and Greg Ver Steeg. Coupled Hidden Markov Models for User Activity in Social Networks. In *IEEE 2nd International Workshop on Social Multimedia Research*, 2013.

Marco Huesch, Greg Ver Steeg and Aram Galstyan. Vaccination (Anti-) Campaigns in Social Media in *AAAI-13 Workshop on Expanding the Boundaries of Health Informatics Using AI (HIAI)*, 2013.

Greg Ver Steeg and Aram Galstyan. Information-Theoretic Measures of Influence Based on Content Dynamics. In *Workshop on Information in Networks(WIN)*, 2012.

Greg Ver Steeg and Aram Galstyan. Information transfer in social media. In *Workshop on Information in Networks(WIN)*, 2011.

Greg Ver Steeg, Armen Allahverdyan, and Aram Galstyan. Semi-supervised clustering in sparse networks. In *International Conference on Complex Systems(ICCS)*, 2011.

Yoon Sik Cho, Greg Ver Steeg, and Aram Galstyan. Co-evolving mixed membership blockmodels. In *NIPS workshop on Networks Across Disciplines*, 2010.

Greg Ver Steeg and Aram Galstyan. Ruling out latent homophily in social networks. In *NIPS workshop on Social Computing*, 2010.

Armen Allahverdyan, Aram Galstyan, and Greg Ver Steeg. Clustering with prior information. In *NIPS workshop: Clustering: Science or Art? Towards Principled Approaches*, 2009.