

**Contact Information**

Title: Head, Image Analysis Core  
UC Davis Center for Molecular and Genomic Imaging  
University of California, Davis  
E-mail: [zharmany@gmail.com](mailto:zharmany@gmail.com)  
Twitter: [@ZacHarmany](https://twitter.com/ZacHarmany)  
Web: <http://drz.ac>  
Phone: (919) 308-2702

**Research Interests**

Signal, Image, and Video Processing, Statistical Signal Processing, Convex Optimization, Machine Learning, Online Learning, Statistical Learning Theory, Compressed Sensing, Inverse Problems, Medical Imaging, Spectral Imaging, Statistical and Mathematical Modeling, Fluorescent Microscopy, Histopathological Quantitative Image Analysis

**Education****Ph.D., Electrical and Computer Engineering**, Oct 2012

Duke University, Durham, NC

- Thesis: *Computational Optical Imaging Systems: Sensing Strategies, Optimization Methods, and Performance Bounds*
- NIH T-32 Medical Imaging Training Grant Fellow
- Advisor: Prof. Rebecca M. Willett

**B.S., Electrical Engineering**, May 2006

The Pennsylvania State University, University Park, PA

- Thesis: *Sampling and Reconstruction for Hybrid Digital-Optical Imaging Devices*
- *Magna cum Laude*, with Honors in the major of Electrical Engineering
- Advisor: Prof. Nirmal K. Bose

**B.S., Physics**, May 2006

The Pennsylvania State University, University Park, PA

- Electronics Option (emphasis on topics in electrical and computer engineering)
- *Cum Laude*, Minor in Mathematics

**Professional Experience****UC Davis Center for Molecular and Genomic Imaging**, Davis, CA**Head, Image Analysis Core**, March 2017 – Present

- Provides expert guidance for image analysis, image reconstruction, and image processing for biomedical research

**UC Davis Medical Center**, Sacramento, CA**Assistant Project Scientist**, March 2015 – Present

- Department of Pathology and Laboratory Medicine
- Applying novel signal processing and machine learning methods to histopathological images
- Developing cross-platform graphical interfaces to fluorescent microscopy data visualization algorithms for use in pathological diagnosis and analysis
- Employing coded excitation for enhanced depth resolution in wide-field fluorescence microscopy.
- Designing GPU-accelerated (OpenCL) convex optimization algorithms
- Collaboration with Prof. Richard M. Levenson.

**AFRL/RI Information Institute**, Rome, NY

**Visiting Researcher**, June 2014 – July 2014

- 2014 Visiting Faculty Research Program awardee: On-site collaboration with Air Force Research Laboratory Information Directorate personnel
- Designed and analyzed moving target defense (MTD) IP hopping strategies for increased privacy, security, and reliability of networked defense systems
- Visiting Faculty Research Program Extension Grant awardee: Additional funding for continued independent research

**University of Wisconsin-Madison**, Madison, WI

**Postdoctoral Research Associate**, November 2012 – December 2014

- Department of Electrical and Computer Engineering
- Wisconsin Institute for Discovery (Optimization Research Theme), a transdisciplinary research institute and the public half of the joint public/private Discovery partnership
- Studied convex optimization approaches for community detection in large-scale networks and other machine learning tasks
- Collaboration with Prof. Robert D. Nowak.

**Duke University**, Durham, NC

**Graduate Research Assistant**, August 2006 – October 2012

- Department of Electrical and Computer Engineering
- Research areas: machine learning and signal processing with applications to photon-limited imaging, compressed sensing, biomedical image analysis
- Presented original research at many national and international conferences
- Research mentor for two Masters students and one PhD student

**University of Wisconsin-Madison**, Madison, WI

**Visiting Researcher**, May 2012

- Department of Electrical and Computer Engineering and the Laboratory for Computational and Optical Instrumentation (LOCI)
- Joint collaboration with Prof. Robert D. Nowak and Kevin W. Eliceiri
- Developed computational tools for denoising multiphoton fluorescence microscopy data requiring statistical and mathematical modeling of the imaging system
- Maintained a GitHub repository for large-scale imaging datasets and MATLAB code

**The University of California, Merced**, Merced, CA

**Visiting Researcher**, January 2010 – May 2010

- Department of Applied Mathematics
- Developed reconstruction methods for constrained sparsity-regularized inverse problems, with applications to photon-limited imaging and video reconstruction
- Mentored two Masters students with interests in signal processing and applied mathematics
- Collaboration with Prof. Roummel F. Marcia

**Teaching Experience**

**The University of California, Merced, Merced, CA**

**Visiting Instructor**, Spring 2010

- Math 289: *Wavelets and Multiscale Analysis* (Graduate Directed Group Study)
- Team-taught with Prof. Roummel F. Marcia, including lecturing and facilitating group discussion

**Duke University, Durham, NC**

**Teaching Assistant**, Fall 2009

- ECE 189: *Image Processing* (Undergraduate)
- Instructor: Prof. Rebecca M. Willett
- Responsible for homework grading, project report grading, and providing homework solutions
- Held twice-weekly office hours for students

**Teaching Assistant**, Spring 2009

- ECE 282: *Digital Signal Processing* (Graduate)
- Instructor: Prof. Rebecca M. Willett
- Responsible for grading homework and providing homework solutions
- Held twice-weekly office hours for students

**Peer-reviewed Publications**

- [1] J. L. Mueller, **Z. T. Harmany**, J. K. Mito, S. A. Kennedy, Y. Kim, L. Dodd, J. Geradts, D. G. Kirsch, R. M. Willett, J. Q. Brown, and N. Ramanujam, “Quantitative segmentation of fluorescence microscopy images of heterogeneous tissue: Application to the detection of residual disease in tumor margins,” *PLoS ONE*, vol. 8, p. e66198, June 2013. doi:10.1371/journal.pone.0066198
- [2] J. Salmon, **Z. T. Harmany**, C.-A. Deledalle, and R. M. Willett, “Poisson noise reduction with non-local PCA,” *Journal of Mathematical Imaging and Vision*, pp. 1-16, 2013. doi:10.1007/s10851-013-0435-6
- [3] **Z. T. Harmany**, R. F. Marcia, R. M. Willett, “This is SPIRAL-TAP: Sparse Poisson Intensity Reconstruction ALgorithms—Theory and Practice,” *IEEE Transactions on Image Processing*, vol. 21, pp. 1084–1096, Mar. 2012. doi:10.1109/TIP.2011.2168410
- [4] M. Raginsky, S. Jafarpour, **Z. T. Harmany**, R. F. Marcia, R. M. Willett, and R. Calderbank, “Performance bounds for expander-based compressed sensing in Poisson noise,” *IEEE Transactions on Signal Processing*, vol. 59, pp. 4139–4153, Sept. 2011. doi:10.1109/TSP.2011.2157913
- [5] M. Raginsky, **Z. T. Harmany**, R. F. Marcia, and R. M. Willett, “Compressed sensing performance bounds under Poisson noise,” *IEEE Transactions on Signal Processing*, vol. 58, no. 8, pp. 3990–4002, Aug. 2010. doi:10.1109/TSP.2010.2049997

**In-review Journal Publications**

- [1] F. Fereidouni, **Z. T. Harmany**, M. Tian, A. Todd, J. Kintner, M. Lechpammer, S. G. Demos and R. L. Levenson, “Microscopy with UV Surface Excitation (MUSE) for Rapid Histology,” submitted to *Nature Biomedical Engineering*.

**Book  
Chapters**

- [1] **Z. T. Harmany**, F. Fereidouni, R. L. Levenson, “Spectral unmixing methods and tools for the detection and quantitation of collagen and other macromolecules in tissue specimens,” *Fibrosis: Methods and protocols*, edited by Laure Rittié, Methods in Molecular Biology Series, Springer, *Appearing 2017*.
- [2] R. F. Marcia, R. M. Willett, and **Z. T. Harmany**, “Compressive optical imaging: Architectures and algorithms,” *Optical and Digital Image Processing Fundamentals and Applications*, edited by G. Cristobal, P. Schelkens, and H. Thienpont, Wiley-VCH Verlag GmbH & Co. KGaA, 2011.

**Conference  
Publications**

- [1] R. M. Levenson, **Z. T. Harmany**, S. G. Demos, and F. Fereidouni, “Slide-free histology via MUSE: UV surface excitation microscopy for imaging unsectioned tissue,” *SPIE Photonics West*, 2016.
- [2] A. K. Oh, **Z. T. Harmany**, and R. M. Willett, “To  $e$  or not to  $e$  in Poisson image reconstruction,” *IEEE International Conference on Image Processing (ICIP)*, 2014. Top 10% Paper Recognition at ICIP 2014.
- [3] **Z. T. Harmany**, R. F. Marcia, and R. M. Willett, “Dual-scale masks for spatio-temporal compressive imaging,” *IEEE Global Conference on Signal and Information Processing (GlobalSIP)*, pp. 1045–1048, Dec. 2013. doi:10.1109/GlobalSIP.2013.6737073
- [4] A. K. Oh, **Z. T. Harmany**, and R. M. Willett, “Logarithmic total variation regularization for cross-validation in photon-limited imaging,” *IEEE International Conference on Image Processing (ICIP)*, 2013.
- [5] J. L. Mueller, **Z. T. Harmany**, J. K. Mito, S. A. Kennedy, Y. Kim, L. Dodd, J. Geradts, D. G. Kirsch, R. M. Willett, J. Q. Brown, N. Ramanujam, “Quantitative segmentation of fluorescence microscopy images of heterogeneous tissue: Approach for tuning algorithm parameters”, *Proceedings of SPIE 8587, Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues XI*, pp. 85871F, Feb. 2013. doi:10.1117/12.2006429
- [6] **Z. T. Harmany**, X. Jiang, R. M. Willett, “The value of multispectral observations in photon-limited quantitative tissue analysis,” *IEEE Statistical Signal Processing Workshop (SSP)*, 2012.
- [7] J. Salmon, C.-A. Deledalle, R. M. Willett, **Z. T. Harmany**, “Poisson noise reduction with non-local PCA,” *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2012.
- [8] **Z.T. Harmany**, A. K. Oh, R. F. Marcia, R. M. Willett, “Motion-adaptive compressive coded apertures,” *Proceedings of SPIE*, vol. 8165, pp. 81651C–81651C-5, Sept. 2011.
- [9] **Z. T. Harmany**, J. Mueller, J. Q. Brown, N. Ramanujam, R. M. Willett, “Tissue quantification in photon-limited microendoscopy,” *Proceedings of SPIE*, vol. 8138, pp. 81380F–81380F-6, Sept. 2011.
- [10] **Z. T. Harmany**, D. O. Thompson, R. M. Willett, and R. F. Marcia. “Gradient projection for linearly constrained convex optimization in sparse signal recovery,” *IEEE International Conference on Image Processing (ICIP)*, pp. 3361–3364, Sept. 2010.
- [11] D. O. Thompson, **Z. T. Harmany**, and R. F. Marcia, “Sparse video recovery using linearly constrained gradient projection,” *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, pp. 1329–1332, May 2011.

- [12] J. Hernandez, **Z. T. Harmany**, D. O. Thompson, and R. F. Marcia, “Bounded gradient projection methods for sparse signal recovery,” *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, pp. 949–952, May 2011.
- [13] R. F. Marcia, **Z. T. Harmany**, and R. M. Willett. “Compressive coded apertures for high-resolution imaging,” *Proceedings of SPIE*, vol. 7723, pp. 772304–772304-11, Apr. 2010.
- [14] R. M. Willett, **Z. T. Harmany**, and R. F. Marcia. “Poisson image reconstruction with total variation regularization,” *IEEE International Conference on Image Processing (ICIP)*, pp. 4177–4180, Sept. 2010.
- [15] **Z. T. Harmany**, R. F. Marcia, and R. M. Willett. “SPIRAL out of convexity: Sparsity-regularized algorithms for photon-limited imaging,” *Proceedings of SPIE*, vol. 7533, pp. 75330R–75330R-12, Feb. 2010.
- [16] **Z. T. Harmany**, R. F. Marcia, and R. M. Willett. “Sparsity-regularized photon-limited imaging,” *IEEE International Symposium on Biomedical Imaging: From Nano to Macro (ISBI)*, pp. 772–775, Apr. 2010.
- [17] **Z. T. Harmany**, R. F. Marcia, and R. M. Willett. “Sparse Poisson intensity reconstruction algorithms,” *IEEE Workshop on Statistical Signal Processing (SSP)*, pp. 634–637, 2009.
- [18] R. F. Marcia, **Z. T. Harmany**, and R. M. Willett. “Compressive coded aperture imaging,” *Proceedings of SPIE Computational Imaging VII*, pp. 72460G–72460G-13, 2009.
- [19] **Z. T. Harmany**, R. M. Willett, A. Singh, and R. D. Nowak, “Controlling the error in fMRI: hypothesis testing or set estimation?,” *IEEE International Symposium on Biomedical Imaging (ISB)*, pp. 552–555, May 2008.

#### **Selected Presentations**

- [1] “Challenges in Imaging Informatics,” Heath Informatics Seminar Series, UC Davis Medical School, Oct. 26, 2016.
- [2] “Microscopy with Ultra-violet Surface Excitation,” Biophotonics and Bioimaging Designated Emphasis Meeting, University of California, Davis, Oct. 8, 2015.
- [3] “Challenges in Imaging Informatics,” Heath Informatics Seminar Series, UC Davis Medical School, Oct. 7, 2015.
- [4] “Doing more with less: Photon-limited image processing,” Mouse Biology Program Seminar, Center for Comparative Medicine, University of California, Davis, Mar. 24, 2015.
- [5] “Won’t you be my neighbor?” Systems Information Learning Optimization (SILO) Seminar Series, Wisconsin Institutes for Discovery, Dec. 4, 2013.
- [6] “Nuclear proliferation and convex relaxations: Experimental results of just-in-time research,” Systems Information Learning Optimization (SILO) Seminar Series, Wisconsin Institutes for Discovery, Feb. 19, 2013.
- [7] “Solving inverse problems in imaging: Applications to video and tissue analysis,” ECE Graduate Research Workshop, Duke University, Jan. 19, 2012
- [8] “Sparsity-based reconstruction methods in medical imaging,” Physics and Applied Mathematics Seminar Series, University of California, Merced, Jan. 29, 2010

**Professional  
Activities**

**Peer Reviewer**

- *IEEE Transactions on Image Processing*, 2007–Present
- *IEEE Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 2008–Present
- *IEEE International Conference on Image Processing (ICIP)*, 2009–Present
- *IEEE Statistical Signal Processing Workshop (SSP)*, 2009–Present
- *Conference on Neural Information Processing Systems (NIPS)*, 2009–Present
- *International Conference on Machine Learning (ICML)*, 2011–Present
- *IEEE Signal Processing Letters*, 2012–Present
- *Journal of Machine Learning Research (JMLR)*, 2013–Present
- *SIAM Journal on Imaging Sciences (SIIMS)*, 2013–Present
- *Proceedings of the National Academy of Sciences (PNAS)*, 2013–Present
- *IEEE Transactions on Computational Imaging*, 2016–Present
- *Biomedical Optics Express*, 2016–Present
- *Bioinformatics*, 2016–Present
- *Optics Communications*, 2016–Present
- *Cytometry Part A*, 2016–Present

**Professional Societies**

- IEEE (Signal Processing Society, Information Theory Society), 2006–Present
- SIAM, 2008–Present
- SPIE, 2009–Present

**Other Activities**

- Startup Weekend Sacramento: Health Edition, April 29–May 1, 2016,  
Member of winning team (PT Track)
- Health 2.0 at HackerLab Sacramento, 2015–Present
- Engineering Track Cochair for Duke Engineering Entrepreneurship Week, 2008

**Skills**

**Programming** MATLAB, Mathematica, C, Python, Swift, R, Ruby, HTML, CSS, JavaScript, Bash Scripting, AppleScript

**Other Software** Git, SVN, L<sup>A</sup>T<sub>E</sub>X, OS X, iOS, ImageJ, Adobe Creative Suite, Microsoft Office