

Reinhard Heckel

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Research interests

Machine learning, statistical learning theory, signal processing, high-dimensional statistics, sparse signal recovery, compressive sensing.

Education

- 08/2010 - **ETH Zurich**, Zurich, Switzerland.
- 10/2014 Ph.D. in Electrical Engineering
 - Thesis: “Sparse signal processing: Subspace clustering and system identification”
 - Advisor: Prof. Helmut Bölcskei
 - Co-examiners: Prof. Peter Bühlmann (ETH Zurich) and Prof. Holger Boche (TU Munich)
- 09/2013 - **Stanford University**, Stanford, CA, United States.
- 12/2013 Visiting Ph.D. Student with Prof. Emmanuel Candès
- 10/2005 - **University of Ulm**, Ulm, Germany.
- 05/2010 Diploma (equiv. M.S. degree) in Electrical Engineering, **with Honors**

Awards and funding

- NSF IIS Small “Actively learning from the crowd”, amount awarded: \$474,322, 2018.
- ETH Zurich medal for outstanding Ph.D. thesis, 2015
- IBM first patent application invention achievement award, 2015
- Early Postdoc.Mobility fellowship from the Swiss National Science Foundation, 2014
- Best student paper award at the Int. Workshop on Comp. Systems Biology, 2012

Academic experience

- 08/2017 - **Rice University**, Houston, TX.
 - present Assistant Professor at the Department of Electrical and Computer Engineering
- 01/2016 - **University of California Berkeley**, Berkeley, CA.
 - 07/2017 Postdoc at the Department of Electrical Engineering and Computer Sciences
- 12/2014 - **IBM Research**, Zurich, Switzerland.
 - 12/2015 Researcher at the Department of Cognitive Computing & Computational Sciences
- 08/2010 - **ETH Zurich**, Zurich, Switzerland.
 - 11/2014 Research and teaching assistant at the Communication Technology Laboratory

Teaching

- Fall 2018, ELEC 578: Introduction to machine learning
- Spring 2018, ELEC 631: Deep networks for inference and estimation, jointly taught with Richard Baraniuk
- Fall 2017, ELEC 577: Optimization for data science

Publications

4 representative papers marked with *

Preprints

- *P1 **R. Heckel** and P. Hand “Deep decoder: Concise image representations from untrained non-convolutional networks,” arXiv, Oct. 2018.
- *P2 **R. Heckel**, N. B. Shah, K. Ramchandran, and M. J. Wainwright “Active ranking from pairwise comparisons and when parametric assumptions don’t help,” *under review at Ann. Stat., 2016*.
- P3 **R. Heckel**, W. Huang, P. Hand, V. Voroninski, “Deep Denoising: Rate-Optimal Recovery of Structured Signals with a Deep Prior,” arXiv:1805.08855, May. 2018.
- P4 **R. Heckel**, G. Mikutis, and R. N. Grass, “A Characterization of the DNA Data Storage Channel,” arXiv:1803.03322, Mar. 2018.

Journal articles

- J1 **R. Heckel**, “An archive written in DNA,” Nature Biotechnology, 2018.
- J2 M. Vlachos, C. Duenner, **R. Heckel**, V.G. Vassiliadis, T. Parnell, K. Atasu, “Addressing interpretability and cold-start in matrix factorization for recommender systems,” IEEE Trans. on Knowl. and Data Eng., 2018.
- J3 N. Antipa, G. Kuo, **R. Heckel**, B. Mildenhall, E. Bostan, R. Ng, L. Waller, “Diffuser-Cam: Lensless single-exposure 3D imaging,” Optica, 2018.
- * J4 **R. Heckel** and M. Soltanolkotabi, “Generalized line spectral estimation via convex optimization,” *IEEE Trans. Inf. Theory*, 2018.
- J5 **R. Heckel**, M. Tschannen, and H. Bölcskei, “Dimensionality-reduced subspace clustering,” *Information and Inference: A Journal of the IMA*, 2017.
- J6 M. Vlachos, V.G. Vassiliadis, **R. Heckel**, A. Labbi, “Toward interpretable predictive models in B2B recommender systems,” *IBM Journal of Research and Development*, 2016.
- J7 **R. Heckel**, V. I. Morgenshtern, M. Soltanolkotabi, “Super-resolution radar,” *Information and Inference: A Journal of the IMA*, 2016.
- J8 **R. Heckel** and H. Bölcskei, “Robust subspace clustering via thresholding,” *IEEE Trans. Inf. Theory*, 2015.
- J9 D. Paunescu, C. A. Mora, L. Querci, **R. Heckel**, M. Puddu, B. Hattendorf, D. Günther, and R. N. Grass, “Detecting and number counting of single engineered nanoparticles by digital particle polymerase chain reaction,” *ACS Nano*, 2015, **selected by ACS as Editors Choice**.
- *J10 R. Grass, **R. Heckel**, M. Puddu, D. Paunescu, and W. J. Stark, “Robust chemical preservation of digital information on DNA in silica with error-correcting codes,” *Angewandte Chemie International Edition*, 2015, **featured in Nature as research highlight, press coverage by BBC, CNN, and IEEE Spectrum** ¹.

See for example the following BBC video on our research: <http://www.bbc.com/future/story/20151122-this-is-how-to-store-human-knowledge-for-eternity>.

- J11 **R. Heckel** and H. Bölcskei, “Identification of sparse linear operators,” *IEEE Trans. Inf. Theory*, 2013.
- J12 **R. Heckel**, S. Schober, and M. Bossert, “Harmonic analysis of Boolean networks: Determinative power and perturbations,” *EURASIP J. Bioinform. Syst. Biol.*, 2013.
- J13 J. Klotz, **R. Heckel**, and S. Schober, “Bounds on the average sensitivity of nested canalizing functions,” *PLoS ONE*, 2013.
- J14 S. Schober, D. Kracht, **R. Heckel**, and M. Bossert, “Detecting controlling nodes of Boolean regulatory networks,” *EURASIP J. Bioinform. Syst. Biol.*, 2011.

Refereed conference proceedings

- C1 **R. Heckel**, M. Simchowitz, K. Ramchandran, and M. Wainwright, “Approximate ranking from pairwise comparisons,” AISTATS, 2018.
- C2 **R. Heckel** and K. Ramchandran, “The sample complexity of online one-class collaborative filtering,” ICML 2017.
- C3 **R. Heckel**^{*}, I. Shomorony^{*}, K. Ramchandran, and D. Tse “Fundamental Limits of DNA Storage Systems,” ISIT 2017 (* denotes equal contribution).
- C4 **R. Heckel**, M. Vlachos, T. Parnell, and C. Dünner, “Scalable and interpretable product recommendations via overlapping co-clustering,” *ICDE 2017*.
- C5 **R. Heckel** and M. Vlachos, “Private and right-protected big data publication: An analysis,” *SIAM Data Mining 2017*.
- C6 **R. Heckel** and M. Soltanolkotabi, “Generalized Line Spectral Estimation for Radar and Localization,” *CoSeRa*, 2016, **invited paper**.
- C7 **R. Heckel**, “Super-resolution MIMO radar,” *ISIT, 2016*.
- C8 **R. Heckel**, M. Tschannen, and H. Bölcskei, “Subspace clustering of dimensionality reduced data,” *ISIT, 2014*.
- C9 A. Jung, **R. Heckel**, H. Bölcskei, and F. Hlawatsch, “Compressive nonparametric graphical model selection for time series,” *ICASSP*, 2014.
- C10 **R. Heckel**, E. Agustsson, and H. Bölcskei, “Neighborhood selection for thresholding based subspace clustering,” *ICASSP*, 2014.
- C11 **R. Heckel** and H. Bölcskei, “Noisy subspace clustering via thresholding,” *ISIT*, 2013.
- C12 **R. Heckel** and H. Bölcskei, “Subspace clustering via thresholding and spectral clustering,” *ICASSP*, 2013.
- C13 **R. Heckel** and H. Bölcskei, “Joint sparsity with different measurement matrices,” Allerton, 2012, **invited paper**.
- C14 **R. Heckel**, S. Schober, and M. Bossert, “Determinative power and tolerance to perturbations in Boolean networks,” *WCSB*, 2012, **best student paper award**.
- C15 **R. Heckel** and H. Bölcskei, “Compressive identification of linear operators,” *ISIT*, 2011.

- C16 S. Schober, **R. Heckel**, and D. Kracht, “Spectral properties of a Boolean model of the E. coli genetic network and its implication on network inference,” *WCSB*, 2010.
- C17 **R. Heckel**, S. Schober, and M. Bossert, “On random Boolean threshold networks,” *SCC*, 2010.
- C18 **R. Heckel** and S. Schober, “A Boolean genetic regulatory network created by whole genome duplication,” *WCSB*, 2009.

Patents

- P1 **R. Heckel**, V. Vasileiadis, and M. Vlachos, “Method and system for identifying dependent components”, US Patent 20,160,063,392, 2016.
- P2 **R. Heckel** and M. Vlachos, “The obfuscation and protection of data rights”, US 14/805514, filed July 2015.

Book Chapters

- B1 **R. Heckel**, “Super-resolution radar imaging via convex optimization”, Chapter in upcoming book “Compressed Sensing based Radar Signal Processing”, 2018.

Invited talks

- Sep. 2017, “Robust preservation of digital information on DNA with error correcting codes”, UT Austin, DNA23 conference, Microsoft Research Redmond.
- Jan. 2018
- Feb., “Robustness and complexity tradeoffs in inference and learning”, Rice University, University of Lugano, Aarhus University, Cornell, Cornell Tech, TU Munich.
- Mar. 2017
- Feb. 2017 “Active ranking from pairwise comparisons and when parametric assumptions dont help”, Information Theory and Applications Workshop.
- Jul., “Generalized line spectral estimation via convex optimization”, FAU Erlangen, RWTH Aachen, Germany
- Sep. 2016
- Feb. 2016 “Super-resolution radar and generalized line spectral estimation”, Communications, Networks & Systems Seminar at USC, Los Angeles, CA
- Sep. 2015 “Robust Data Storage in DNA with Error-Correcting Codes”, Leading Edge Embedded NVM Workshop, Gardanne, France
- Jun., “Super Resolution Radar”, FTW Telecommunications Forum, Vienna, Austria; EPFL-
- Mar. 2015 Idiap-ETH Sparsity Workshop, Lausanne, Switzerland
- May 2012 “Compressive identification of linear operators”, 6th IEEE Workshop on Advanced Information Processing for Wireless Communication, Copenhagen, Denmark