David Samuel Smith

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Education

The University of Texas at Austin — PhD Astrophysics, 2006
Thesis: Astrophysical Radiation Environments of Habitable Worlds
Harrington Fellow

Harvard University — AM Astronomy, 2002
NSF Graduate Research Fellow

The University of Texas at Austin — BS Physics, BA Astronomy, 2001
GPA: 3.93 overall, 4.00 major, Dean's Honored Graduate

Research Focus

My primary effort is on finding new uses of compressed sensing and large-scale optimization to improve magnetic resonance imaging (MRI), particularly in application to cancer diagnosis and treatment monitoring. Synergistically with my compressed sensing research, I am using statistical techniques to better understand and improve MRI by approaching it as an error-prone physics experiment. I also maintain an active interest in high-field MRI and parallel computing.

Selected Honors

Board of Visitors Second-Year Research Defense Award	2003
NSF Graduate Research Fellowship	2002
Harrington Doctoral Fellowship	2002
Dean's Honored Graduate	2001
Phi Beta Kappa	2001
Sigma Xi	1999
Sigma Pi Sigma	1999
Terry Scholar	1997
National Merit Scholar	1997
High School Valedictorian	1997
Biology Top Scorer and Champion: UIL Science, Texas State Meet	1997
Outstanding Performer: Texas State Solo & Ensemble Contest, trumpet	1997
Eagle Scout	1994

Employment History

Research Assistant Professor — Aug 2014–present
Department of Radiology and Radiological Sciences

Postdoctoral Research Fellow — Jan 2010–Jul 2014
Vanderbilt University Institute of Imaging Science

Medical Physics Resident — Jul 2008–Jan 2010
Dept. of Radiation Oncology, Vanderbilt University Medical Center

Postdoctoral Research Associate — Aug 2006–Jun 2008
Lunar and Planetary Laboratory, University of Arizona

Harrington Doctoral Fellow — Jun 2005–Aug 2006
Dept. of Astronomy, The University of Texas at Austin

National Science Foundation Graduate Fellow — Jun 2002–May 2005
Dept. of Astronomy, The University of Texas at Austin

Graduate Research Associate — Sep 2001–May 2002
Dept. of Astronomy, Harvard University

Undergraduate Research Assistant — Jun 2000–Aug 2000
Dept. of Astronomy, The University of Texas at Austin

NSF Research Experience for Undergraduates (REU) — Jul 1999–Aug 1999
Smithsonian Astrophysical Observatory

Undergraduate Research Assistant — Jan 1998–Dec 1998
Dept. of Physics, The University of Texas at Austin

Refereed Publications

1. Sengupta S, **DS Smith**, and EB Welch, 2014. Continuously moving table MRI with golden angle radial sampling. *Mag Reson Med*, doi: 10.1002/mrm.25531.
2. **DS Smith**, X Li, RG Abramson, CC Quarles, TE Yankeelov, and EB Welch, 2013. Review: Potential of compressed sensing in quantitative MR imaging of cancer. *Cancer Imaging*, 13(4), 633-44.
3. **DS Smith**, J Berglund, J Kullberg, H Ahlström, MJ Avison, and EB Welch, 2013. Optimization of fat-water separation algorithm selection and options using image-based metrics with validation by ISMRM fat-water challenge datasets. *Proc. ISMRM 2013*, #1973.
4. **DS Smith**, SL Barnes, and TE Yankeelov, 2013. Separating signal and noise with the Kolmogorov-Smirnov test. *Proc. ISMRM 2013*
5. **DS Smith**, RK Robison, and EB Welch, 2013. A more realistic non-sparse phantom for compressed sensing MRI reconstruction. *Proc. ISMRM*.
6. **DS Smith**, LR Arlinghaus, TE Yankeelov, and EB Welch, 2013. Curvelets as a sparse basis for compressed sensing magnetic resonance imaging. *SPIE Med. Imag.*, 866929-7.
7. **DS Smith**, LR Arlinghaus, TE Yankeelov, and EB Welch, 2012. Optimizing random Fourier sampling patterns for compressed sensing using point spread functions. *Proc. ISMRM 2012*, #2252.
8. **DS Smith** and MG Stabin, 2012. Exposure rate constants and lead shielding values for over 1200 radionuclides. *Health Physics*, 102(3): 271–291.
9. **DS Smith**, X Li, JV Gambrell, LR Arlinghaus, CC Quarles, TE Yankeelov, and EB Welch, 2012. Robustness of quantitative compressive sensing MRI: The effect of random undersampling patterns on derived parameters for DCE- and DSC-MRI. *IEEE Trans. Med. Imag.*, 31(2), 504–511.

10. **DS Smith**, JC Gore, TE Yankeelov, and EB Welch, 2011. Real-time compressive sensing MRI reconstruction using GPU computing and split Bregman methods, *Int. J. Biomed. Imag.*, Article ID 864827, 6 pages.
11. **DS Smith**, TE Yankeelov, and CC Quarles, 2011. Low-resolution Cartesian compressed sensing MRI: application to dynamic susceptibility MRI, *Proc. ISMRM 2011*, #1973.
12. **DS Smith**, EB Welch, X Li, LR Arlinghaus, ME Loveless, T Koyama, JC Gore, and TE Yankeelov, 2011. Quantitative effects of using compressed sensing in dynamic contrast enhanced MRI. *Phys. Med. Bio.*, 56, 4933.
13. LR Arlinghaus, X Li, M Levy, **DS Smith**, EB Welch, JC Gore, and TE Yankeelov, 2010. Current and future trends in magnetic resonance imaging assessments of the response of breast tumors to neoadjuvant chemotherapy. *J. Oncology*, 919620.
14. **DS Smith** and J Scalo, 2009. M star astrosphere size fluctuations and habitable planet descreening. *Astrobiology*, 9(7), 673–681.
15. **DS Smith** and J Scalo, 2007. Risks due to X-ray flares during astronaut extravehicular activity. *Space Weather*, 5, S06004.
16. **DS Smith** and J Scalo, 2007. Solar X-ray flare hazards on the surface of Mars. *Plan. Sp. Sci.*, 55, 517–527.
17. **DS Smith**, J Scalo, and JC Wheeler, 2004. Transport of ionizing radiation in terrestrial-like exoplanet atmospheres. *Icarus*, 171, 229–253.
18. **DS Smith**, J Scalo, and JC Wheeler, 2004. Importance of biologically active aurora-like UV emission: Stochastic irradiation of Earth and Mars by flares and explosions. *Origins of Life and Evol. of the Biosphere*, 34, 513–532.
19. K Wood, **DS Smith**, B Whitney, K Stassun, SJ Kenyon, MJ Wolff, and KS Bjorkman, 2001. Scattered light models of protostellar envelopes: Multiple outflow cavities and misaligned circumstellar disks. *Astrophys. J.*, 561, 299–307.

Non-refereed Publications

1. **DS Smith**, RK Robison, LR Arlinghaus, TE Yankeelov, and EB Welch, 2013. HUGE GALORE: Highly undersampled gradient echo using a golden angle, low order radial encoding. *VUIIS Retreat Poster*
2. **DS Smith**, LR Arlinghaus, TE Yankeelov, and EB Welch, 2013. Curvelets as a sparse basis for compressed sensing magnetic resonance imaging. *Proc. SPIE*.
3. **DS Smith**, RK Robison, and EB Welch, 2012. Automated RF spike noise removal with compressed sensing. *Proc. ISMRM 2012*, #2268.
4. **DS Smith**, JC Gore, and EB Welch, 2011. Accelerating compressed sensing MRI reconstruction with GPU computing. *Proc. ISMRM 2011*, #2546.
5. **DS Smith** and EB Welch, 2011. Non-sparse phantom for compressed sensing MRI reconstruction. *Proc. ISMRM 2011*, #2845.
6. **DS Smith**, EB Welch, LR Arlinghaus, TE Yankeelov, 2010. Development of a clinically relevant 3 T breast protocol. *VUIIS Annual Retreat*, poster.

7. **DS Smith** and J Giacalone, 2007. Hybrid simulations of pickup ion acceleration and transport. Solar, Heliospheric, and Interplanetary Environment Workshop, Whister, BC, Canada.

8. S Redfield, JM Scalo, and **DS Smith**, 2007. Reconstructing our Interstellar Past: A Look at the Small Scale Structure in the Direction of the Historical Solar Trajectory. SINS—Small Ionized and Neutral Structures in the Diffuse Interstellar Medium ASP Conf. Series, Vol. 365, p. 78.

9. JM Scalo and **DS Smith**, 2004. Lethality of Martian Exposure of Organisms to Large Solar Flares, Third NASA Astrobiology Science Conference, Moffett Field, CA.

10. **DS Smith**, JM Scalo, and S Redfield, 2004. Statistics and Astrobiological Implications of Cosmic-ray Fluctuations for Habitable Planets in the Interstellar Environment, Third NASA Astrobiology Science Conference, Moffett Field, CA.

11. JM Scalo, **DS Smith**, and JC Wheeler, 2003. Radiative Transfer Study of Exposure of Terrestrial and Martian Organisms During a Large Solar Flare. American Astronomical Society, DPS meeting #35, #19.11; Bulletin of the AAS, Vol. 35, p. 949.

12. A Andreeshchev, JM Scalo, and **DS Smith**, 2002. Very Low Mass Stars as Optimum Sites of Habitable Planets and Their Detection. Second NASA Astrobiology Science Conference, Moffett Field, CA.

13. **DS Smith**, JM Scalo, and JC Wheeler, 2002. Chemical and Astrobiological Effects of Ionizing Irradiation on Planetary Atmospheres. Second NASA Astrobiology Science Conference, Moffett Field, CA.

14. JM Scalo, **DS Smith**, and E Vazquez-Semadeni, 2002. Statistics of Galactic Cosmic Ray Modulation Variations Using Simulations of the Turbulent Interstellar Medium. American Astronomical Society, 201st AAS Meeting, #47.01; Bulletin of the AAS, Vol. 34, p. 1177.

15. **DS Smith**, JM Scalo, JC Wheeler, 2001. Chemical and Astrobiological Effects of Ionizing Irradiation of Planetary Atmospheres, American Astronomical Society, 199th AAS Meeting, #03.13; Bulletin of the AAS, Vol. 33, p. 1305.

16. **DS Smith**, K Wood, B Whitney, S Kenyon, and K Stassun, 1999. Scattered Light Models of Protostellar Envelopes: Multiple Outflow Cavities and Misaligned Circumstellar Disks, American Astronomical Society, 195th AAS Meeting, #02.10; Bulletin of the AAS, Vol. 31, p. 1368.

Skills and Experience

Extensive numerical simulation and modeling, including Monte Carlo simulation of X-ray and gamma-ray transport, magnetohydrodynamic simulation of plasmas, kinetic modeling of cosmic-ray transport, implicit and explicit solution of nonlinear ODEs and PDEs, Fourier analysis, parallel and GPU programming, genetic algorithms, compressed sensing and convex optimization, iterative MRI reconstruction. Statistical analysis and optimization of large data sets.

Proficient with Python, Matlab, C, C++, Julia, R, Fortran, Awk, LaTeX, Microsoft Office, Windows, Linux, and Mac OS X.

Teaching Experience

Vanderbilt University — Fall 2013
Guest lecturer for BME 377 Advanced Quantitative and Functional Imaging

University of Arizona — Spring 2007
Guest lecturer for planetary science survey course

Harvard University — Spring 2002
Teaching Fellow for astronomy survey course

The University of Texas at Austin — Summer 2000
Editor and writer for online astronomy magazine

TA Brown Elementary, Austin, TX — 1999–2000
Astronomy outreach program teacher for 5th grade

Professional Service

Associate Editor for Medical Physics. Referee for Astrophysical Journal, Astrophysical Journal Letters, New Astronomy, Astrobiology, Magnetic Resonance Imaging, Medical Physics, IEEE Transactions in Biomedical Engineering, Journal of Electronic Imaging, Magnetic Resonance in Medicine, NMR in Biomedicine, and Physics in Medicine and Biology.

Member of ISMRM, IEEE, SPIE.

Grant Funding

NIH NCI K25CA176219 (2014–2019) — $740,803
Applying Compressed Sensing to Dynamic Contrast Enhanced MRI of Breast Cancer

Sigma Xi Grants-in-Aid of Research — $1800
Cosmic Rays and the Mutational History of Habitable Planets

Talks Given

1. DCE MRI analysis for the poor, impatient perfectionists; Dec 2014, Cancer Imaging Group
2. Improving MR Imaging of Cancer using Compressed Sensing; Jan 2014, Cancer Imaging Group
3. Improving MR Imaging of Cancer with Advanced Reconstruction and Imaging Analysis; Nov 2012, Cancer Imaging Group.
4. Progress and Pitfalls in Continuous Golden Angle Radial Imaging; Jun 2012, VUIIS Annual Retreat.
5. Progress toward Clinical Compressed Sensing MRI; Nov 2011, Cancer Imaging Group.
6. Applications of Compressed Sensing; Jan 2011, VUIIS Seminar.
7. Improving Cancer Imaging with Compressed Sensing MRI; Oct 2010, Cancer Imaging Group.
8. Hybrid Simulations of Pickup Ion Acceleration and Transport; Nov 2007, National Solar Observatory.
9. Hybrid Code Modeling of Pickup Ion Transport; May 2007, National Solar Observatory.
10. Pickup Ion Anisotropies in the Solar Wind; Lunar and Planetary Laboratory Conference, May 2007, U. of Arizona.

11. Benefits of Ada for Scientific Computing; Theoretical Astrophysics Symposium, Mar 2007, U. of Arizona.
12. Astrophysical Radiation Environments of Habitable Worlds; Dissertation Defense, Aug 2006, UT-Austin.
13. Solar X-ray Flare Hazards on the Martian Surface; Theoretical Astrophysics Symposium, Mar 2006, U. of Arizona.
14. Astrospheres, Magnetospheres, and Cosmic-ray Planetary Environments; Planets and Life Seminar, Oct 2004, UT-Austin.
15. Astrobiology and Exogenetics; Harrington Board Luncheon, Apr 2004, Amarillo, TX.
16. Exposure of Terrestrial-like Planet Surfaces to Ionizing Radiation and Cosmic Rays; Second-year Defense, May 2003, UT-Austin.
17. Transport of Ionizing Radiation in Habitable Exoplanet Atmospheres; Planets and Life Seminar, Oct 2002, UT-Austin.
18. The Origin of Water on Earth, Star and Planet Formation Journal Club; Jan 2002, Harvard-Smithsonian Center for Astrophysics.
19. CO Formation in Supernovae; Interstellar Medium Seminar, May 2001, UT-Austin.