

Stephen Becker

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Research topics: optimization, machine learning, signal processing, imaging, inverse problems in quantum information, PDE-constrained optimization, and randomized numerical linear algebra

Date: 2/3/2020

Education

California Institute of Technology

Ph.D., Applied & Computational Mathematics

Advisor: Emmanuel Candès

Pasadena, CA

2005–2011

Wesleyan University

B.A.'s, Math (high honors), and physics (high honors)

Physics thesis advisor: Francis Starr. Mathematics honors talk advisor: Wai Kiu “Billy” Chan.

Included study abroad in “Budapest Semesters in Math,” 2003

Middletown, CT

2001–2005

Academic Positions

University of Colorado

Assistant Professor, Dept. Applied Math

Prof. in Electrical Engineering by courtesy

Boulder, CO

2014–present

IBM Research

Goldstine Postdoctoral Fellow

T. J. Watson research center, Yorktown Heights, NY

2013–2014

Fond. Sciences Math. de Paris

Postdoctoral Fellow, UPMC Paris 6

Prof. Patrick Combettes (host)

Laboratoire Jacques-Louis Lions, Paris, France

2011–2013

Papers and talks

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

Journal publications (published or in press).....

24. *Optimization and Learning with Information Streams: Time-varying Algorithms and Applications*, E. Dall’Anese, A. Simonetto, S. Becker, L. Madden†, to appear May 2019 in **IEEE Signal Processing Magazine**.
23. *Safe Feature Elimination for Non-Negativity Constrained Convex Optimization*, J. Folberth†, S. Becker, **J. Optimization Theory and Applications (JOTA)**, 2019. [DOI link](#)
22. *Improved Fixed-Rank Nystrom Approximation via QR Decomposition: Practical and Theoretical Aspects*, F. Pourkamali-Anaraki†, S. Becker, **Neurocomputing**, 363(21), pp. 261–272, 2019. [DOI link](#)

21. *On Quasi-Newton Forward–Backward Splitting: Proximal Calculus and Convergence*, S. Becker, J. Fadili, P. Ochs, **SIAM J. Optimization** 29(4), 2445–2482, 2019. [DOI link](#)
20. *Stochastic Lanczos estimation of genomic variance components for linear mixed models*, R. Border[†], S. Becker. **BMC Bioinformatics**, 20(411), 2019, pp. 1–16. [DOI link](#)
19. *Adapting Regularized Low-Rank Models for Parallel Architectures*, D. Driggs[†], A. Aravkin, S. Becker. **SIAM J. Scientific Computing** vol 41(1), pp. A163–A189, Jan 2019. [DOI link](#)
18. *Template Polyhedra and Bilinear Optimization*, J. Gronski[†], M.-A. Ben Sassi, S. Becker, S. Sankaranarayanan. **Formal Methods in System Design (FORM)**, 2018, pp. 1–37. [DOI link](#)
17. *Achieving superresolution with illumination enhanced sparsity*, J.-Y. Yu, S. Becker, J. Folberth[†], B. F. Wallin, S. Chen, and C. J. Cogswell. **Optics Express** vol 26(8), pp. 9850–9865 (2018). [DOI link](#)
16. *Preconditioned Data Sparsification for Big Data with Applications to PCA and K-means*, F. Pourkamali-Anaraki[†], S. Becker, **IEEE Trans. Info. Theory** vol 63(5), pp. 2954 – 2974 (2017). [DOI link](#)
15. *Efficient Adjoint Computation for Wavelet and Convolution Operators*, J. Folberth[†], S. Becker, **IEEE Signal Processing Magazine**, vol 33(6), pp. 135–147 (2016). [DOI link](#)
14. *Dual Smoothing Techniques for Variational Matrix Decomposition*, S. Becker and A. Aravkin, pp. 3-1 – 3-34, in “Robust Low-Rank and Sparse Matrix Decomposition: Applications in Image and Video Processing”, T. Bouwmans, N. Aybat, E. Zahzah, eds. CRC Press, 2016. **(book chapter)**
13. *Designing Statistical Estimators That Balance Sample Size, Risk, and Computational Cost*, J. J. Bruer, J. A. Tropp, V. Cevher, S. Becker. **IEEE J. Selected Topics in Signal Processing**, 9 (2015), no. 4, 612–624. [DOI link](#)
12. *Convex optimization for big data: Scalable, randomized, and parallel algorithms for big data analytics*, V. Cevher, S. Becker, and M. Schmidt, **IEEE Signal Processing Magazine** 31 (2014), no. 5, 32–43. [DOI link](#)
11. *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.
10. *Improving IMRT delivery efficiency with reweighted l_1 -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. [DOI link](#)
9. *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, **IEEE J. Emerging Sel. Topics Circuits Systems (JETCAS)**, 2(3) pp. 626–638. 2012.
8. *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, **IEEE J. Emerging Sel. Topics Circuits Systems (JETCAS)**, 2(3) pp. 516–529. 2012.
7. *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.

6. *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>
5. *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.
4. *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.
3. *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).
2. *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.
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 (competitive journal-equivalent conferences, peer-reviewed).....

9. *Low-rank Tucker decomposition of large tensors using TensorSketch*, O. Malik[†], [S. Becker](#). Advances in Neural Information Processing Systems (**NIPS**), Dec. 2018, Montreal, Canada.
8. *Randomized Clustered Nystrom for Large-Scale Kernel Machines*, F. Pourkamali-Anaraki[†], [S. Becker](#), M. Wakin. Conference on Artificial Intelligence (**AAAI**), San Francisco, Feb 2018.
7. *Robust Compressed Least Squares*, [S. Becker](#), M. Petrik, B. Kawas. Conference on Artificial Intelligence (**AAAI**), San Francisco, Feb 6–9 2017.
6. *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.
5. *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.
4. *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.
3. *A proximal splitting method for inf-convolutive variational models in image recovery*, [S. Becker](#) and P. L. Combettes, *accepted in* International Conference on Image Processing (**ICIP**), (September 2013, Melbourne).
2. *Sparse Projections onto the Simplex*, [S. Becker](#), V. Cevher, C. Koch, A. Kyrillidis, International Conference on Machine Learning (**ICML**), (June 2013, Atlanta), spotlight presentation.
1. *A Quasi-Newton Proximal Splitting Method*, [S. Becker](#) and J. Fadili, Advances in Neural Information Processing Systems (**NIPS**), Dec 2012, Lake Tahoe, awarded a spotlight presentation.

Refereed Conferences (moderately competitive).....

8. *Online Sparse Subspace Clustering*, L. Madden[†], [S. Becker](#), Emiliano Dall’Anese. 2nd IEEE Data Science Workshop, **DSW**, Minneapolis, June 2019. [DOI link](#)

7. *Perturbed Proximal Descent to Escape Saddle Points for Non-convex and Non-smooth Objective Functions*, Z. Huang[†], S. Becker. **INNS Big Data and Deep Learning**, Genoa, Italy, 16-18 April 2019. [DOI link](#)
6. *A Randomized Approach to Efficient Kernel Clustering*, F. Pourkamali-Anaraki[†], S. Becker. IEEE Global Conference on Signal and Information Processing (**GlobalSIP**), accepted as lecture (not poster), Washington D.C., Nov 2016.
5. *Efficient Dictionary Learning via Very Sparse Random Projections*, F. Pourkamali-Anaraki[†], S. Becker, S. M. Hughes, in Sampling and Approximation Theory (**SampTA**) 2015.
4. *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.
3. *Randomized Singular Value Projection*, S. Becker, V. Cevher, A. Kyrillidis, in Sampling and Approximation Theory (**SampTA**) 2013, Bremen Germany.
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, Radio Frequency Integrated Circuits Symposium (**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, Proceedings of the 2012 IEEE International Conference on Acoustics, Speech, and Signal Processing (**ICASSP**), (March 2012, Kyoto, Japan).

Conferences (less competitive), Workshop Papers, Posters, Extended abstracts.....

13. *One-Pass Sparsified Gaussian Mixtures*, E. Kightley[†], S. Becker. In “Special Session” on Machine Learning in Big Data, at the 2019 IEEE International Conference on Big Data (**IEEE BigData 2019**) Dec 9-12, 2019, Los Angeles, CA
12. *Online Sparse Subspace Clustering*, L. Madden[†], S. Becker, E. Dall’Anese. In 2nd **IEEE Data Science Workshop**, June 2019 Minneapolis
11. *Estimating Active Subspaces with Randomized Gradient Sampling*, F. Pourkamali-Anaraki[†], S. Becker. In **SIAM Workshop on Dimension Reduction** Pittsburgh, PA, July 2017
10. *Surpassing Diffraction-Limited Resolution by Limiting the Illumination Field and Applying Image Analysis*, J.-Y. Yu, J. Xing, S. Chen, B. F. Wallin, J. Folberth[†], S. Becker, R. H. Cormack, U. Herzfeld, and C. J. Cogswell. In **FOM2017** Bordeaux, France, April 2017
9. *Scanning EPIC Microscopy: Toward Simultaneous Super-Resolution of Continuous 3D Fluorescent Structures at Speed*, C. J. Cogswell, J.-Y. Yu, S. Chen, J. Xing, R. H. Cormack, J. Folberth[†], S. Becker. In **FOM2017** Bordeaux, France, April 2017
8. *Is There an Optimized Point Spread Function for 3D Super-resolution Imaging?*, S. Chen, J.-Y. Yu, J. Xing, S. Becker, C. J. Cogswell. In Three-Dimensional Microscopy Conference, **SPIE Photonics West**, San Francisco, Jan/Feb 2017.
7. *Super-resolving 3D Fluorescent Objects using Reduced Excitation Regions and Numerical Optimization* (poster), S. Chen, J.-Y. Yu, J. Xing, S. Becker, M. Winey, C. J. Cogswell. In **Conference on Quantitative Bioluminescence Imaging (QBI)** in College Station, TX, USA, January 5–7 2017.

6. *PSF Engineering as a Tool for Three-Dimensional Super-Resolution Microscopy* (invited talk), C. J. Cogswell, J.-Y. Yu, S. Chen, J. Xing, R. Cormack, R. Zahreddine, S. Becker. In **Conference on Quantitative Biolmaging (QBI)** in College Station, TX, USA, January 5–7 2017.
5. *3D Super-resolution Microscopy using Reduced Excitation Regions and Numerical Optimization* (poster), S. Chen, J.-Y. Yu, J. Xing, S. Becker, M. Winey, C. J. Cogswell. In **Colorado Photonics Industries Association (CPIA) annual meeting**, Boulder CO, November 2016. Poster received first prize award
4. *EPIC microscopy generates 3D images of continuous structures without changing focus*, J.-Y. Yu, S. Chen, J. Xing, R. N. Zahreddine, R. H. Cormack, B. Wallin, S. Becker, U. C. Herzfeld, C. J. Cogswell. In **SPIE Photonics West**, San Francisco, Feb 16 2016.
3. *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)
2. *Scalable and accurate quantum tomography from fewer measurements*, S. Becker, V. Cevher, **SPARS** (July 2013, Lausanne, Switzerland).
1. *Sparse Projections onto the Simplex*, A. Kyrillidis, S. Becker and V. Cevher, **NIPS Workshop on Discrete Optimization in Machine Learning** (Dec 2012, Lake Tahoe).

Theses.....

2. *Practical Compressed Sensing: modern data acquisition and signal processing*, Ph.D. dissertation, April 2011, <http://resolver.caltech.edu/CaltechTHESIS:06022011-152525054>.
1. *Translational and Rotational Dynamics of Supercooled Water*, undergraduate physics honor thesis, April 2005, available at http://ugcs.caltech.edu/~srbecker/thesis_Wesleyan.pdf

Invited Talks (§indicates conference minisymposium or equivalent, i.e., unfunded).....

36. “Stochastic Subspace Descent”, Derivative Free Optimization Symposium (DFOS), University of British Columbia, Okanagan Campus (Canada), Aug 10–14, 2020.
35. “One-pass stochastic Tucker decompositions” (exact title TBD), “mathematics for complex data”, KTH, Stockholm, June 8–11, 2020.
34. “Stochastic Subspace Descent”, Nonlinear analysis seminar, North Carolina State University (NCSU), April 29 2020
33. §“Stochastic Subspace Descent”, Joint Mathematical Meetings (JMM), Denver January 2020, minisymposium on DFO.
32. “Randomized tensor decompositions”, U Mass Lowell CS Dept Machine Learning seminar (Sept 2019, Lowell, MA)
31. §“Stochastic Subspace Descent”, International Conference on Continuous Optimization (ICCOPT), (August 2019, Berlin, Germany)
30. §“Certifying accuracy and uniqueness in ill-conditioned imaging problems”, SIAM CS&E (February 2019, Spokane)
29. §“ADMM vs gradient methods and other issues in ill-conditioned imaging problems”, International Symposium on Mathematical Programming (ISMP), (July 2018, Bordeaux, France)
28. “Imaging, Optimization, and Randomness”, University of Colorado Boulder, Dept of Applied Math colloquium, March 3 2018.
27. §“Parallel Algorithms for Robust PCA Using Marginalization”, SIAM Conference on Optimization (May 2017, Vancouver, Canada)

26. "Efficient robust PCA algorithms for the GPU",
 - Colorado State University, Fort Collins, Dept. of Math, applied math seminar, Feb 2 2017.
 - U. North Carolina Chapel Hill, Dept. of Stat. and Operations Research colloquium, Nov 21 2016.
25. "Subsampling large datasets via random mixing", Colorado School of Mines, Dept. of Applied Math and Statistics Colloquium, Sept 2 2016.
24. "Applications of randomized sketching to subsampling, robust regression and linear algebra", Simons Seminar, UT Austin. Nov 20 2015.
23. "Matrix Completion and Robust PCA"
 - University of Colorado Boulder, Center for Computational Language and Education Research (CLEAR). Sept 16 2015.
 - University of Colorado Boulder, Institute of Cognitive Science colloquium, Boulder, CO. March 6 2015.
 - University of Colorado Boulder, Computer Science department colloquium, Boulder, CO. Nov 20 2014.
22. §"Solving Constrained and Non-Smooth Problems with Efficient Dual Techniques", International Symposium on Mathematical Programming (ISMP), Pittsburgh, July 16 2015.
21. §"Matrix-Free Solvers for Robust PCA and Distance Matrix Completion", SIAM Conference on Computational Science and Engineering, Salt Lake City, March 15 2015.
20. "A Quasi-Newton Proximal Splitting Method", Rocky Mountain INFORMS chapter, March 11 2015.
19. "Sketching and Smoothing: robust sketching, and smoothing for time-data trade-offs", Colorado State University, Statistics department colloquium, Jan 26 2015
18. §"Robust Compressed Least Squares Regression", NIPS 2014 workshop "Robustness: Out of the Box", Montreal, Canada. Dec 12, 2014.
17. "Optimization for machine learning and compressed sensing", Wesleyan University summer science seminar, Middletown, CT. July 18 2014
16. "A class of quasi-Newton methods for non-smooth/constrained problems",
 - §SIAM Optimization 2014, San Diego, CA. May 22 2014
 - NatImages workshop, Nice, France. July 2012.
15. "The interplay of optimization and randomized linear algebra," colloquium talk, Dept. of Industrial and Systems Engineering, Lehigh University, September 18 2013.
14. §"Randomized singular value projection," Fourth International Conference on Continuous Optimization (ICCOPT 2013), Lisbon, Portugal, August 1 2013.
13. "Compressed sensing for quantum tomography,"
 - groupe de travail "Méthodes Mathématiques pour l'Imagerie" (Gabriel Peyré), CEREMADE, université Paris-Dauphine. June 2 2013.
 - groupe de travail "Méthodes Numériques", LJLL, Paris 6. June 3 2013.
 - Seminar on interactions of Computer Science and Mathematics, LIP6 and LJLL at Paris 6. April 15 2013.
12. "Information extraction via optimization,"
 - Applied Math, University of Colorado. November 2013.
 - EECS, Colorado School of Mines. February 2012.
 - Numerical Analysis Group (Mathematical Institute), University of Oxford. January 2012.
11. §"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.
10. "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.

9. §“Advances in first-order methods: constraints, non-smoothness and faster convergence,” minisymposium, SIAM Imaging Science, Philadelphia. May 2012.
8. “TFOCS: A General Framework for Constrained Optimization,”
 - internal seminar for the JLL lab (Paris 6 University, Paris, France), March 2012.
 - Séminaire Parisien de Statistique (Institut Henri Poincaré, Paris, France), March 2012
 - Séminaire de Probabilités-Statistique (Lab. de Mathématiques de Besançon, Besançon, France), February 2012
 - journée SMAI-SIGMA (Paris 6 University, Paris, France), November 2011
 - EPFL seminar (Lausanne, Switzerland), October 2011
 - GREYC-ENSICAEN imaging seminar (Caen, France), October 2011
 - Laboratoire de Cosmologie et Statistiques seminar (CEA, Gif-sur-Yvette, France), October 2011
 - Sparse Statistics, Optimization and Machine Learning (11w5012) at Banff, Canada. Jan 2011.
7. §“Practical Design of a Random Demodulation Sub-Nyquist ADC,” at SPARS 2011, Edinburgh. June 2011.
6. §“TFOCS: Flexible First-order Methods for Rank Minimization,” at “Low-rank matrix optimization” minisymposium, SIAM conference on Optimization, Darmstadt, Germany. May 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

Funding

As PI.....

\$356,994, as PI	2019–’22
<i>NSF (MPS>DMS, AMPS-Algorithms for Modern Power Systems). With E. Dall’Anese as Co-PI</i>	
“AMPS: Online and Model-Free Optimization of Power and Energy Systems”, award # 1923298, 8/1/19 – 7/31/22	
\$150,000, as PI	2018–’22
<i>NSF (MPS>DMS, Computational Math). Single investigator</i>	
“Information Extraction from Scientific Simulations”, award # 1819251, 8/1/18 – 7/31/21	
\$4,060, as PI	2018
<i>CU Office for Outreach and Engagement</i>	
“2018 CU/Northrop-Grumman/St.Vrain STEM Camp” Community Impact Grant	
\$50,000, as PI	2018
<i>Northrop Grumman. Single investigator</i>	
“Analytic Techniques for Signal Processing Efficiencies”, CY ’18	
\$49,977, as PI	2017
<i>CU Innovative Seed Grant Program (ISGP). With T. Murray as Co-PI</i>	
“Blind Structured Illumination Photoacoustic Microscopy with Compressed Sensing”, AY ’17–’18	
\$100,000, as PI	2017
<i>Northrop Grumman. Single investigator</i>	
“Analytic Techniques for Signal Processing Efficiencies”, CY ’17	
\$52,000, as PI	2016–’17
<i>Bloomberg. Spring 2016, unrestricted gift. Single investigator</i>	
“Online clustering of time-sensitive data”	

As Co-PI or Senior Personnel	
\$365,000, as Co-PI	2018–'22
<i>NSF (ENG>ECCS, Electronic, Photonic and Magnetic Devices); PI T. Murray</i>	
"Photoacoustic Imaging in Optically Diffusive Media Using Structured Illumination", award # 1810314, 8/15/18–8/14/22	
1 shared postdoc, as 1 of 4 Co-PIs	2018–'19
<i>Argonne ALCF Aurora Early Science Program for Data and Learning; PI Ken Jansen</i>	
"Data Analytics and Machine Learning for Exascale CFD"	
\$30,000, as 1 of 2 Co-PIs	2018
<i>CU Imaging Science IRT; PI Carol Cogswell</i>	
"A transformative approach to microscopy imaging that links breakthroughs in nanoparticle contrast agent development to innovations in computational optical super-resolution imaging"	
\$10,000, as 1 of 2 Co-PIs	2018
<i>CU Imaging Science IRT; PI Kelvin Wagner</i>	
"Fourier Telescopic Imaging through Turbulence: Self-Cal vs TAFT"	
\$350,000, as Co-PI	2015–'18
<i>NSF. PI: Sriram Sankaranarayanan (CU-Boulder)</i>	
"SHF: Small: Bilinear Constraint Solving and Optimization for Program Verification and Synthesis Problems", 9/1/2015 – 8/31/2018	
200,000 Swiss Francs, as Sr. Personnel	2013–'16
<i>Swiss NSF, senior personnel. PI: Volkan Cevher (EPFL, Lausanne)</i>	
"Scalable and Accurate Quantum Tomography"	

Teaching

Legend: Graduate classes are underlined. All classes are full credit (i.e., at CU, 3 credit hours) unless otherwise noted. Number of students is approximate.

Instructor positions at U. Colorado Boulder

- Fall 2016 – Spring 2020. APPM 8500 Statistics, Optimization and Machine Learning seminar. Co-listed with CSCI 7000 (Rafael Frongillo). 1 credit (no teaching credit). Secured funding for external speakers.
- Spr 2020. APPM 7400 Special Topics: Theoretical Machine Learning. 16 students, plus about 5 auditing.
- Fall 2019. APPM 5440 Applied Analysis I. 19 students.
- Spr 2019. APPM 4720/5720 Special Topics: Randomized Algorithms. 20 students enrolled, plus about 8 auditing.
- Fall 2018. APPM 2360 Differential Equations with Linear Algebra. 2 sections (about 80 and 100 students each). Course coordinator for all sections (joint with Bengt Fornberg).
- Spr 2018. APPM 4720/5720 Special Topics: Advanced Convex Optimization. 10 students enrolled, about 8 auditing.
- Spr 2018. APPM 5450 Applied Analysis II. 15 students.
- Fall 2017. APPM 5440 Applied Analysis I. 20 students.
- Fall 2017. APPM 1350 Calculus I. 120 students.

- Spr 2016. APPM 4720/5720 *Special Topics: Advanced Convex Optimization*, spring 2016. 25 students. **new course**
- Fall 2016. APPM 2360 *Differential Equations with Linear Algebra*. 2 sections, both about 130 students. Course coordinator for all sections.
- Spr 2016. APPM 5450 *Applied Analysis II*. 20 students.
- Spr 2016. APPM 2360 *Differential Equations with Linear Algebra*, spring 2016. 130 students.
- Spr 2015. APPM 5450 *Applied Analysis II*. 20 students.
- Fall 2014. APPM 5440 *Applied Analysis I*. 20 students.

Invited courses outside of U. Colorado Boulder.....

- “First-order methods for large scale optimization problems”, 6-hours of lectures, AIMS South Africa workshop, part of AIMS Spring School on the Mathematics of Data Science organized by Bubacarr Bah and Holger Rauhut; Muizenberg, Cape Town, South Africa. September 23–27 2019
- “First-order methods for large scale optimisation problems”, 8-hours of lectures, CCIMI short-course, given at the University of Cambridge (UK), June 4 – June 15, 2018.

Instructor positions at the California Institute of Technology.....

- ACM 11 *Intro to Matlab and Mathematica*, co-instructor, fall quarter 2008. 1 credit.

Teaching Assistant positions at the California Institute of Technology.....

- ACM/CS 114 *Parallel Algorithms for Scientific Applications*, winter 2009/10
- ACM 105 *Functional Analysis*, spring 2008
- ACM 104 *Linear Algebra*, winter 2007/08
- ACM 11 *Intro to Matlab/Mathematica*, fall 2007
- ACM 95/100c *Intro to PDE*, spring 2007
- ACM 104 *Linear Algebra*, winter 2006/07
- ACM 105 *Functional Analysis*, fall 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

Postdocs.....

- Farhad Pourkamali-Anaraki, co-advised with Michael Wakin (Colorado School of Mines). March 2017 – June 2018. Now tenure-track professor at U. Mass Lowell.

PhD students (× indicates co-advised student).....

- Farhad Pourkamali-Anaraki, ECE department. January 2015 – March 2017. Now tenure-track at U. Mass Lowell.
- James Folberth, Applied math department. September 2015 – October 2018. Now works at ICR, Inc.
- Jessica Gronski, Applied math department. September 2015 – April 2019. Now works at United Health Care.

- Eric Kightley, Applied math department. June 2017 – April 2019. Now works at Respond Software.
- Osman Malik, Applied math department. June 2017 – **present**.
- Zhishen (Leo) Huang, Applied math department, June 2018 – **present**.
- Richard Clancy, Applied math department, Jan 2019 – **present**.
- Erik Johnson, Applied math department, May 2019 – **present**.
- Akshay Seshadri, Physics math department, Jan 2019 – **present**.
- × David Kozak, *co-advised*, Applied Math & Stat., Colorado School of Mines (principal advisor: Luis Tenorio), Jan 2018 – **present**.
- × Liam Madden, *co-advised*, Applied math department, (co-advisor: Emiliano Dall’Anese), March 2018 – **present**.

MS students.....

- Derek Driggs, Applied math department, BS/MS. June 2015 – Sept 2017. Now PhD candidate at Cambridge as a Gates Cambridge Scholar.
- Richard Border, MS in applied math (fall 2018), (concurrently worked toward PhD in Psychology and Neuroscience with M. Keller)
- Marc Thomson, MS in applied math (spring 2019). Now at ExxonMobil Research and Engineering.
- × J. Matt Maierhofer, MS in applied math (primarily advised by Michael Mozer, CS dept) (spring 2019)

Other.....

Undergraduate research projects, summer: Cheryl Hansen '17–'19, Abby Schmid '17, Ashley Nelson '17, Will Shand '18–'19, John Tucker '19, Israel Miles '19

Undergraduate research projects via DLA: Derek Driggs ('15–'17, BS/MS), Ben van Court ('15–'16, DLA and UROP), Raymond Duncan ('16), Jeffrey Everett ('17–'18)

Non-thesis graduate research projects: Aswin Karna ('15, MS, ECEE), Naga Elluri ('16, MS, ECEE), Wenqi (Flora) Zhang ('15, PhD)

Honors and Awards

- 2019 Top 400 NeurIPS (formerly NIPS) reviewer (of about 4500) and given free registration
- 2017 NIPS Reviewer award (75 awards given among 2078 reviewers, <https://nips.cc/Conferences/2017/Awards>)
- 2017 Marinus Smith Award (internal CU award, “recognizes faculty and staff members who have had a particularly positive impact on our students”)
- 2015 ICML Reviewer Award (for going “above and beyond in your duties as a reviewer”)
- 2015 Beale Orchard-Hays Prize of the Mathematical Optimization Society for 2011 paper co-authored with E. Candès and M. Grant. Details <http://www.mathopt.org/?nav=boh>; prize awarded every three years.
- Herman Goldstine Memorial Postdoctoral Fellowship from the Business Analytics and Mathematical Sciences Department of the IBM Thomas J. Watson Research Center, 2013–2014.
- Postdoc fellowship from Foundation Sciences Mathématiques de Paris, 2011–2013.

- W.P. Carey, co-winner, May 2011, for best dissertation in pure or applied mathematics, California Institute of Technology.
- Bertman Prize, May 2005, for a senior physics major at Wesleyan University.
- Graham Prize, co-winner, May 2005, for excellence in natural science at Wesleyan University.
- Rice Prize, co-winner, May 2005, for excellence in math by a senior at Wesleyan University.
- *Phi Beta Kappa*, early induction, November 2004.
- 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, Professional Activities, and Scholarly Service

Associate editor (or equivalent) for journals/conferences.....

- Mathematical Programming Computation (MPC), on editorial board as a Technical Editor since Dec 2019
- ICML, area chair in 2018 (aka meta-reviewer, similar to associate editor)

Reviews for competitive conferences, typical year since 2014:.....

- ICML (5 to 8 papers, 8 pages each); area chair for ICML 2018
- NIPS (5 to 7 papers, 8 pages each)
- AISTATS (4 to 6 papers, 8 pages each)
- ICLR (2 to 6 papers, 8 pages each)

Journals reviewed (in no particular order).....

36. Information and Inference: A Journal of the IMA
35. Advances in Computational Mathematics
34. Lecture Notes in Mathematics (2018, 350+ pages)
33. IEEE Trans. Image Processing (IEEE TIP)
32. IEEE Trans. Info. Theory (IEEE TIT)
31. IEEE Trans. Signal Processing (IEEE TSP)
30. IEEE Signal Processing Letters
29. IEEE J. Selected Topics in Signal Processing
28. IEEE Geoscience and Remote Sensing Letters
27. IEEE Sig. Proc. Society best paper award committee
26. SIAM J. Optimization (SIOPT)
25. SIAM J. Imaging Sciences (SIIMS)
24. SIAM J. Scientific Computing (SISC)
23. SIAM J. on Mathematics of Data Science (SIMODS).
22. SIAM J. Matrix Analysis and Applications (SIMAX)
21. Signal Processing
20. Signal Image and Video Processing
19. Optimization Methods and Software
18. J. Machine Learning Research (JMLR)
17. J. Optimization Theory and Applications (JOTA)
16. ISIT 2010 (IEEE International Symposium on Information Theory)
15. Fields Institute Communications Series on Discrete Geometry and Optimization
14. Circuits, Systems & Signal Processing
13. Mathematical Programming Computation (MPC)
12. Intl. J. Computer Vision
11. EUSIPCO 2014 conference
10. ICCASP 2014 conference

9. Electronic Transactions on Numerical Analysis (ETNA)
8. Quantum Information Processing (QIP)
7. J. of Math. Imaging and Vision
6. Applied and Computational Harmonic Analysis (ACHA)
5. Physica A
4. LVA ICA 2018
3. Transactions on Pattern Analysis and Machine Intelligence (TPAMI)
2. Soft Computing
1. assorted book chapters

Workshops organized.....

- Co-organize (with L. Tenorio), “SIAM Minisymposium on Derivative Free Optimization for High-Dimensional Problems”, AMS/MA Joint Mathematical Meetings, Jan 2020, Denver.
- Program committee for “Workshop on Robust Subspace Learning and Computer Vision”, RSL-CV, at ICCV 2015 (Santiago, Chile)
- 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)
- 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)
- 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.
- Organize “Efficient methods for sparse optimization” at International Symposium on Mathematical Programming (ISMP), July 12–17 2015, Pittsburgh, PA.
- Organize “Advances in Large-Scale Nonsmooth Optimization” at fifth International Conference on Continuous Optimization (ICCOPT), Tokyo, Japan. Aug 7–11, 2016.

Misc.....

- SIAM member (2008-present)
- IEEE member (2010-present)

Languages

English: Native

French: Conversational

Spanish: Basic

Major software packages

6. Sparsified K-means, written in MATLAB and C. Uses new sub-sampling ideas to speed up computation. Released Fall 2015. MIT license. <https://github.com/stephenbecker/SparsifiedKMeans>. #9 result of 4,613 total on github when searching for “kmeans” (all languages, “best match”, 02/07/2019) and #1 result in Matlab.
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/>