Zachary Taylor Harmany

curriculum vitae

Contact Information

Title: Postdotoral Research Associate
Department of Electrical and Computer Engineering
The Univeristy of Wisconsin-Madison
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Research Interests

Signal Processing, Communications, Inverse Problems, Estimation Theory, Prediction, Convex Optimization, Nonlinear Programming, Compressed Sensing, Subspace Tracking, Level Set Estimation, Adaptive Filtering, Photon-limited Imaging, Image Processing, Video Processing, Spectral Imaging, Medical Imaging, Emission Tomography, Astronomy, Night Vision, fMRI, Computational Optics, Multi-photon Microscopy.

Education

Ph.D., Electrical and Computer Engineering, Oct 2012
Duke University, Durham, NC

- Thesis Topic: *Computational Optical Imaging Systems: Sensing Strategies, Optimization Methods, and Performance Bounds.*
- Advisor: Rebecca M. Willett
- Area of Study: Signal Processing & Communications

B.S., Electrical Engineering, May 2006
The Pennsylvania State University, University Park, PA

- *Magna cum Laude*, with Honors in Electrical Engineering
- Signal Processing & Communications specialization
- Undergraduate Thesis Advisor: Nirmal K. Bose
- Thesis Topic: *Sampling and Reconstruction for Hybrid Digital-Optical Imaging Devices*

B.S., Physics, May 2006
The Pennsylvania State University, University Park, PA

- *Cum Laude*, Electronics Option
- Minor in Mathematics

Refereed Journal Publications

[1] 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

[2] 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

[3] 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

Submitted Journal Publications

[4] 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, "High-resolution quantitative pathology in heterogeneous tissues: Application to tumor margins," submitted to *Radiology*.

[5] Z.T. Harmany, R.F. Marcia, R.M. Willett, "Spatio-temporal compressed sensing with coded apertures and keyed exposures," submitted to *IEEE Transactions on Image Processing*.

[6] J. Salmon, C.-A. Deledalle, R.M. Willett, Z.T. Harmany, "Poisson noise reduction with non-local PCA," submitted to *Journal of Mathematical Imaging and Vision (JMIV)*.

Book Chapters

[7] 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

[8] 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.

[9] 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.

[10] Z.T. Harmany, A. Oh, R.F. Marcia, R.M. Willett, "Motion-adaptive compressive coded apertures," *Proceedings of SPIE*, vol. 8165, pp. 81651C–81651C-5, Sept. 2011.

[11] 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.

[12] 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.

[13] 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.

[14] 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.

[15] 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.

[16] 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.

[17] 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.

[18] 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.

[19] 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.

[20] 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.

[21] Z.T. Harmany, R.M. Willett, A. Singh, and R. Nowak, "Controlling the error in fMRI: hypothesis testing or set estimation?," *IEEE International Symposium on Biomedical Imaging (ISB)*, pp. 552–555, May 2008.

Teaching Experience

The University of California, Merced Merced, CA

Visiting Instructor **Spring 2010**

- Math 289: Directed Group Study *Wavelets and Multiscale Analysis*
- Co-lead a discussion group with Prof. Roummel F. Marcia

Duke University, Durham, NC

Teaching Assistant **Fall 2009**

- ECE 189: Image Processing
- 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
- Instructor: Prof. Rebecca M. Willett
- Responsible for grading homework and providing homework solutions
- Held twice-weekly office hours for students

Professional Experience

The University of Wisconsin-Madison, Madison, WI

Visiting Researcher **May 2012**

- Joint collaboration with Prof. Robert D. Nowak and Kevin W. Eliceiri
- Developed computational tools reconstructing photon-limited multiphoton microscopy data utilizing a multi-photon microscope at the Laboratory for Computational and Optical Instrumentation (LOCI).

The University of California, Merced, Merced, CA

Visiting Researcher **January 2010 – May 2010**

- Collaboration with Prof. Roummel F. Marcia
- Developed reconstruction methods for constrained sparsity-regularized inverse problems, with applications to photon-limited imaging and video reconstruction.

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

- Engineering Track Cochair for Duke Engineering Entrepreneurship Week 2008

References Available to Contact

Dr. Rebecca M. Willett (e-mail: willett@duke.edu; phone: +1-919-660-5544)

- Assistant Professor, Electrical and Computer Engineering, Duke University
  - Box 90291, Durham, NC 27708
  - ⋆ *Dr. Willett was my PhD advisor.*

Dr. Roummel F. Marcia (e-mail: rmarcia@ucmerced.edu; phone: +1-209-228-4874)

- Associate Professor, Applied Mathematics, The University of California, Merced
  - 5200 North Lake Road, Merced, CA 95343
  - ⋆ *Dr. Marcia was my advisor while I was a visiting researcher at UC Merced and a collaborator on numerous papers.*