Zachary Taylor Harmany

Contact Information	Title: Assistant Project Scientist Department of Pathology and Laboratory Medicine UC Davis Medical Center E-mail: zarmany@gmail.com Twitter: @ZacHarmany Web: http://drz.ac Phone: (919) 308-2702

Research Interests

Machine Learning, Convex Optimization, Online Learning, Statistical Learning Theory, Image and Video Processing, Statistical Signal Processing, 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 Medical Center, Sacramento, CA

Assistant Project Scientist, March 2015 – Present

- 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.
- Collaboration with Prof. Richard M. Levenson.

AFRL/RI Information Institute, Rome, NY

Visiting Researcher, June 2014 – July 2014

- Awarded a 2014 Visiting Faculty Research Program appointment, allowing on-site collaboration with Air Force Research Laboratory Information Directorate personnel.
- Collaborated on the design and analysis of moving target defense (MTD) IP hopping strategies for increased privacy, security, and reliability of networked defense systems.
- Subsequently awarded a Visiting Faculty Research Program Extension Grant, enabling continued research after the conclusion of the program.

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
- Studying 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 Asistant, 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
- Mentored two Masters students and one PhD student in signal processing research

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
- Collaboration with Prof. Roummel F. Marcia
- 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

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

Book Chapters

[1] 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] 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.

[2] 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.

[3] 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

[4] **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.

[5] 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.

[6] **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.

[7] **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.

[8] **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.

[9] 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.

[10] 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.

[11] 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.

[12] 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.

[13] **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.

[14] **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.

[15] **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.

[16] 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.

[17] **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] "Microscopy with Ultra-violet Surface Excitation," Biophotonics and Bioimaging Designated Emphasis Meeting, University of California, Davis, Oct. 8, 2015.

[2] "Challenges in Imaging Informatics," Heath Informatics Seminar Series, UC Davis Medical School, Oct. 7, 2015.

[3] "Doing more with less: Photon-limited image processing," Mouse Biology Program Seminar, Center for Comparative Medicine, University of California, Davis, Mar. 24, 2015.

[4] "Won't you be my neighbor?" Systems Information Learning Optimization (SILO) Seminar Series, Wisconsin Institutes for Discovery, Dec. 4, 2013.

[5] "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.

[6] "Solving inverse problems in imaging: Applications to video and tissue analysis," ECE Graduate Research Workshop, Duke University, Jan. 19, 2012

[7] "Sparsity-based reconstruction methods in medical imaging," Physics and Applied Mathematics Seminar Series, University of California, Merced, Jan. 29, 2010

Professional Activities

Peer Reviewer
- *Conference on Neural Information Processing Systems (NIPS)*
- *International Conference on Machine Learning (ICML)*
- *IEEE Transactions on Image Processing (TIP)*
- *IEEE International Conference on Image Processing (ICIP)*
- *IEEE Statistical Signal Processing Workshop (SSP)*
- *SIAM Journal on Imaging Sciences (SIIMS)*
- *Proceedings of the National Academy of Sciences (PNAS)*

Professional Societies
- IEEE, Graduate Student Member
  Signal Processing Society, Information Theory Society
- SIAM Student Member
- SPIE Member

Other Activities
- Health 2.0 at HackerLab Sacramento
- 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, LaTeX, OS X, iOS, ImageJ, Adobe Creative Suite, Microsoft Office