Russell J. Hewett — Curriculum Vitae

Russell J. Hewett
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Education

Ph.D. in Computer Science (with Computational Science and Engineering option), University of Illinois at Urbana-Champaign, December, 2011. Thesis: *Numerical Methods for Solar Tomography in the STEREO Era*, Advisors: Michael T. Heath and Farzad Kamalabadi.

B.S. *in Honors* in Computer Science, Virginia Polytechnic Institute and State University (Virginia Tech), May, 2005, *Summa Cum Laude*. Thesis: *Wavelet Analysis of Solar Active Regions*, Advisors: Calvin Ribbens and Peter T. Gallagher.

Academic Positions

Postdoctoral Associate, Imaging and Computing Group, Department of Mathematics, Massachusetts Institute of Technology, September 2011–April 2014.

Postdoctoral Associate, Earth Resources Laboratory, Massachusetts Institute of Technology, September 2011–April 2014.

Industrial Research Positions

Research Scientist, Computational Science & Engineering Department,
TOTAL E&P Research and Technology USA, LLC, May 2014 – Present.

- Research finite difference and discontinuous Galerkin solvers for wave and Helmholtz equations
- Research mesh adaptation and numerical optimization in context of seismic imaging
- Research numerical and high performance computing (HPC) aspects discontinuous Galerkin methods in seismic imaging
- Architect performance portable Fortran HPC research time-domain seismic imaging and inversion code as platform for:
  - Research on numerical methods (e.g., PDEs, optimization, meshing)
  - Research on HPC software and programming models (e.g., multicore, OpenACC)
  - Research on geophysical methods (e.g., imaging, inversion)
- Propose and develop new research projects in the above areas
- Supervise interns and postdocs on computational science and mathematics research
- Supervise software development contractors in CSE department
- Liaise and collaborate with university research groups on CSE research
- Collaborate on joint industry projects

Fellowships and Grants

NASA Graduate Student Research Program (GSRP) Fellowship for *Large Scale Dynamic Reconstruction of Coronal Density and Temperature from Multi-spacecraft Measurements*, 2008-2011. ($90,000)

Other Research History and Work Experience

Research Assistant — June 2007–August 2007, January 2008–July 2011
University of Illinois at Urbana-Champaign

- Constrained Kalman and ensemble Kalman filtering for dynamic inverse problems.
- Scalable construction of tomographic projection operators on unstructured meshes.
- Phase-field based level set methods for tomography from temporally and spatially sparse observations.
- Finite element methods for optimizing phase field based image segmentation and joint segmentation-tomography energy functionals.

– GPU acceleration of ensemble Kalman filter.

Visiting Student June 2006–September 2006
Trinity College Dublin

– Wavelet methods for extracting magnetic power spectra from solar magnetic field images.

Junior Programmer September 2004–September 2006
NASA Goddard Space Flight Center L3-Communications GSI

– Wavelet methods for extracting magnetic power spectra from solar magnetic field images.
– Redesigned and reimplemented SolarMonitor.org.

Student Intern May 2003–August 2003, May 2004–August 2004
NASA Goddard Space Flight Center The Catholic University of America

– Developed software for processing, analysing, and presenting data from RHESSI spacecraft.

Student Intern June 2000–August 2001
NASA Goddard Space Flight Center ERHS & The Catholic University of America

– Developed software for construction of Burst Alert Telescope on SWIFT spacecraft.
– Assisted with calibration of Roll Angle Sensor on RHESSI spacecraft.

Teaching Experience

Recitation Instructor, 18.06 Linear Algebra, Massachusetts Institute of Technology, Spring, 2013.

Co-organizer, Earth Resources Laboratory Reading Group on Full Waveform Inversion, Massachusetts Institute of Technology, Spring, 2013.

Guest Lecturer, 18.325 Special Topics in Applied Mathematics: Waves and Imaging, Massachusetts Institute of Technology, November, 2012.

Guest Lecturer, CS498dwh Computational Photography, University of Illinois, November, 2010.

Teaching Assistant, CS450 Intro to Numerical Analysis (U/G), University of Illinois, Fall 2007.

Teaching Assistant, CS450 Intro to Numerical Analysis (U/G), University of Illinois, Spring 2007.

Teaching Assistant, CS450 Intro to Numerical Analysis (U/G), University of Illinois, Fall 2006.

Teaching Assistant, CS450 Intro to Numerical Analysis (U/G), University of Illinois, Spring 2006.

Teaching Assistant, CS232 Intro to Computer Architecture II, University of Illinois, Fall 2005.

Summer Schools

Instructor for Computational Exercises, Introduction to the Mathematics of Seismic Imaging, Mathematical Sciences Research Institute (MSRI), July-August 2013.

Workshops and Minisymposia

Co-organizer, minisymposium, "Numerical and computational challenges in high order DG methods," at 2017 SIAM Conference on Computational Science and Engineering, Atlanta, GA, February, 2017, *proposed*.

Co-convenor, workshop, "Open-source Software in Applied Geosciences," at 78th EAGE Conference & Exhibition 2016, Vienna, Austria, May, 2016.

Co-organizer, minisymposium, "Advances in Software for Computational Geosciences," at 2015 SIAM Conference on Mathematical & Computational Issues in the Geosciences, Palo Alto, CA, June, 2015.

Co-organizer, minisymposium, "Discontinuous Galerkin Methods in Seismology," at 2015 SIAM Conference on Mathematical & Computational Issues in the Geosciences, Palo Alto, CA, June, 2015.

Python for Science and Engineering Workshop, hosted by SIAM Student Chapter and Engineering Graduate Student Advisory Council, University of Illinois, April, 2011, with M. Gates.

Python for Scientific Computing Workshop, hosted by SIAM Student Chapter, University of Illinois, October, 2010, with M. Gates.

Students Supervised

Zheng Wang, intern with Computational Science & Engineering Department at TOTAL E&P Research & Technology, USA (TOTAL), on multirate time stepping DG methods for the wave equation and DG methods in imaging and inversion, Summer 2016.

Peter Geldermans, intern with Computational Science & Engineering Department at TOTAL E&P Research & Technology, USA (TOTAL), on HPS solvers for the Helmholtz equation and applications to imaging and inversion, Summer 2016.

Kevin Tuil, VIE with Computational Science & Engineering Department at TOTAL E&P Research & Technology, USA (TOTAL), on computational and numerical aspects of full waveform inversion, Summer 2015 - Summer 2016.

Mamadou N'diaye, VIE with Computational Science & Engineering Department at TOTAL E&P Research & Technology, USA (TOTAL), on optimizing finite difference coeffients for wave equations, Summer and Fall 2014.

Léopold Cambier, intern with Imaging and Computing Group at MIT, on applications of matrix probing to the full waveform inversion Hessian, Summer 2013.

Christine Cutting, intern with Imaging and Computing Group at MIT, on uncertainty quantification and stochastic Newton methods for seismic imaging (full waveform inversion), Summer 2013.

Minghua "Michel" Rao, intern with Imaging and Computing Group at MIT, on locally one-dimensional methods for wave equations, Summer 2012.

Ph.D. Thesis Committees

Marie Bonhasse-Gahot, University of Nice, France, 2015.

Refereed Journal Publications

A. Modave, A. Atle, J. Chan, **R. J. Hewett**, and T. Warburton, "High-Order Absorbing Boundary Conditions for Time-Domain Wave Propagation with DG Methods," *in preparation.*

L. Demanet, **R. J. Hewett**, A. Scheuer, and L. Zepeda–Núñez, "The Method of Polarized Traces for the 3D Helmholtz Equation," *in preparation for submission to* Geophysics.

J. Chan, **R. J. Hewett**, and T. Warburton, "Weight Adjusted Discontinuous Galerkin Methods: Curvilinear Meshes," *submitted to* the SIAM Journal on Scientific Computing.

J. Chan, **R. J. Hewett**, and T. Warburton, "Weight Adjusted Discontinuous Galerkin Methods: Wave Propagation in Heterogeneous Media," *submitted to* the SIAM Journal on Scientific Computing.

J. Chan, **R. J. Hewett**, Z. Wang, and T. Warburton, "Reduced Storage Nodal Discontinuous Galerkin Methods on Semi-structured Prismatic Meshes," *submitted to* Computers and Mathematics with Applications.

The SunPy Community, S. J. Mumford, S. Christe, D. Pérez-Suárez, J. Ireland, A. Y. Shih, A. R. Inglis, S. Liedtke, **R. J. Hewett**, F. Mayer, K. Hughitt, N. Freij, T. Meszaros, S. M. Bennett, M. Malocha, J Evans, A. Agrawal, A. J. Leonard, T. P. Robitaille, B. Mampaey, J. Iván Campos-Rozo, and M. S. Kirk, "SunPy–Python for solar physics," *Computational Science and Discovery*, Volume 8, Issue 1, January 2015.

R. J. Hewett, I. H. Jermyn, M. T. Heath, and F. Kamalabadi, "A Phase Field Method for Tomographic Reconstruction from Limited Data," *Proceedings of the British Machine Vision Conference*, pp. 120.1-120.11, August, 2012.

R. A. Frazin, A. M. Vàsquez, W. T. Thompson, **R. J. Hewett**, P. Lamy, A. Llebaria, A. Vourlidas, and J. Burkpile, "Intercomparison of the LASCO-C2, SECCHI-COR1, SECCHI-COR2, and Mk4 Coronagraphs,"*Solar Physics*, Volume 280, Issue 1, pp. 273-293, 2012.

R. J. Hewett, M. T. Heath, M. D. Butala, and F. Kamalabadi, "A Robust Null Space Method for Linear Equality Constrained State Estimation," *IEEE Transactions on Image Processing*, Volume 58, Issue 8, pp. 3961-3971, August, 2010.

M. D. Butala, **R. J. Hewett**, R. A. Frazin, and F. Kamalabadi, "Dynamic Three-Dimensional Tomography of the Solar Corona," *Solar Physics*, Volume 262, Issue 2, pp. 495-509, February, 2010.

J. Ireland, C. A. Young, R. T. J. McAteer, C. Whelan, **R. J. Hewett**, and P. T. Gallagher, "Multiresolution Analysis of Active Region Magnetic Structure and Its Correlation with the Mt. Wilson Classification and Flaring Activity," *Solar Physics*, Volume 252, Issue 1, pp. 121-137, August, 2008.

R. J. Hewett, P. T. Gallagher, R. T. J. McAteer, C. A. Young, J. Ireland, P. A. Conlon, and K. Maguire, "Multiscale Analysis of Turbulence in Active Regions Using Wavelets," *Solar Physics*, Volume 248, Issue 2, pp. 297-309, April, 2008.

P. A. Conlon, P. T. Gallagher, R. T. J. McAteer, J. Ireland, C. A. Young, P. Kestener, **R. J. Hewett**, and K. Maguire, "Multifractal Properties of Evolving Active Regions," *Solar Physics*, Volume 248, Issue 2, pp. 311-322, April, 2008.

Conference Proceedings

M. N'Diaye, **R. J. Hewett**, A. Atle, and H. Calandra, "Optimized finite difference coefficients for the Helmholtz equation," 85th Annual Meeting, SEG, Expanded Abstracts, October, 2015.

L. Zepeda–Núñez, **R. J. Hewett**, and L. Demanet, "Preconditioning the 2D Helmholtz equation with polarized traces," 84th Annual Meeting, SEG, Expanded Abstracts, October, 2014.

L. Zepeda–Núñez, **R. J. Hewett**, M. Rao, and L. Demanet, "Time-stepping beyond CFL: a locally one-dimensional scheme for acoustic wave propagation," 83rd Annual Meeting, SEG, Expanded Abstracts, September, 2013.

M. Leinonen, **R. J. Hewett**, X. Zhang, L. Ying, and L. Demanet, "High-dimensional wave atoms and compression of seismic datasets," 83rd Annual Meeting, SEG, Expanded Abstracts, September, 2013.

S. Mumford, D. Pérez-Suárez, S. Christe, F. Mayer, and **R. J. Hewett**, "SunPy: Python for Solar Physicists," Proceedings of the 12th Python in Science Conference, July, 2013.

R. T. J. McAteer, P. T. Gallagher, J. Ireland, C. A. Young, **R. J. Hewett**, and P. Conlon, "The Complex Sun: Turbulence and Complexity of the Solar Atmosphere," *SOHO-17. 10 Years of SOHO and Beyond*, 2006.

Book Chapters

B. Hewett and **R. J. Hewett**, *IM Talking about Literacy: Instant Messaging in the Workplace*, in *Handbook of Research on Virtual Workplaces and the New Nature of Business Practices.* Eds.: Kirk St. Amant and Pavel Zemliansky. Hershey, PA, USA: IGI Global, 2008.

P. T. Gallagher, R. T. J. McAteer, C. A. Young, J. Ireland, **R. J. Hewett**, and P. A. Conlon, *Solar Activity Monitoring*, in *Space Weather: Research Towards Applications in Europe.* Ed.: Jean Lilensten. Dordrecht, The Netherlands: Springer, 2007.

Conference Talks as Primary Contributor

R. J. Hewett "PySIT: Seismic Imaging Toolbox for Python," *SIAM Geoscience 2015*, Stanford University, Palo Alto, CA, June 2015.

R. J. Hewett, L. Zepeda–Núñez, and L. Demanet, "A Polarized-Trace Solver for 2D Helmholtz and Frequency Domain Full-Waveform Inversion," *Inverse Problems: Theory and Applications*, Bristol, UK, August 2014.

R. J. Hewett, I. Jermyn, M. T. Heath, and F. Kamalabadi, "Toward Tomographic Reconstruction of CMEs with a Phase Field Method," *Solar Image Processing Workshop VI*, Bozeman, MT, August 2012.

R. J. Hewett, "Tomographic Imaging of the Solar Corona from Multi-spacecraft Measurements," *Goddard Space Flight Center Graduate Student Symposium*, Greenbelt, MD, September 2010.

R. J. Hewett and W. K. Cochran,"Computing Tomographic Projection Operators on Unstructured Meshes," *SIAM Imaging Science 2010*, Chicago, IL, April 2010.

R. J. Hewett, M. D. Butala, F. Kamalabadi, and R. A. Frazin, "Dynamic 3D Coronal Density Reconstructions with Data from Multiple Observatories," *Solar Image Processing Workshop IV*, Baltimore, MD, October 2008.

R. J. Hewett, P. T. Gallagher, R. T. J. McAteer, C. A. Young, J. Ireland, P. A. Conlon, and K. Maguire, "Multiscale Analysis of Turbulence in Active Regions Using Wavelets," *Solar Image Processing Workshop III*, Dublin, Ireland, September 2006.

Conference Posters as Primary Contributor

R. J. Hewett, I. Jermyn, F. Kamalabadi, and M. T. Heath, "Joint Tomography and Segmentation of Coronal Mass Ejections," *Solar Image Processing Workshop V*, Les Diablerets, Switzerland, September 2010.

R. J. Hewett, M. D. Butala, F. Kamalabadi, and O. C. St.Cyr, "Large Scale Dynamic Reconstruction of Coronal Density and Temperature from Multi-spacecraft Measurements," *Goddard Space Flight Center Graduate Student Symposium*, Greenbelt, MD, September 2009.

R. J. Hewett, P. T. Gallagher, R. T. J. McAteer, C. A. Young, and J. Ireland, "Multiscale Structure of Active Region Magnetic Fields: A Continuous Wavelet Approach," *American Astronomical Society: Solar Physics Division Annual Meeting*, Durham, NH, June 2006.

Other Conference Presentations

L. Demanet, L. Zepeda–Núñez, **R. J. Hewett**, M. Taus, and A. Scheuer, "The Method of Polarized Traces for the Helmholtz Equation," *SIAM Annual Meeting 2016*, Boston, MA, July 2016.

F. Kamalabadi, **R. J. Hewett**, and M. D. Butala, "Time-Dependent Tomographic Imaging of the Solar Atmosphere," *SIAM Imaging Science 2010*, Chicago, IL, April 2010.

F. Kamalabadi, **R. J. Hewett**, M. D. Butala, and R. A. Frazin, "An Assimilative 3-D Model of Coronal Density from Multi-Spacecraft Observations," *Eos Transactions of the American Geophysical Union*, Volume 90, Issue 52, Fall Meeting Supplement, San Francisco, CA, December 2009.

M. D. Butala, **R. J. Hewett**, R. A. Frazin, Y. Chen, and F. Kamalabadi, "Reconstruction of the Dynamic 3D Solar Atmosphere with the Ensemble Kalman Filter," *Solar Image Processing Workshop IV*, Baltimore, MD, October 2008.

P. A. Conlon, P. T. Gallagher, R. T. J. McAteer, C. A. Young, J. Ireland, **R. J. Hewett**, and K. Maguire, "Multifractal Analysis of Solar Magnetograms," *Solar Image Processing Workshop III*, Dublin, Ireland, September 2006.

Seminars (Invited)

"A Polarized-Trace Solver for the 2D Helmholtz Equation," Computational and Applied Mathematics Seminar, Rice University, November, 2014.

"A Polarized-Trace Solver for the 2D Helmholtz Equation," Scientific Computing Seminar, University of Texas at Dallas, Novermber, 2014.

"PySIT and Seismic Inversion in the Imaging and Computing Group," Princeton Geophysics Brown-bag, April, 2014.

"An Introduction to Solar Tomography," MIT Haystack Observatory, Massachusetts Institute of Technology, April 2013.

"An Informal Introduction to Seismic Imaging," MIT Camera Culture Group Seminar, Media Lab, Massachusetts Institute of Technology, November 2011.

"Numerical Methods for Solar Tomography in the STEREO Era," Imaging and Computing Seminar, Department of Mathematics, Massachusetts Institute of Technology, February 2011.

Honors, Awards, and Outstanding Achievements

First Place Industry Choice Award in Virginia Tech Undergraduate Research in Computer Science (VTURCS), for "Wavelet analysis of solar active regions," Spring 2005.

Phi Beta Kappa, 2005.

Upsilon Pi Epsilon, 2004.

First Place Judge's Choice Award in Virginia Tech Undergraduate Research in Computer Science (VTURCS), for "The design and implementation of a refineable keyword search engine," with D. Arendt and J. Giacalone, Spring 2002.

Software Contributions

PySIT: Python Seismic Imaging Toolbox, lead designer and developer. Released under BSD license, November 22, 2013. (www.pysit.org)

SunPy: A Community Python Library for Solar Physics, contributor and member of the Board of Directors. (www.sunpy.org)

Minor contributions: AstroPy, NumPy

Service

Committee Member, Numerics and Acquisition Committee, SEG SEAM Pore Pressure Prediction project, as representative of CSE Dept. at TOTAL, 2016.

Program Committee Member, Solar Astronomy Big Data (SABiD) 1st Workshop on Management, Search and Mining of Massive Repositories of Solar Astronomy Data, IEEE BigData 2014, October 2014.

Executive Secretary, NASA Living With a Star/NSF Collaborative Space Weather Modeling Program Review Panel, September 2012.

Article referee for *Geophysics*, *IEEE Transactions on Signal Processing*, *Applied Mathematics and Computation*, *Automatica*, *IEEE Transactions on Aerospace and Electronic Systems*, and *Journal of Systems and Control Engineering*.

Skills, Programming Languages, and Tools

Programming Languages: Fortran, Python, C++, Matlab, LaTeX

Version Control & Project Management: git, hg, JIRA, BitBucket, GitHub

Languages: English (native), French (basic)

References

Upon request.