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Degrees:

Ph.D., Mathematics, University of California, Berkeley, 1999.
M.A., Mathematics, University of California, Berkeley, 1994.
B.Sc. (Hons.), Mathematics, University of Manitoba, 1993.

Grants and Awards:

UC Laboratory Fees Research grant, "Sparse modeling for high dimensional data," LANL PI, $1.5M, July 2012–June 2015.
LANL Directed Research grant, "Hierarchical sparse models for robust analysis of video data," co-PI, $5.28M, FY2012–FY2014.
LANL Exploratory Research grant, "Let the data choose the signatures," PI, $200K, FY2011.
LANL Exploratory Research grant, "Nonconvex compressed sensing," PI, $900K, FY2008–FY2010.
LANL Certificate of Appreciation, R&D 100 Awards Entry "Muon Tomography Scanner," 2007.
LANL Programmatic Impact Award, 2006.
LANL Teamwork Award, 2005.
UC Berkeley Mathematics Department Research Fellowship, 1998.
Teaching Effectiveness Award, UC Berkeley, 1996–97.
Outstanding Graduate Student Instructor Award, UC Berkeley, 1996–97.
Earl C. Anthony Fellowship, UC Berkeley, 1995.
Governor General's Medal for best graduating bachelor's student at the University of Manitoba, 1993.

Research Experience:

Technical Staff Member/Scientist 3, Los Alamos National Laboratory, September 2005–present. Working on compressive sensing, image/signal reconstructions from very few data, video analysis, optimization, image restoration, modeling the geometry of images and image processes in high dimensions, novel forms of image reconstruction, radiographic inversions, data-informed regularizations, and novel forms of tomography.

Postdoctoral Research Associate, Los Alamos National Laboratory, October 2003–September 2005. Worked on new regularization methods for image reconstruction, developed image warping algorithm for solving the Monge-Kantorovich problem; applied support-vector machine classification to cosmic-ray muon-scattering data for detection of nuclear material.

Research Assistant Professor, University of Illinois at Chicago, Fall 2000–Spring 2002. Operators on holomorphic function spaces, sequential dynamical systems.

Visiting Assistant Professor, Middlebury College, Fall 1999–Spring 2000. Operators on and structure of holomorphic function spaces.

Graduate Student, UC Berkeley, Fall 1993–Summer 1999. Operators on and structure of holomorphic function spaces.

Teaching Experience:

Research Assistant Professor, University of Illinois at Chicago, Fall 2000–Spring 2002. Calculus I, Multivariable Calculus, Linear Algebra I and II.

Visiting Assistant Professor, Middlebury College, Fall 1999–Spring 2000. Calculus I and II, Multivariable Calculus, How to Read and Write Proofs, Measure and Integration.

Instructor, UC Berkeley, Summers 1994–1999, Fall 1996, Spring 1998. Precalculus, Calculus, Introduction to Analysis.

Teaching Assistant, UC Berkeley, Fall 1993–Spring 1999. Calculus, Honors Calculus, Analytic Geometry and Calculus, Linear Algebra, Multivariable Calculus, Introduction to Topology and Analysis.

Teaching Assistant, University of Manitoba, Fall 1990–Winter 1993. Calculus I, II, IIIA, and IIIB, Honors Calculus, Linear Algebra. Total of 54 discussion sections (5–10 per week) over 6 semesters and two summers.

Students Advised

Huiyi Hu, Summer 2013. 1 paper [2]. Currently a Ph.D. student at UCLA.

Alan Mackey, Summer 2013. 2 papers in preparation. Currently a Ph.D. student at UCLA.

Joe Woodworth, Summer 2013. 1 paper in preparation. Currently a Ph.D. student at UCLA.

Valentina Staneva, Fall 2006–Summer 2007. 4 published papers [21, 26, 28, 34] with 176 citations and a technical report. Currently a Ph.D. student at Johns Hopkins University, Center for Imaging Science.

Triet Le, Summer 2005. One published paper [31] with 115 citations. Currently a Lecturer at the University of Pennsylvania, Department of Mathematics.

Invited Presentations:

"Sparse image reconstruction and the high-dimensional geometry of video." St. Mary's College of Maryland, Math Club, January, 2014.

"Generalized shrinkage and penalty functions." Joint Mathematics Meetings, Baltimore, Maryland, January 2014.

"New algorithms for image reconstruction via nonconvex optimization.' 'Applied Mathematics Colloquium, UCLA, November 2013.

"Nonconvex compressive sensing for X-ray CT: an algorithm comparison." Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, California, November, 2013.

"A comparison of algorithms for nonconvex compressive sensing." Center for Domain-Specific Computing, UCLA, March 2013.

"Nonconvex optimization for extracting information from high-dimensional data." Workshop on Statistical Image Analysis, Santa Fe, New Mexico, March 2013.

"Nonconvex optimization and the high-dimensional geometry of video." Applied Mathematics Colloquium, UCLA, January 2013.

"Mathematics careers in industry and government." University of Wisconsin-Stout REU, July 2012.

"Image processing and reconstruction." University of Wisconsin-Stout REU, July 2012.

"Nonconvex compressive sensing: fast, easy, and better." Compressive Sensing Workshop, UCLA, March, 2012.

"Splitting algorithms for nonconvex, matrix optimization." Joint Mathematics Meetings, Boston, Massachusetts, January 2012.

"Information extraction from data using nonconvex optimization." Department of Mathematics Colloquium, Tulane University, November, 2011.

"Nonconvex splitting algorithms for information extraction." Applied and Computational Mathematics Seminar, Georgia Tech University, September, 2011.

"Nonconvex splitting algorithms and video decomposition." Duke Workshop on Sensing and Analysis of High-Dimensional Data, Durham, North Carolina, July 2011.

"Information extraction from high-dimensional data." New Mexico Workshop on Monte Carlo for Particle Therapy Treatment Planning, Albuquerque, New Mexico, May 2011 (keynote address).

"Information extraction from few, corrupted data." University of New Mexico, Computer Science Colloquium, April 2011.

"Nonconvex optimization for image reconstruction." Claremont Colleges Mathematics Colloquium, October 2010.

"Nonconvex compressive sensing and Dvoretzky's Theorem for quasi-normed spaces." 13th International Conference on Approximation Theory, San Antonio, Texas, March 2010.

"Nonconvex compressive sensing: getting the most from very little information." University of British Columbia Institute for Applied Mathematics, November 2009.

"Fast algorithms for nonconvex compressive sensing." Physics of Algorithms Conference, Santa Fe, New Mexico, September, 2009.

"Fast algorithms for nonconvex compressive sensing." International Symposium on Mathematical Programming, Chicago, Illinois, August, 2009.

"Fast algorithms for nonconvex compressive sensing." Compressive Sensing Workshop, Duke University, February, 2009.

"Nonconvex compressive sensing: getting the most from very little information (and the other way around)." Washington State University, Data Challenge Cooperative Lecture Series, November 2008.

"Nonconvex compressive sensing." Shanks Workshop, Vanderbilt University, October 2008.

"Nonconvex compressive sensing." University of New Mexico, Computer Science Colloquium, October 2008.

"Nonconvex compressive sensing: random vs. structured sampling." SIAM Conference on Imaging

Science, San Diego, California, July 2008.

"Nonconvex compressive sensing." SIAM Conference on Imaging Science, San Diego, California, July 2008.

"Nonconvex compressive sensing." INFORMS Optimization Conference, Atlanta, Georgia, March 2008.

"Nonconvex compressive sensing." Rice University, Electrical and Computer Engineering, Computer and Information Technology Institute, Dean of Engineering, and IEEE Signal Processing Society Colloquium, November 2007.

"Nonconvex minimization and compressed sensing." Second Mathematical Programming Society International Conference on Continuous Optimization, Hamilton, Ontario, August 2007.

"Nonconvex compressed sensing." AMS von Neumann Symposium, Snowbird, Utah, July 2007.

"Algorithms for total-variation regularization with general data fidelity terms." SIAM Conference on Imaging Science, Minneapolis, Minnesota, May 2006.

"A variational approach to reconstructing images corrupted by Poisson noise." AMS Section Meeting, Annandale-on-Hudson, New York, October 2005.

"A gradient descent solution to the Monge-Kantorovich problem." Clarkson University, Mathematics Colloquium, September 2004. Montana State University, DynaChat, September 2004. UCLA, Applied Mathematics Colloquium, October 2004. UC Berkeley, PDE seminar, October 2004. Georgetown University, Mathematics Colloquium, February 2005. LANL, DDMA Speaker Series, February 2005.

"Detecting nuclear materials from muon-scattering data." Montana State University, Physics Colloquium, September 2004. American Association for the Advancement of Science, Annual Meeting, February 2005. Institute for Pure and Applied Mathematics, Graduate Summer School, July 2005.

"Multipliers and Carleson Measures for $D(\mu)$." AMS Section Meeting, Birmingham, Alabama, October 2000. Joint Meetings, New Orleans, January 2001. Southeastern Analysis Meeting, Athens, Georgia, March 2001. Operators and Function Theory conference, Berkeley, January 2003.

"Toeplitz operators on $D(\mu)$." Joint Meetings, San Antonio, January 1999.

"Zero sets and invariant subspaces of Hilbert spaces of holomorphic functions." AMS Section meeting, Manhattan, Kansas, March 1998.

Professional Service:

Secretary, SIAM Activity Group on Imaging Science, Jan. 2008–Dec. 2009.

Lead Guest Editor, IEEE Journal of Selected Topics in Signal Processing, Special Issue on Compressive Sensing, April, 2010.

Referee for Acta Automatica Sinica, Applied Mathematics Research Express, Applied and Computational Harmonic Analysis, Computers & Chemical Engineering, Computers and Mathematics with Applications, EURASIP Journal on Advances in Signal Processing, IEEE Journal of Selected Topics in Signal Processing, IEEE Journal on Emerging and Selected Topics in Circuits and Systems, IEEE Signal Processing Letters, IEEE Transactions on Biomedical Engineering, IEEE Transactions on Image Processing, IEEE Transactions on Information Theory, IEEE Transactions

on Medical Imaging, IEEE Transactions on Neural Networks and Learning Systems, IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Transactions on Signal Processing, IET Signal Processing, Information Sciences, International Journal of Adaptive Control and Signal Processing, International Journal of Imaging Systems and Technology, Inverse Problems and Imaging, Inverse Problems, Journal of Computational Mathematics, Journal of Electrical and Computer Engineering, Journal of Electronic Imaging, Journal of Geophysical Research, Journal of Mathematical Imaging and Vision, Journal of Visual Communication and Image Representation, Journal of X-ray Science and Technology, Machine Vision and Applications, Mathematical Biosciences and Engineering, Mathematical Programming A, Mathematical and Computer Modelling, Mathematics of Computation, Neurocomputing, Optical Engineering, Research Letters in Signal Processing, Sensors, SIAM Journal on Imaging Sciences, SIAM Journal on Optimization, SIAM Journal on Scientific Computing, and Signal Processing.

Panel reviewer for NSF on four occasions.

Professional Memberships:

Society for Industrial and Applied Mathematics (Secretary of the Activity Group on Imaging Science, 2008–2009). American Mathematical Society. Institute of Electrical and Electronics Engineers (Senior Member). Mathematical Optimization Society.

Symposia/Workshops Organized:

"Applied, Computational, and Discrete Mathematics at National Laboratories and Federal Research Agencies." Minisymposium of the Society for Industrial and Applied Mathematics, Joint Mathematics Meetings, San Diego, California, January 2013.

"New Trends in Mathematical Methods in Imaging Science." Minisymposium of the Society for Industrial and Applied Mathematics, Joint Mathematics Meetings, San Francisco, California, January 2010.

"Monge-Kantorovich Optimal Transport - Theory and Applications." Workshop of the LANL Center for Nonlinear Studies, Santa Fe, New Mexico, October 2009.

"Mathematics and America's Future: A Call to Action." American Association for the Advancement of Science, Annual Meeting, San Francisco, California, February 2007. Science policy leaders from four professional societies.

"Mathematical Methods for the Analysis of Images and High-Dimensional Data." American Mathematical Society, Eastern Section Meeting, Annandale-on-Hudson, New York, October 2005. Fifteen speakers.

"Detecting the Unseen with Cosmic-Ray Muons." American Association for the Advancement of Science, Annual Meeting, Washington, D.C., February 2005. Four speakers from three countries. Media coverage resulted in thousands of news stories appearing across the planet.

Publications:

[1] R. Chartrand, "Shrinkage mappings and their induced penalty functions," in *IEEE Int. Conf. Acoust. Speech Signal Process.*, 2014.

[2] H. Hu, B. Wohlberg, and R. Chartrand, "Task-driven dictionary learning for inpainting," in *IEEE Int. Conf. Acoust. Speech Signal Process.*, 2014.

[3] W. Landecker, R. Chartrand, and S. DeDeo, "Robust sparse coding and compressed sensing with the difference map," in *European Conference on Computer Vision*, vol. 8691 of *Lecture Notes in Computer Science*, pp. 315–329, Springer International Publishing, 2014.

[4] E. Y. Sidky, R. Chartrand, J. M. Boone, and X. Pan, "Constrained TpV minimization for enhanced exploitation of gradient sparsity: application to CT image reconstruction," *IEEE J. Transl. Eng. Health Med.*, vol. 2, pp. 1–18, 2014.

[5] R. Chartrand, "Nonconvex compressive sensing for X-ray CT: an algorithm comparison," in *Asilomar Conf. Signal Syst. Comput.*, 2013.

[6] R. Chartrand, "Generalized shrinkage and penalty functions," in *IEEE Glob. Conf. Signal Inform. Process.*, 2013.

[7] R. Chartrand and B. Wohlberg, "A nonconvex ADMM algorithm for group sparsity with sparse groups," in *IEEE Int. Conf. Acoust. Speech Signal Process.*, 2013.

[8] E. Y. Sidky, R. Chartrand, J. S. Jørgensen, and X. Pan, "Nonconvex optimization for improved exploitation of gradient sparsity in CT image reconstruction," in *Fully 3-Dimens. Image Recon. Rad. Nucl. Med.*, 2013.

[9] S. Voronin and R. Chartrand, "A new generalized thresholding algorithm for inverse problems with sparsity constraints," in *IEEE Int. Conf. Acoust. Speech Signal Process.*, 2013.

[10] Z. Ji, J. Theiler, R. Chartrand, G. Kenyon, and S. P. Brumby, "SIFT-based sparse coding for large-scale visual recognition," in *SPIE Defense Security Sens.*, 2013.

[11] R. Chartrand, "Nonconvex splitting for regularized low-rank + sparse decomposition," *IEEE Trans. Signal Process.*, vol. 60, pp. 5810–5819, 2012.

[12] B. Wohlberg, R. Chartrand, and J. Theiler, "Local principal component pursuit for nonlinear datasets," in *IEEE Int. Conf. Acoust. Speech Signal Process.*, 2012.

[13] A. E. Galbraith, S. P. Brumby, and R. Chartrand, "Simulating vision through time: Hierarchical, sparse models of visual cortex for motion imagery," in *IEEE Appl. Imagery Patt. Recog. Workshop*, 2012.

[14] R. Chartrand, "Numerical differentiation of noisy, nonsmooth data," *ISRN Appl. Math.*, vol. 2011, 2011. Article ID 164564.

[15] R. Chartrand, E. Y. Sidky, and X. Pan, "Frequency extrapolation by nonconvex compressive sensing," in *IEEE Int. Symp. Biomed. Imaging*, 2011.

[16] R. Chartrand and B. Wohlberg, "Total-variation regularization with bound constraints," in *IEEE Int. Conf. Acoust. Speech Signal Process.*, 2010.

[17] E. Y. Sidky, R. Chartrand, Y. Duchin, C. Ullberg, and X. Pan, "High resolution image reconstruction with constrained, total-variation minimization," in *IEEE Nucl. Sci. Symp. Rec.*, 2010.

[18] R. Chartrand, "Fast algorithms for nonconvex compressive sensing: MRI reconstruction from very few data," in *IEEE Int. Symp. Biomed. Imaging*, 2009.

[19] E. M. Bollt, R. Chartrand, S. Esedoḡlu, K. R. Vixie, and P. Schultz, "Graduated, adaptive image denoising: local compromise between total variation and isotropic diffusion," *Adv. Comp. Math*, vol. 31, pp. 61–85, 2009.

[20] R. Chartrand, K. R. Vixie, B. Wohlberg, and E. M. Bollt, "A gradient descent solution to the Monge-Kantorovich problem," *Appl. Math. Sci.*, vol. 3, pp. 1071–1080, 2009.

[21] R. Chartrand and V. Staneva, "Restricted isometry properties and nonconvex compressive sensing," *Inverse Problems*, vol. 24, no. 035020, pp. 1–14, 2008.

[22] R. Chartrand and W. Yin, "Iteratively reweighted algorithms for compressive sensing," in *IEEE Int. Conf. Acoust. Speech Signal Process.*, 2008.

[23] R. Saab, R. Chartrand, and Özgür Yilmaz, "Stable sparse approximations via nonconvex optimization," in *IEEE Int. Conf. Acoust. Speech Signal Process.*, 2008.

[24] E. Y. Sidky, I. Reiser, R. M. Nishikawa, X. Pan, R. Chartrand, D. B. Kopans, and R. H. Moore, "Practical iterative image reconstruction in digital breast tomosynthesis by non-convex TpV optimization," in *SPIE Med. Imaging*, 2008.

[25] R. Chartrand, "Nonconvex compressive sensing and reconstruction of gradient-sparse images: random vs. tomographic Fourier sampling," in *IEEE Int. Conf. Image Process.*, 2008.

[26] R. Chartrand and V. Staneva, "Total variation regularisation of images corrupted by non-Gaussian noise using a quasi-Newton method," *IET Image Process.*, vol. 2, pp. 295–303, 2008.

[27] C. L. Morris, C. C. Alexander, J. D. Bacon, G. S. Blanpied, K. N. Borozdin, R. Chartrand, D. J. Clark, C. J. Espinoza, A. M. Fraser, M. C. Galassi, J. J. Gomez, J. S. Gonzales, J. A. Green, N. W. Hengartner, G. E. Hogan, A. V. Klimenko, P. McGaughey, J. J. Medina, F. E. Pazuchanics, W. C. Priedhorsky, J. C. Ramsey, A. Saunders, R. C. Schirato, L. J. Schultz, and M. J. Sossong, "Tomographic imaging with cosmic ray muons," *Sci. Glob. Secur.*, vol. 16, pp. 37–53, 2008.

[28] R. Chartrand and V. Staneva, "A faster-converging algorithm for image segmentation with a modified Chan-Vese model," in *Int. Conf. Image Process. Comput. Vision Patt. Recog.*, 2008.

[29] R. Chartrand, "Exact reconstructions of sparse signals via nonconvex minimization," *IEEE Signal Process. Lett.*, vol. 14, pp. 707–710, 2007.

[30] R. Chartrand, "Nonconvex regularization for shape preservation," in *IEEE Int. Conf. Image Process.*, 2007.

[31] T. Le, R. Chartrand, and T. J. Asaki, "A variational approach to reconstructing images corrupted by Poisson noise," *J. Math. Imaging Vision*, vol. 27, pp. 257–263, 2007.

[32] E. Y. Sidky, R. Chartrand, and X. Pan, "Image reconstruction from few views by non-convex optimization," in *IEEE Med. Imaging Conf. Rec.*, 2007.

[33] R. Chartrand, "Nonconvex compressed sensing and error correction," in *IEEE Int. Conf. Acoust. Speech Signal Process.*, 2007.

[34] R. Chartrand and V. Staneva, "Nonconvex regularization for image segmentation," in *Int. Conf. Image Process. Comput. Vision Patt. Recog.*, 2007.

[35] C. L. Rousculp, J. E. Hammerberg, D. M. Oro, G. Rodriguez, P. M. Goodwin, M. A. Salazar, R. E. Reinovsky, R. J. Faehl, R. Chartrand, J. R. Becker, R. A. Berglin, K. W. Delzer, G. H. Gomez, R. M. Malone, D. V. Morgan, T. V. Pate, K. E. Theuer, D. A. Rigney, and H. J. Kim, "Dynamic friction experiments at the atlas pulsed power facility," in *IEEE Int. Pulsed Power Conf.*, pp. 881–885, 2007.

[36] T. J. Asaki, P. R. Campbell, R. Chartrand, C. E. Powell, K. R. Vixie, and B. Wohlberg, "Abel inversion using total variation regularization: applications," *Inverse Probl. Sci. Eng.*, vol. 14, pp. 873–885, 2006.

[37] J. A. Green, C. Alexander, T. Asaki, J. Bacon, G. Blanpied, K. Borozdin, A. Canabal-Rey, M. Cannon, R. Chartrand, D. Clark, C. Espinoza, E. Figueroa, A. Fraser, M. Galassi, J. Gomez, J. Gonzales, A. Green, N. Hengartner, G. Hogan, A. Klimenko, P. McGaughey, G. McGregor, J. Medina, C. Morris, K. Mosher, C. Orum, F. Pazuchanics, W. Priedhorsky, A. Sanchez, A. Saunders, R. Schirato, L. Schultz, M. Sossong, M. Sottile, J. Tenbrink, R. V. de Water, K. Vixie, and B. Wohlberg, "Optimizing the tracking efficiency for cosmic ray muon tomography," in *IEEE Nuc. Sci. Symp. Conf. Rec.*, 2006.

[38] K. Borozdin, T. Asaki, R. Chartrand, M. Galassi, A. Greene, N. Hengartner, G. Hogan, A. Klimenko, C. Morris, W. Priedhorsky, A. Saunders, R. Schirato, L. Schultz, and M. Sottile, "Cosmic-ray muon tomography and its application to the detection of high-Z materials," in *Proc. Ann. Meet.*, Inst. Nucl. Mat. Manage., 2005.

[39] T. J. Asaki, R. Chartrand, K. R. Vixie, and B. Wohlberg, "Abel inversion using total-variation regularization," *Inverse Problems*, vol. 21, pp. 1895–1903, 2005.

[40] K. Borozdin, T. Asaki, R. Chartrand, N. Hengartner, G. Hogan, C. Morris, W. Priedhorsky, R. Schirato, L. Schultz, M. Sottile, K. Vixie, B. Wohlberg, and G. Blanpied, "Information extraction from muon radiography data," in *Int. Conf. Cybernetics Inform. Tech. Syst. Appl. and 10th Int. Conf. Inform. Syst. Anal. Synth. Vol 2, Proc.: Commun. Inform. Control Syst. Tech. Appl.*, pp. 27–30, 2004.

[41] R. Chartrand, "Multipliers and Carleson measures for $D(\mu)$," *Integral Equations Operator Theory*, vol. 45, pp. 309–318, 2003.

[42] R. Chartrand, "Toeplitz operators on Dirichlet-type spaces," *J. Operator Theory*, vol. 48, pp. 3–13, 2002.

[43] R. Chartrand, *Hilbert spaces of holomorphic functions: zero sets, invariant subspaces, and Toeplitz operators.* PhD thesis, University of California, Berkeley, 1999.

[44] R. Chartrand and T. Kucera, "Deissler rank complexity of powers of indecomposable injective modules," *Notre Dame J. Formal Logic*, vol. 35, pp. 398–402, 1994.