

# Matthew J. Hirn

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## CURRENT POSITION

2013-Present *Chercheur Contractuel*, École normale supérieure, Département d'Informatique  
Member of the Data Team (head: Stéphane Mallat)

## RESEARCH INTERESTS

Applied analysis, with particular emphasis on:

- Wavelet and scattering transforms
- Manifold learning via diffusion processes
- Lipschitz extensions and more generally smooth extensions
- Algorithmic issues related to computing smooth interpolants
- Shortest path metrics
- Frame theory
- Applications to image analysis, hyperspectral image analysis, biological data, dynamical systems, fluid mechanics

## APPOINTMENTS HELD

Jun-Aug, 2013 *Visiting Assistant Professor*, Cornell University, Department of Mathematics  
Director of REU project on high dimensional data analysis

2009-2013 *Postdoctoral Associate*, Yale University, Department of Mathematics  
Mentor: Ronald R. Coifman

## EDUCATION

- 2004-2009 PhD in Mathematics, University of Maryland  
Thesis: Enumeration of harmonic frames and frame based dimension reduction  
Advisors: John J. Benedetto and Kasso Okoudjou
- 2000-2004 BA in Mathematics, Cornell University  
Senior Thesis: The refinability of step functions  
Advisor: Robert R. Strichartz

## FELLOWSHIPS & GRANTS

- 2013 SIAM Early Career Travel Award (declined)
- 2012-2014 AMS-Simons Travel Grant
- 2009 Ann G. Wylie Dissertation Fellowship, University of Maryland
- 2009 VIGRE Dissertation Fellowship, University of Maryland (declined)

## SHORT-TERM INVITATIONS

- 2012 Scientific Researcher, Fields Institute
- 2011 Visiting Researcher, Institute of Research of Mathematics of Rennes

## PUBLICATIONS

### PREPRINTS

- 2013 Matthew J. Hirn. Algorithms for computing the optimal Lipschitz constant of interpolants with Lipschitz derivative. Submitted. arXiv:1307.3292.
- 2012 Matthew J. Hirn and Erwan Le Gruyer. A general theorem of existence of quasi absolutely minimal Lipschitz extensions. Submitted. arXiv:1211.5700.

### PEER REVIEWED

- 2013 Ronald R. Coifman and Matthew J. Hirn. Diffusion maps for changing data. To appear in *Applied and Computational Harmonic Analysis*. arXiv:1209.0245.
- 2013 Ronald R. Coifman and Matthew J. Hirn. Bi-stochastic kernels via asymmetric affinity functions. *Applied and Computational Harmonic Analysis*, volume 35, number 1, pages 177-180, 2013. arXiv:1209.0237.
- 2012 Martin Ehler and Matthew J. Hirn. Sparse endmember extraction and demixing. In *Proceedings of the IEEE 2012 International Geoscience and Remote Sensing Symposium*, pages 1385-1388, Munich, Germany, July 22-27, 2012.
- 2010 Matthew J. Hirn. The number of harmonic frames of prime order. *Linear Algebra and Its Applications*, volume 432, number 5, pages 1105-1125, 2010. arXiv:1209.0153.
- 2010 John J. Benedetto, Wojciech Czaja, Martin Ehler, Justin C. Flake, and Matthew J. Hirn.

Wavelet packets for multi and hyperspectral imagery. In *Proceedings of IS&T/SPIE Electronic Imaging 2010, Wavelet Applications in Industrial Processing VII*, San Jose, California, January 2010.

- 2009 John J. Benedetto, Wojciech Czaja, Justin C. Flake, and Matthew J. Hirn. Frame based kernel methods for automatic classification in hyperspectral data. In *Proceedings of the IEEE 2009 International Geoscience and Remote Sensing Symposium*, volume 4, pages 697-700, Cape Town, South Africa, July 12-17, 2009.
- 2008 Matthew J. Hirn. The refinability of step functions. *Proceedings of the American Mathematical Society*, volume 136, number 3, pages 899-908, 2008.

#### EXPOSITORY ARTICLES

- 2013 Matthew J. Hirn. Distinguished lecture series: Assaf Naor on the Lipschitz extension problem. *Fields Notes*, volume 12, number 3, page 14, Winter 2013.

#### UNPUBLISHED ARTICLES

- 2007 Matthew J. Hirn and David Widemann. Frames for subspaces of  $\mathbb{C}^n$ . Available online at <http://www.math.yale.edu/~mh644/>.

#### TALKS

- Sep 3, 2013 Diffusion maps for changing data. Statistics Mathematics and Applications, Fréjus, France
- Jul 3, 2013 Diffusion geometry for high dimensional data. Smorgasbord Seminar, Cornell University
- Feb 21, 2013 Quasi absolutely minimal Lipschitz extensions. Analysis Seminar, Yale University
- Dec 3, 2012 New developments in the theory of absolutely minimal Lipschitz extensions. Analysis Seminar, Cornell University
- Nov 29, 2012 Diffusion maps for changing data. Colloquium, Kansas State University
- Nov 5, 2012 Diffusion maps for changing data. Image Analysis Seminar, University of Houston
- Oct 17, 2012 Diffusion maps for changing data. Computational Analysis Seminar, Vanderbilt University
- Oct 2, 2012 Diffusion maps for changing data. Norbert Wiener Center Seminar, University of Maryland
- Aug 28, 2012 A general theorem of existence of quasi absolutely minimal Lipschitz extensions. Workshop on Whitney type extension and trace problems, The Fields Institute
- Jul 26, 2012 Diffusion maps for changing data. Mathematics Colloquium and Informal Seminar, Bell Labs
- Jul 21, 2012 Diffusion maps for changing data. Operator Algebras, Frames, and Undergraduate Research: A Conference in Honor of the 70<sup>th</sup> Birthday of David R. Larson, Texas A&M University
- Jan 23, 2012 Diffusion maps for changing data. Applied Mathematics Seminar, Duke University
- Dec 7, 2011 Minimal interpolants in  $C^{1,1}(\mathbb{R}^n)$ . Groupe de travail “applications des mathématiques,” École Normale Supérieure de Cachan, Antenne de Bretagne, France

- Aug 4, 2011 Wells' construction of interpolants in  $C^{1,1}(\mathbb{R}^n)$ . Fourth Whitney Problems Workshop, College of William and Mary
- Oct 6, 2009 Sparse endmember extraction and demixing. Applied Mathematics Seminar, Yale University
- Aug 21, 2009 Harmonic frames of prime order. Mini-Conference in Harmonic Analysis on the Occasion of John Benedetto's 70<sup>th</sup> Birthday, University of Maryland
- May 9, 2009 Frame based kernel methods for hyperspectral imagery data. Recent Advances in Harmonic Analysis and Elliptic Partial Differential Equations, University of Virginia
- May 1, 2009 Frame based kernel methods for hyperspectral imagery data. Graduation Conference 2009, University of Maryland
- Nov 8, 2007 Uncertainty principles in sparse representation and compressed sensing. Norbert Wiener Center Seminar, University of Maryland
- Sep 20, 2007 Uncertainty principles for finite abelian groups. Norbert Wiener Center Seminar, University of Maryland
- Aug 2, 2002 Mock Fourier series for the standard Cantor measure. Mathematical Association of America Mathfest, Burlington, Vermont

## TEACHING

### LECTURER

- 2010, Fall Math/Amth 244: Discrete Mathematics, Yale University
- 2009, Fall Math/Amth 244: Discrete Mathematics, Yale University
- 2007, Summer Review Course for Analysis PhD Qualifying Exam, University of Maryland
- 2006, Spring Math III: Introduction to Probability, University of Maryland
- 2005, Fall Math III: Introduction to Probability, University of Maryland

### TEACHING ASSISTANT

- 2007, Spring Math 140: Calculus I, University of Maryland
- 2006, Fall Math 141: Calculus II, University of Maryland
- 2005, Spring Math 220: Elementary Calculus I, University of Maryland
- 2004, Fall Math 220: Elementary Calculus I, University of Maryland

## SERVICE TO THE PROFESSION

- 2012-Present Applied Mathematics Seminar co-organizer, Yale University
- 2010-2012 Reference for two former undergraduate students
- 2009-2013 Journal referee for:
- Applied and Computational Harmonic Analysis
  - IEEE Transactions on Information Theory
  - Linear Algebra and Its Applications
  - Neural Computation
  - Proceedings of the American Mathematical Society
  - SIAM Journal on Applied Dynamical Systems

2009 Speaker at Putnam Exam review sessions, Yale University  
2007-2008 Norbert Wiener Center Seminar co-organizer, University of Maryland