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Education

Ph.D., California Institute of Technology 2005–2011
Applied & Computational Mathematics Pasadena, CA
Adviser: Emmanuel Candès. Passed candidacy exam in 2006. Defended thesis April 7, 2011.

B.A.s, Wesleyan University 2001–2005
Math (high honors), and physics (high honors) Middletown, CT
Physics honors thesis adviser: Francis Starr. Mathematics honors talk adviser: Wai Kiu “Billy” Chan.

Academic positions

Assistant Professor 2015–present
Applied Math (and ECE dept., by courtesy) University of Colorado Boulder

Goldstine Postdoctoral Fellow 2013–2014
Dr. Naoki Abe (host) IBM Research, T. J. Watson research center

Postdoctoral Fellow, Fond. Sciences Math. de Paris 2011–2013
Prof. Patrick Combettes (host) Laboratoire Jacques-Louis Lions, UPMC Paris 6

Research Assistant 2006–2011
Prof. Emmanuel Candès (Ph.D. adviser) California Institute of Technology

Papers and talks

A dagger [†] indicates a student author. Reverse chronological order.

Journal publications (published, accepted or under minor revision)

15. *Time–Data Tradeoffs by Smoothing*, J. J. Bruer, J. A. Tropp, V. Cever, S. Becker. **IEEE J. Selected Topics in Signal Processing**, *accepted*
14. *Convex optimization for big data: Scalable, randomized, and parallel algorithms for big data analytics*, V. Cevher, S. Becker, and M. Schmidt, **IEEE Sig. Proc. Mag.** 31 (2014), no. 5, 32–43
13. *An Algorithm for Splitting Parallel Sums of Linearly Composed Monotone Operators, with Applications to Signal Recovery*, S. Becker and P. L. Combettes, **J. Nonlinear and Convex Analysis** 15 (2014), no. 1, 137–159.
12. *Improving IMRT delivery efficiency with reweighted l1-minimization for inverse planning*, H. Kim, S. Becker, R. Lee, S. Lee, S. Shin, E. Candès, L. Xing, and R. Li, , **Medical physics** 40 (2013), no. 7, 071719.
11. *A Compressed Sensing Parameter Extraction Platform for Radar Pulse Signal Acquisition*, J. Yoo, C. Turnes, E. Nakamura, C. Le, S. Becker, E. Sovero, M. Wakin, M. Grant, J. Romberg, A. Emami-Neyestanak, E. Candès, *accepted in* **IEEE J. Emerging Sel. Topics Circuits Systems (JETCAS)**.
10. *A Non-Uniform Sampler for Wideband Spectrally-Sparse Environments*, M. Wakin, S. Becker, E. Nakamura, M. Grant, E. Sovero, D. Ching, J. Yoo, J. Romberg, A. Emami-Neyestanak, E. Candès, *accepted in* **JETCAS** (special issue on Compressed Sensing).
9. *Dynamical Behavior Near a Liquid–Liquid Phase Transition in Simulations of Supercooled Water*, P. H. Poole, S. R. Becker, F. Sciortino, F. W. Starr, **J. Physical Chemistry B**, Vol. 115 No. 48, August 2011.
8. *Templates for Convex Cone Problems with Applications to Sparse Signal Recovery*, S. Becker, E. Candès, M. Grant, **Mathematical Programming Computation**, Vol. 3 No. 3, July 2011, <http://tfocs.stanford.edu>

7. *Practical Compressed Sensing: modern data acquisition and signal processing*, Ph.D. dissertation, April 2011, <http://resolver.caltech.edu/CaltechTHESIS:06022011-152525054>.
6. *NESTA: A Fast and Accurate First-order Method for Sparse Recovery*, S. Becker, J. Bobin, and E. Candès, **SIAM J. Imaging Sciences**, Vol. 4 No. 1, Jan 2011.
5. *Quantum State Tomography via Compressed Sensing*, D. Gross, Y-K. Liu, S. Flammia, S. Becker, and J. Eisert, **Physical Review Letters**, Vol. 105 No. 15, October 2010.
4. *Relation between the Widom line and the breakdown of the Stokes-Einstein relation in supercooled water*, P. Kumar, S.V. Buldyrev, S.R. Becker, P.H. Poole, F.W. Starr, and H.E. Stanley, **Proc. National Academy of Science**, Vol. 104, 9575–9579 (2007).
3. *Fractional Stokes-Einstein and Debye-Stokes-Einstein relations in a network forming liquid*, S. R. Becker, P.H. Poole and F. W. Starr, **Physical Review Letters**, Vol. 97 No. 5., August 2006.
2. *Translational and Rotational Dynamics of Supercooled Water*, undergraduate physics honor thesis, April 2005, available at http://ugcs.caltech.edu/~srbecker/thesis_Wesleyan.pdf
1. *The Dynamics of Falling Dominoes*, S. Wagon, A. Pontarelli, S. Becker and W. Briggs, **UMAP Journal**, Vol. 26 No. 1, 2005, pp. 37–48.

Refereed Conference Papers

13. *General Optimization Framework for Robust and Regularized 3D FWI*, S. Becker, L. Horesh, A. Aravkin, E. van den Berg, S. Zhuk, accepted as extended abstract at **EAGE** (Madrid, Spain, June 2015)
12. *Time–data tradeoffs by aggressive smoothing*, J. J. Bruer, J. A. Tropp, V. Cevher, and S. Becker, Advances in Neural Information Processing Systems (**NIPS**), 2014, pp. 1664–1672.
11. *Quic & dirty: A quadratic approximation approach for dirty statistical models*, C.-J. Hsieh, I. S. Dhillon, P. K. Ravikumar, S. Becker, and P. A. Olsen, Advances in Neural Information Processing Systems (**NIPS**), 2014.
10. *A variational approach to stable principal component pursuit*, A. Aravkin, S. Becker, V. Cevher, and P. Olsen, Uncertainty in Artificial Intelligence (**UAI**), (Quebec City), 2014.
9. *Metric learning with rank and sparsity constraints*, B. Bah, V. Cevher, S. Becker, and B. Gözcü, Proceedings of the 2014 IEEE International Conference on Acoustics, Speech, and Signal Processing (**ICASSP**), 2014.
8. *A proximal splitting method for inf-convolutive variational models in image recovery*, S. Becker and P. L. Combettes, accepted in **ICIP** (September 2013, Melbourne).
7. *Scalable and accurate quantum tomography from fewer measurements*, S. Becker, V. Cevher, **SPARS** (July 2013, Lausanne).
6. *Randomized Singular Value Projection*, S. Becker, V. Cevher, A. Kyrillidis, **SampTA** (July 2013, Bremen). Extended abstract.
5. *Sparse Projections onto the Simplex*, S. Becker, V. Cevher, C. Koch, A. Kyrillidis, **ICML** (June 2013, Atlanta), spotlight presentation.
4. *A Quasi-Newton Proximal Splitting Method*, S. Becker and J. Fadili, **NIPS** (Dec 2012, Lake Tahoe), awarded a spotlight presentation.
3. *Sparse Projections onto the Simplex*, A. Kyrillidis, S. Becker and V. Cevher, **NIPS Workshop on Discrete Optimization in Machine Learning** (Dec 2012, Lake Tahoe).
2. *A 100MHz-2GHz 12.5x sub-Nyquist Rate Receiver in 90nm CMOS*, J. Yoo, S. Becker, M. Loh, M. Monge, E. Candès, A. Emami-Neyestanak, **RFIC** (May 2012, Montreal, Canada).
1. *Design and implementation of a fully integrated compressed-sensing signal acquisition system*, J. Yoo, S. Becker, M. Monge, M. Loh, E. Candès, A. Emami-Neyestanak, **ICASSP** (March 2012, Kyoto, Japan).

Invited Talks

35. “Matrix-Free Solvers for Robust PCA and Distance Matrix Completion”, SIAM Conference on Computational Science and Engineering, Salt Lake City, March 15 2015.
34. “A Quasi-Newton Proximal Splitting Method”, Rocky Mountain INFORMS chapter, March 11 2015.
33. “Matrix Completion and Robust PCA”, University of Colorado Boulder, Institute of Cognitive Science colloquium, Boulder, CO. March 6 2015.
32. “Sketching and Smoothing: robust sketching, and smoothing for time-data trade-offs”, Colorado State University, Statistics department colloquium, Jan 26 2015
31. “Robust Compressed Least Squares Regression”, NIPS 2014 workshop “Robustness: Out of the Box”, Montreal, Canada. Dec 12, 2014.
30. “Matrix Completion and Robust PCA”, University of Colorado Boulder, Computer Science department colloquium, Boulder, CO. Nov 20 2014.
29. “Optimization for machine learning and compressed sensing”, Wesleyan University summer science seminar, Middletown, CT. July 18 2014
28. “A class of quasi-Newton methods for non-smooth/constrained problems”, SIAM Optimization 2014, San Diego, CA. May 22 2014
27. “The interplay of optimization and randomized linear algebra,” colloquium talk, Dept. of Industrial and Systems Engineering, Lehigh University, September 18 2013.
26. “Randomized singular value projection,” Fourth International Conference on Continuous Optimization (ICCOPT 2013), Lisbon, Portugal, August 1 2013.
25. “Compressed sensing for quantum tomography,” groupe de travail “Méthodes Mathématiques pour l’Imagerie” (Gabriel Peyré), CEREMADE, université Paris-Dauphine. June 2 2013.
24. “Compressed sensing for quantum tomography,” groupe de travail “Méthodes Numériques”, LJLL, Paris 6. June 3 2013.
23. “Compressed sensing for quantum tomography,” Seminar on interactions of Computer Science and Mathematics, LIP6 and LJLL at Paris 6. April 15 2013.
22. “Information extraction via optimization,” EECS, Colorado School of Mines. February 2012.
21. “Information extraction via optimization,” Numerical Analysis Group, Oxford. January 2012.
20. “A class of quasi-Newton methods for non-smooth/constrained problems,” NatImages workshop, Nice, France. July 2012.
19. “Improved first-order methods: how to handle constraints, non-smoothness, and slow convergence,” minisymposium, SIAM Linear Algebra, Valencia Spain. June 2012. Part of the 8-speaker minisymposium I organized at SIAM LA.
18. “A class of quasi-Newton methods for non-smooth/constrained problems, and sparse projections onto the simplex”, IPAM “Modern trends in optimization and its applications”, reunion conference. June 2012.
17. “Advances in first-order methods: constraints, non-smoothness and faster convergence,” minisymposium, SIAM Imaging Science, Philadelphia. May 2012.
16. “TFOCS: A General Framework for Constrained Optimization,” at an internal seminar for the JLL lab (Paris 6 University, Paris, France), March 2012.
15. “TFOCS: A General Framework for Constrained Optimization,” at Séminaire Parisien de Statistique (Institut Henri Poincaré, Paris, France), March 2012
14. “TFOCS: A General Framework for Constrained Optimization,” at Séminaire de Probabilités-Statistique (Lab. de Mathématiques de Besançon, Besançon, France), February 2012
13. “TFOCS: A General Framework for Constrained Optimization,” at journée SMAI-SIGMA (Paris 6 University, Paris, France), November 2011
12. “TFOCS: A General Framework for Constrained Optimization,” at EPFL seminar (Lausanne, Switzerland), October 2011

11. “TFOCS: A General Framework for Constrained Optimization,” at GREYC-ENSICAEN imaging seminar (Caen, France), October 2011
10. “TFOCS: A General Framework for Constrained Optimization,” at Laboratoire de Cosmologie et Statistiques seminar (CEA, Gif-sur-Yvette, France), October 2011
9. “Practical Design of a Random Demodulation Sub-Nyquist ADC,” at SPARS 2011, Edinburgh. June 2011.
8. “TFOCS: Flexible First-order Methods for Rank Minimization,” at “Low-rank matrix optimization” minisymposium, SIAM conference on Optimization, Darmstadt, Germany. May 2011.
7. “Practical Compressed Sensing: Applications and Optimization,” thesis defense, April 7 2011.
6. “TFOCS: A General Framework for Solving Constrained Optimization,” Sparse Statistics, Optimization and Machine Learning (11w5012) at Banff, Canada. Jan 2011.
5. “First-order methods for constrained linear inverse problems,” Canadian Mathematical Society winter meeting, Dec 2010
4. “Templates for convex cone problems,” UCLA IPAM “Modern Trends in Optimization and its Applications” seminar series, Nov 2010
3. “Algorithms for very large scale ℓ_1 minimization,” INFORMS, October 2009
2. “A generalization of Mason’s Theorem”, math honors talk at Wesleyan University, April 2005
1. “Translational and rotational dynamics of supercooled water”, condensed matter seminar at Wesleyan University, April 2005

Major software packages

5. fastRPCA, written in MATLAB. Solves a new formulation of robust PCA in an efficient manner. Released October 2014. BSD license. <https://github.com/stephenbecker/fastRPCA>
4. zeroSR1, written in MATLAB. A quasi-Newton approach for solving optimization programs. Released Feb 2014. BSD license. <http://amath.colorado.edu/faculty/becker/zeroSR1.html>
3. TFOCS, written in MATLAB. Solves wide variety of convex programs via modular first-order algorithms. Released fall 2010. BSD license. <http://tfocs.stanford.edu/>
2. NESTA, written in MATLAB. Solves the “basis pursuit”-type of inverse problem. Released summer 2009. Freely licensed. <http://www-stat.stanford.edu/~candes/nesta/>
1. SVT, written in MATLAB and C. Solves the “matrix completion” problem. Released fall 2008. Freely licensed. <http://svt.stanford.edu/>

Teaching Experience

Legend: Graduate classes are underlined

— **Instructor** positions at the **University of Colorado Boulder** —

APPM 5450 Applied Analysis II, spring 2015.

APPM 5440 Applied Analysis I, fall 2014.

— **Instructor** positions at the **California Institute of Technology** —

ACM 11 *Intro to Matlab and Mathematica*, co-instructor, fall quarter 2008.

— **Teaching Assistant** positions at the **California Institute of Technology** —

ACM/CS 114 Parallel Algorithms for Scientific Applications, winter quarter 2009/10.

ACM 105 Functional Analysis, spring quarter 2008.

ACM 104 Linear Algebra, winter quarter 2007/08.

ACM 11 *Intro to Matlab and Mathematica*, fall quarter 2007.

ACM 95/100 c *Intro to PDE*, spring quarter 2007.

ACM 104 Linear Algebra, graduate level, winter quarter 2006/07.

ACM 105 Functional Analysis, graduate level, fall quarter 2006.

— **Teaching Assistant** positions at **Wesleyan University** —

Introductory Physics, fall 2004

Quantum Mechanics, spring 2004

Discrete Math, spring 2004

Linear Algebra, spring 2003

Introductory Calculus, fall 2002

Introductory Physics, fall 2002

Introductory Physics, spring 2002

Students

1. Farhad Pourkamali-Anaraki, ECE department. January 2015 – present.

Defense committees

2. Comprehensive review, Farhad Pourkamali-Anaraki, January 2015.
1. PhD defense, Ramzi Zahreddine, (expected) April 2015.

University service

2. Undergraduate committee, Applied math department, 2014–2015 year.
1. Faculty-Student mentorship program (FSMP), 2014–2015 year.

Honors and Awards

8. Herman Goldstine Memorial Postdoctoral Fellowship from the Business Analytics and Mathematical Sciences Department of the IBM Thomas J. Watson Research Center, 2013–2014.
7. Postdoc fellowship from Foundation Sciences Mathématiques de Paris, 2011–2013.
6. W.P. Carey, co-winner, May 2011, for best dissertation in pure or applied mathematics, California Institute of Technology.
5. Bertman Prize, May 2005, for a senior physics major at Wesleyan University.
4. Graham Prize, co-winner, May 2005, for excellence in natural science at Wesleyan University.
3. Rice Prize, co-winner, May 2005, for excellence in math by a senior at Wesleyan University.
2. *Phi Beta Kappa*, early induction, November 2004.
1. Various math/physics prizes at Wesleyan, 2002–2004 (Rae Shortt Prize and Van Dyke prize, co-winner, Robertson Prize and Sherman Prize, honorable mention).

Memberships and professional activities

Reviewer for:

(in no particular order)

26. IEEE Trans. Image Processing
25. IEEE Trans. Info. Theory
24. IEEE Trans. Signal Processing
23. IEEE Signal Processing Letters
22. IEEE J. Selected Topics in Signal Processing
21. SIAM J. Optimization (SIOPT)
20. SIAM J. Imaging Sciences (SIIMS)
19. SIAM J. Scientific Computing (SISC)
18. Signal Processing
17. Signal Image and Video Processing

16. Optimization Methods and Software
15. J. Machine Learning Research
14. ISIT 2010 (IEEE International Symposium on Information Theory)
13. ICML 2013, 2014, 2015 (International Conference on Machine Learning)
12. Fields Institute Communications Series on Discrete Geometry and Optimization
11. Circuits, Systems & Signal Processing
10. Mathematical Programming Computation
9. IEEE Geoscience and Remote Sensing Letters
8. NIPS 2013, 2014
7. AISTATS 2014
6. Intl. J. Computer Vision
5. EUSIPCO 2014 conference
4. ICCASP 2014 conference
3. Electronic Transactions on Numerical Analysis (ETNA)
2. IEEE Sig. Proc. Society best paper award committee
1. Quantum Information Processing

Workshops organized

4. Co-organize (with D. Lorenz) “Solving ill-posed systems via signal-processing techniques” mini-symposium at SIAM Conference on Applied Linear Algebra. June 18-22, 2012 (Valencia, Spain)
3. Co-organize (with A. Lozano and A. Aravkin) “Out of the Box: Robustness in High Dimension” workshop at Neural Information Processing Systems (NIPS) conference, December 12 2014 (Montreal, Canada)
2. Co-organize (with L. Horesh) “Large-Scale Inversion and Uncertainty Mitigation” mini-symposium at SIAM Conference on Computational Science and Engineering (CSE15), March 14–18 2015, Salt Lake City, UT.
1. Organize “Efficient methods for sparse optimization” at International Symposium on Mathematical Programming (ISMP), July 12–17 2015, Pittsburgh, PA.

Misc

2. SIAM member (2008-present)
1. IEEE member (2010-present)

Feb 26 2015