Eva L. Dyer

Contact Information

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Research Interests

Computational neuroscience, signal processing and machine learning for neural data analysis; low-dimensional signal models, unions of subspaces, sparse signal recovery; algorithms and architectures for distributed optimization and large-scale machine learning.

Education

Rice University, Houston, Texas
Ph.D. in Electrical & Computer Engineering, September 2014
Thesis title: *New Theory and Methods for Signals in Unions of Subspaces*
Thesis advisor: Richard G. Baraniuk

M.S. in Electrical & Computer Engineering, October 2011
Thesis title: *Endogenous Sparse Recovery*
Thesis advisor: Richard G. Baraniuk

University of Miami, Coral Gables, Florida
B.S. in Electrical & Computer Engineering, May 2007
Double Major in Audio Engineering and Physics

Positions Held

Georgia Institute of Technology and Emory University, Atlanta, Georgia
Sept 2017 – Present Assistant Professor, Coulter Department of Biomedical Engineering

Northwestern University, Rehabilitation Institute of Chicago, Chicago, Illinois
May 2016 – Aug 2017 Research Scientist, Dept. of Physical Medicine and Rehabilitation
Sept 2014 – April 2016 Postdoctoral Fellow, Dept. of Physical Medicine and Rehabilitation

Rice University, Houston, Texas
Aug 2007 – Aug 2014 Research Assistant, Dept. of Electrical & Computer Engineering
Aug 2009 – Dec 2012 Teaching Fellow, Dept. of Electrical & Computer Engineering
Jun 2008 – Jun 2010 National Library of Medicine Predoctoral Fellow

The Johns Hopkins University, Baltimore, Maryland
May 2006 – Jul 2006 Research Assistant, Center for Computer Integrated Surgical Syst.

Honors and Awards

People's Choice Award at the Summer Workshop on the Dynamic Brain, September 2016.
Best PhD Presenter, Dept. of Electrical & Computer Engineering, Rice University, April 2013
National Science Foundation Graduate Research Fellowship, (awarded 2009) 2010–2013
National Library of Medicine Fellowship in Computational Biology & Medicine, 2008–2010
George R. Brown School of Engineering Presidential Fellowship, Rice University, 2007–2013
Texas Instruments Distinguished Graduate Fellowship, Rice University, 2007–2014
Outstanding Student in Electrical Engineering, University of Miami Honors Convocation, 2007
Eliahu Jury Award for Undergraduate Scholarship in EE, University of Miami, 2007
C.V. Starr Scholarship, University of Miami, 2006–2007
John Farina Scholarship, University of Miami's College of Engineering, 2005–2007
Ann Bachellor Scholarship, University of Miami's College of Engineering, 2004–2005

In Review

X. Yang, V. De Andrade, F. De Carlo, **E.L. Dyer**, N. Kasthuri, D. Gürsoy: *Seeing the structure of objects at the nanoscale through low dose X-ray tomography*, in review at Nature Scientific Reports.

E.L. Dyer, M. Azar, H.L. Fernandes, M. Perich, S. Naufel, L.E. Miller, K.P. Körding: *A cryptography-inspired approach for movement decoding*, in review at Nature Biomedical Engineering. (`http://dx.doi.org/10.1101/080861`)

Publications

E.L. Dyer, W. Gray Roncal, J.A. Prasad, H.L. Fernandes, D. Gürsoy, V. De Andrade, K. Fezzaa, X. Xiao, J.T. Vogelstein, C. Jacobsen, K.P. Körding, N. Kasthuri: *Quantifying mesoscale neuroanatomy using X-ray microtomography*, to appear in eNeuro, 2017. (`http://docs.neurodata.io/xbrain`)

A. Mirhoseini, **E.L. Dyer**, E.Songhori, R.G. Baraniuk, F. Koushanfar: *RankMap: A platform-aware framework for distributed learning from dense datasets*, IEEE Trans. on Neural Networks and Learning Systems, May 2017. (`https://doi.org/10.1109/TNNLS.2016.2631581`)

M. Azar, **E.L. Dyer**, K.P. Körding: *Convex relaxation regression: Black-box optimization of smooth functions by learning their convex envelopes*, Proc. of the Conference on Uncertainty in Artificial Intelligence (UAI), June 2016, accepted for oral presentation (top 10% of submissions). (`http://arxiv.org/abs/1602.02191`)

R.J. Patel, T.A. Goldstein, **E.L. Dyer**, A. Mirhoseini, R.G. Baraniuk: *Deterministic column sampling for low-rank matrix approximation: Nyström vs. incomplete Cholesky decomposition*, Proc. of SIAM Conference on Data Mining (SDM), May 2016. (`http://dx.doi.org/10.1137/1.9781611974348.67`)

E.L. Dyer, C. Studer, J.T. Robinson, R.G. Baraniuk: *A robust and efficient method to recover neural events from noisy and corrupted data*, IEEE/EMBS Conference on Neural Engineering (NER), November 2013. (`http://dx.doi.org/10.1109/NER.2013.6696004`)

E.L. Dyer, A.C. Sankaranarayanan, R.G. Baraniuk: *Greedy feature selection for subspace clustering*, Journal of Machine Learning Research, 14(Sep):2487–2517, 2013. (`http://www.jmlr.org/papers/volume14/dyer13a/dyer13a.pdf`)

E.L. Dyer, C. Studer, R.G. Baraniuk: *Subspace clustering with dense representations*, IEEE Conference on Acoustics, Speech, and Signal Processing (ICASSP), May 2013. (`http://dx.doi.org/10.1109/ICASSP.2013.6638260`)

E.L. Dyer, M. Majzoobi, F. Koushanfar: *Hybrid modeling of non-stationary process variations.* ACM Design and Automation Conf. (DAC), June 2011. (`http://dx.doi.org/10.1145/2024724.2024768`)

E.L. Dyer, M.F. Duarte, D.H. Johnson, R.G. Baraniuk: *Recovering spikes from noisy neuronal calcium signals via structured sparse approximation.* Lecture Notes in Computer Science, ICA 2010, Volume 6365/2010, 604-611. (`http://dx.doi.org/10.1007/978-3-642-15995-4_75`)

M. Majzoobi, **E.L. Dyer**, A. Enably, F. Koushanfar: *Rapid FPGA characterization using clock synthesis and signal sparsity.* International Test Conference (ITC) 2010 Proceedings, Nov 2010. (`http://dx.doi.org/10.1109/TEST.2010.5699248`)

G. Fischer, **E.L. Dyer**, C. Csoma, A. Deguet, G. Fichtinger: *Validation system for MR image overlay and other needle insertion techniques*, Medicine Meets Virtual Reality 15- in vivo, in vitro, in silico: Designing the Next in Medicine, IOS Press, 2007.

Peer-reviewed Abstracts

A. Bleckert, A. Bodor, J. Borseth, D. Brittain, D. Bumbarger, D. Castelli, **E.L. Dyer**, T. Keenan, Y. Li, F. Long, J. Perkins, D. Reid, D. Sullivan, M. Takeno, R. Torres, D. Williams, C. Reid, N. da Costa: *Linking functional and anatomical circuit connectivity using fast parallelized TEM imaging*, Society for Neuroscience Annual Meeting (SFN), November 2016.

R. Vescovi, E. Miqueles, D. Gursoy, V. De Andrade, **E.L. Dyer**, K.P. Körding, M. Cardoso, F. De Carlo, C. Jacobsen, N. Kasthuri: *TOMOSAIC: Towards terabyte tomography*, submitted to the International X-ray microscopy (XRM) Conference, August 2016.

E.L. Dyer, H.L. Fernandes, W. Gray Roncal, D. Gursoy, J.T. Vogelstein, X. Xiao, C. Jacobsen, K.P. Körding & N. Kasthuri: *Quantifying mesoscale neuroanatomy using X-ray microtomography*, presented at the Society for Neuroscience Annual Meeting (SFN), Oct 2015; Statistical Analysis of Neural Data (SAND), April 2015.

E.L. Dyer, T.A. Goldstein, R. Patel, K.P. Körding, R.G. Baraniuk: *Sparse self-expressive decompositions for dimensionality reduction and clustering.* Signal Processing with Adaptive Sparse Structured Representations (SPARS), July, 2015.

M. Azar, **E.L. Dyer**, H.L. Fernandes, L.E. Miller, K.P. Körding: *Training brain machine interfaces without supervised data*, Computational and Systems Neuroscience (Cosyne), March 2015.

E.L. Dyer, D.B. Murphy, R.G. Baraniuk, J.T. Robinson: *Compressive neural circuit reconstruction using patterned optical stimulation*, Society for Neuroscience Annual Meeting (SFN), Nov 2013.

E.L. Dyer, C. Studer, R.G. Baraniuk: *Subspace clustering reloaded: Sparse vs. dense representations*, Signal Processing with Adaptive Sparse Structured Representations (SPARS), July, 2013.

E.L. Dyer, U. Rutishauser, R.G. Baraniuk: *Group sparse coding with a collection of winner-take-all networks*, Organization of Computational Neurosciences (OCNS), BMC Neuroscience, 13(1):P184, July, 2012.

E.L. Dyer, A.C. Sankaranarayanan, R.G. Baraniuk: *Learning hybrid linear models via sparse recovery.* Signal Processing with Adaptive Sparse Structured Representations (SPARS), June, 2011.

E.L. Dyer, D.H. Johnson, R.G. Baraniuk: *Learning modular representations from global sparse coding networks.* Organization of Computational Neurosciences (OCNS), BMC Neuroscience, 11:P131, 2010.

E.L. Dyer, D.H. Johnson, R.G. Baraniuk: *Sparse coding in modular networks.* Computational and Systems Neuroscience (Cosyne), Feb 2010.

E.L. Dyer, D.H. Johnson, R.G Baraniuk: *Sparse coding with population sketches*, Organization of Computational Neurosciences (OCNS), BMC Neuroscience, 10(1):P132, 2009.

Other Papers

W. Gray Roncal, **E.L. Dyer**, D. Gürsoy, K.P. Körding, N. Kasthuri: *From sample to knowledge: Towards an integrated approach for neuroscience discovery*, 2016. (`http://arxiv.org/abs/1604.03199`)

E.L. Dyer, T.A. Goldstein, R.J. Patel, K.P. Körding, R.G. Baraniuk: *Self-expressive decompositions for matrix approximation and clustering*, 2015. (`http://arxiv.org/abs/1505.00824`)

Patents

M. Azar, **E.L. Dyer**, K.P. Körding. U.S. Patent App. No. 15/400,941, Non-Convex Function Optimizers (filed January 6, 2017).

Teaching Experience

Rice University, Houston, Texas

Co-Developer of 301x: Discrete-Time Signals & Systems, edX Course **June 2013–April 2014**
Assisted in the content development, course organization, evaluation, and implementation of "301x: Discrete-Time Signals & Systems", a massively open online course (MOOC) on edX.org taught by Richard Baraniuk (18,000 students registered).

- Developed and implemented in browser MATLAB-based case study modules aimed to provide real-world applications of signal processing for edX students.
- Managed of a team of 15 undergraduate course assistants that aid in implementing MATLAB content in edX and moderating the online message board and forum in edX.

- Worked with engineers at Mathworks and edX to integrate MATLAB case studies and develop a new audio feature to enrich student's experience of the material in 301x.

Teaching Fellow, Electrical & Computer Engineering Dept. **Aug 2009 – Dec 2012**
Duties ranged from holding weekly review/problem solving sessions, weekly office hours, aiding instructor in preparation of tests and homework, and serving as a guest lecturer.

- ELEC 301: Signals & Systems, Fall 2012
- ELEC 303: Random Signals & Noise, Fall 2009, Fall 2010, Fall 2011

Teaching Assistant, Electrical & Computer Engineering Dept. **Jan 2012 – May 2012**
Aided instructors in the development of course materials, assisted students in course projects, and maintained course websites.

- ELEC 631: Information Theory and Signal Processing Methods for Neuroengineering

Grading Assistant, Electrical & Computer Engineering Dept. **Aug 2008 – May 2011**
Assisted instructor in grading homework and exams.

- ELEC 241: Fundamentals of Electrical Engineering, Fall 2008
- ELEC 431: Digital Signal Processing, Spring 2010, 2011

University of Miami, Coral Gables, FL

Grading Assistant, Electrical & Computer Engineering Dept. **Aug 2006 – May 2007**
Assisted instructor in grading homework and exams.

- EEN 201 Circuit Theory, Fall 2006
- EEN 218 Intermediate Computer Programming, Fall 2006
- EEN 307 Linear Circuits & Signals, Spring 2006, 2007

Peer tutor, Academic Resource Center **Oct 2004 – May 2007**
Tutored students in various courses in physics, math, and electrical engineering. Participated in courses on tutoring, mentoring, and educational psychology.

Workshops organized

Co-organizer of "BigNeuro 2017: Analyzing brain data from the nano to macroscale" Workshop at NIPS, Long Beach, CA, Dec. 9, 2017.

Co-organizer of "Brains & Bits: Machine learning meets neuroscience" Workshop at NIPS, Barcelona, Spain, Dec. 9-10, 2016.

Co-organizer of "BigNeuro 2015: Making sense of big neural data" Workshop at NIPS, Montreal, Dec. 12, 2015.

Co-organizer of the 1st Annual "Signal Processing at Rice" (SPAR) Workshop at Rice University, Houston, TX, March 27, 2015.

Selected talks

"Sub-micrometer X-ray tomography for neuroanatomy", Symposium of the BRAIN Initiative, Mayo Clinic, Rochester, MN, April 1, 2017 (*invited*).

"Quantifying mesoscale neuroanatomy using X-ray microtomography", NIPS 2016 Workshop, Brains & Bits: Neuroscience Meets Machine Learning, December 9-10, 2016 (*invited*).

"Convex relaxation regression for non-convex optimization", Conference on Uncertainty in Artificial Intelligence, June 27, 2016 (*accepted*).

"Finding structure in the brain: From image acquisition to analysis and back again", Computer Science Department Seminar, Notre Dame University, April 28, 2016 (*invited*).

"X-Brain: Methods for mapping 3D brain structure with X-ray microtomography", Integrative Imaging Initiative Seminar Series at Argonne National Lab, September 2015 (*invited*).

"From single cells to brain areas: Methods for quantifying 3D brain structure", Escaping Flatland: Imaging biological architecture and events in 3 dimensions, Marine Biological Laboratory, Woods Hole, MA, August 7-8, 2015 (*invited*).

"Exploiting low-dimensional structure in wiring diagrams to reduce the complexity of neuromorphic circuits", UCSD Winter School on Neuromorphic Engineering, UCSD, Jan 7, 2014 (*spotlight presentation*).

"Compressed message passing for BIG data", ECE Annual Affiliates Meeting, Rice University, April 3, 2013 (*invited*).

"Learning low-Rank representations from collections of high-dimensional data", Rice University, Computational and Applied Math Department Pre-Colloquium Seminar, October 17, 2011 (*invited*).

"Learning hybrid linear models from data ensembles", Technical University of Delft, Telecom Colloquium, July 7, 2011 (*invited*).

"Learning hybrid linear models via sparse recovery", SPARS 2011 Workshop, Edinburgh, Scotland, June 30, 2011 (*accepted*).

"Hybrid modeling of non-stationary process variations", ACM Design and Automation Conference (DAC) 2011, San Diego, CA, June 5 - 10, 2011 (*accepted*).

"Exploiting dispersive structure in sparse spike recovery", University of Edinburgh, Institute for Digital Communications (IDCOM) Seminar, January 11, 2011 (*invited*).

"Spike recovery with structured sparse approximation", Latent Variable Analysis & Signal Separation (LVA/ICA 2010), Saint Malo, France, September 30, 2010 (*accepted*).

"Sparse coding in modular networks", Interdisciplinary Workshop on Modern Mathematical Methods for High-Dimensional Data, Vrije Universiteit Brussel, Brussels, Belgium, April 7, 2010 (*accepted*).

"Structured sparse coding in the striate cortex", 19th Keck Center Annual Research Conference, M.D. Anderson Cancer Prevention Building, Houston, TX, October 30, 2009 (*invited*).

Professional activities

Guest editor for: PLOS Computational Biology

Reviewer for: Journal of Machine Learning Research (JMLR), Signal Processing Letters, IEEE Transactions on Signal Processing (TSP), International Symposium on Information Theory (ISIT), Neural Information Processing Systems (NIPS), Sampling Theory and Applications (SAMPTA), Biomedical Optics Express (BOE), Knowledge and Information Systems (KAIS), PLOS Computational Biology (PLOS CB), IEEE Transactions on Neural Networks and Learning Systems (TNNLS), IEEE Transactions on Biomedical Engineering (TBME), IEEE Transactions on Human-Machine Systems (THMS).

Member of: Society for Neuroscience (SFN), Institute of Electrical and Electronics Engineers (IEEE), Society for Industrial & Applied Mathematics (SIAM), and Eta Kappa Nu Honor Society.

President and web designer for: Rice University ExCEL (Graduate Women in Electrical and Computer Engineering), 2011-2013.

Short Courses & Workshops

Summer Workshop on the *Dynamic Brain*, University of Washington's Friday Harbor Laboratory, Aug, 2016.

University of California San Diego Winter School on *Neuromorphic Engineering*, La Jolla, CA Jan 7, 2014.

Future Faculty Workshop for Late-Stage Ph.D. Students and Postdoctoral Scholars, Rice University, Houston, TX, November 27-28, 2012.

Capocaccia Workshop for *Neuromorphic Engineering*, Sardinia, Italy, May 2012.

Fourth Annual Winedale Workshop on *Networks & Optimization*, Winedale Conference Center, Round Top, TX, October 15, 2011.

Women in Mathematics Summer Program on *Sparsity & Computation*, Institute for Advanced Studies, Princeton University, Princeton, NJ, May 16–27 2011.

Sparse Models, Algorithms, and Learning for Large-scale data (SMALL) Workshop, Queen Mary University of London, London, UK, January 6–7, 2011.

Third Annual Winedale Workshop on *High-Dimensional Statistical Problems*, Winedale Conference Center, Round Top, TX, October 15, 2010.

Interdisciplinary Workshop on *Modern Mathematical Methods for High-Dimensional Data*, Vrije Universiteit Brussel, Brussels, Belgium, April 6–10, 2010.

Wavelets Mini Course, Rice University, Houston, TX, May 20–21, 2009.

Workshop on *Nonlinear approximation techniques using L1*, Department of Mathematics, Texas A&M University, College Station, TX, May 16–18, 2008.