Matthew J. Hirn

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Research Interests

high dimensional data analysis; harmonic analysis; data science; machine learning

- Mathematical foundations of deep learning: convolutional neural networks, neural networks on graphs and manifolds, generative models
- Geometric and graphical models for high dimensional data analysis: manifold learning, spectral graph theory, topological data analysis on graphs, graph and node embedding, biomedical data applications
- Machine learning and multiscale physics: physics based machine learning models, quantum chemistry, materials science, quantum computing
- Inverse problems: multi-reference alignment
- Smooth extension and interpolation of data: Whitney-type extensions, Lipschitz extensions, efficient algorithms, statistical learning theory for regression

Positions Held

- *Associate Professor* 2020 – Present
  Assistant Professor 2015 – 2020
  Michigan State University
  Department of Computational Mathematics, Science & Engineering (CMSE)
  Department of Mathematics
  Center for Quantum Computing, Science & Engineering
- *Postdoctoral Researcher* 2013 – 2015
  École normale supérieure
  Department of Computer Science
  Mentor: Stéphane Mallat
- *Postdoctoral Associate* 2009 – 2013
  Yale University
  Department of Mathematics, Program in Applied Mathematics
  Mentor: Ronald R. Coifman

Education

- *PhD in mathematics*, University of Maryland, College Park 2004 – 2009
  Advisors: John J. Benedetto, Kasso Okoudjou
- *BA in mathematics*, Cornell University 2000 – 2004
  Advisor: Robert Strichartz

Awards & Honors

- NSF CAREER 2019
- DARPA Director's Fellowship 2018
- Kavli Fellow 2017
- Alfred P. Sloan Fellowship in Mathematics 2016
- DARPA Young Faculty Award (YFA) 2016
- Ann G. Wylie Dissertation Fellowship 2009

Grants & Funding

- DOE #DE-SC0021152, co-I $750,000 2020 – 2023
- NIH #R01GM135929, PI $1,440,100 2019 – 2023
- NSF #1912906, co-PI $150,000 2019 – 2021
- NSF #1845856 (CAREER), sole PI $400,000 2019 – 2024
- DARPA #D16AP00117 (YFA + Fellowship), sole PI $744,297 2016 – 2020
- Sloan Foundation #FG-2016-6607 (Fellowship), sole PI $55,000 2016 – 2020
- NSF #1620216, sole PI $191,775 2016 – 2020
- AMS-Simons Travel Grant, sole PI $4,000 2012 – 2015

Short Term Visits

- *Senior Fellow*, Institute for Pure and Applied Mathematics (IPAM) 2016 (fall)
- *Visiting Assistant Professor*, Cornell University 2013 (summer)
- *Scientific Researcher*, Fields Institute 2012 (two weeks)
- *Visiting Researcher*, Institute of Research of Mathematics of Rennes 2011 (three weeks)

Advising

Postdoctoral Mentoring

- Anna Little, CMSE 2017 – Present
- Paul Sinz, CMSE 2017 – Present
- Michael Perlmutter, CMSE 2017 – 2020
  Now a fixed term Assistant Professor at UCLA

Graduate Student Advising

- Nathan Brugnone, 5th year, Community Sustainability/CMSE 2017 – Present
  Co-advised with Prof. Robert Richardson
- Xavier Brumwell, 5th year, CMSE 2016 – Present
- Jieqian He, 5th year, CMSE/Statistics 2016 – Present

- Ryan LaRose, 4rd year, CMSE/Physics 2017 – Present
- Albert Chua, 3rd year, Mathematics 2020 – Present
- Liping Yin, 3rd year, Mathematics 2020 – Present
- Renming Liu, 2nd year, CMSE 2019 – Present
  Co-advised with Prof. Arjun Krishnan
- Sarah McGuire, 2nd year, CMSE 2019 – Present
  Co-advised with Prof. Elizabeth Munch
- Xitong Zhang, 1st year, CMSE 2020 – Present

UNDERGRADUATE RESEARCH MENTORING

- Muawiz Chaudhary 2018 (summer)
- Nikhil Shankar 2018 (summer)
- Ariel Herbert-Voss 2013 (summer)
- Nicholas Marshall 2013 (summer)
- Frederick McCollum 2013 (summer)
- Christian Smith 2013 (summer)
- Keyi Wu 2013 (summer)
- Wendy Zeng 2013 (summer)

SERVICE

EDITORSHIP

- *Sampling Theory, Signal Processing, and Data Analysis*, Editorial Board 2020 – Present
- *Excursions in Harmonic Analysis, Volume 6 - In Honor of John Benedettos 80th Birthday*, Editor

CONFERENCE AND SEMINAR ORGANIZATION

- *One World Mathematics of INformation, Data, and Signals (MINDS) Seminar* 2020 – Present
  Virtual online seminar
- *Multiscale Data Science Inspired by Biological and Physical System* 2020
  SIAM Annual Meeting
- *Deep thoughts on geometric learning & exploration of non-Euclidean data* 2020
  SIAM Conference on Mathematics of Data Science Conference
- *Machine Learning Applied to Nuclear Physics* 2019
  Facility for Rare Isotope Beams
- *Kernel Learning and Harmonic Analysis* 2016
  IPAM Culminating Workshop
- *8th Whitney Problems Workshop* 2015
  Centre International de Rencontres Mathématiques (CIRM)
- *Applied Mathematics Seminar* 2012 – 2013
  Yale University

- *Norbert Wiener Center Seminar* 2007 – 2008
  University of Maryland

Grant Evaluation

- NSF computational mathematics panel member 2020
- Reviewer for DOE grant proposals 2017
- Joint NSF/NIH panel member 2016

Journal and Conference Reviewer

- Applied and Computational Harmonic Analysis (top 10%) 2011 – 2020
- European Journal of Operational Research 2018 – 2019
- IEEE Signal Processing Letters 2013 – 2014
- IEEE Transactions on Circuits and Systems for Video Technology 2018
- IEEE Transactions on Information Theory 2012
- International Conference on Machine Learning (top 5%) 2019
- International Journal of Quantum Chemistry 2018
- Linear Algebra and Its Applications 2009
- Neural Computation 2013
- Neural Information Processing Systems 2019 – 2020
- NPJ Computational Materials 2017
- Proceedings of the American Mathematical Society 2011
- SIAM Journal on Applied Dynamical Systems 2013
- Signal Processing 2014

University Committees

- Chair of the CMSE Undergraduate Studies Committee 2017 – Present
- Engineering College Advisory Council 2020 – Present
- CMSE Reappointment, Promotion, Tenure Committee 2020 – Present
- CMSE Long Term Steering Committee 2017 – 2018
- CMSE/CSE/ECE Hiring Committee (autonomous vehicles) 2017 – 2018
- CMSE/CSE/BME/ECE Hiring Committee (deep learning) 2017 – 2020
- Mathematics/CMSE Hiring Committee 2017 – 2018
- CMSE/ChEMS Hiring Committee (computational materials science) 2016 – 2017

UNIVERSITY OUTREACH

Michigant State University

- Panel member for the "NSF CAREER coffee break" 2020
- Panel member on "Getting Started at MSU" 2018
- CMSE Department promotional talk (Shanghai Jiao Tong University) 2017
- CMSE Department promotional talk (Fudan University) 2017
- Panel member on "Getting Grants" 2016
- Panel member on "How to look for an academic job" 2015

Yale University

- Speaker at Putnam Exam review sessions 2009

TEACHING

MICHIGAN STATE UNIVERSITY

- CMSE 890: Mathematics of Deep Learning. Spring 2020
- MATH 994: Applied and Computational Harmonic Analysis. Spring 2018/2020
- CMSE 820: Mathematical Foundations of Data Science. Spring 2017
- CMSE 201: Introduction to Computational Modeling. Spring 2016, Fall 2018
- MATH 414: Linear Algebra II. Fall 2015

YALE UNIVERSITY

- MATH/AMTH 244: Discrete Mathematics. Fall 2009, Fall 2010

UNIVERSITY OF MARYLAND

- Review Course for Analysis PhD Qualifying Exam. Summer 2007
- Math 111: Introduction to Probability. Fall 2005, Spring 2006

PAPERS

Authors are listed in alphabetical order and are equal contributors (per the convention in Mathematics), unless otherwise noted as: John Smith[*] (first author); Jane Doe[†] (principal investigator).

25. Matthew Hirn and Anna Little.
Wavelet invariants for statistically robust multi-reference alignment.
Information and Inference: A Journal of the IMA, in press, 2020.
Code: `wavelet-invariants`

24. Paul Sinz[*], Michael Swift[*], Xavier Brumwell, Jialin Liu, Kwang Jin Kim, Yue Qi[†], Matthew Hirn[†].
Wavelet Scattering Networks for Atomistic Systems with Extrapolation of Material Properties.
The Journal of Chemical Physics, volume 153, issue 8, 084109 (15 pages), 2020.

23. Michael Perlmutter*, Feng Gao, Guy Wolf and Matthew Hirn†.
Geometric scattering networks on compact Riemannian manifolds.
Proceedings of The First Mathematical and Scientific Machine Learning Conference, Proceedings of Machine Learning Research, volume 107, pages 570–604, 2020.

22. Mathieu Andreux, Tomás Angles, Georgios Exarchakis, Roberto Leonarduzzi, Gasper Rochette, Louis Thiry, John Zarka, Stéphane Mallat, Joakim Andén, Eugene Belilovsky, Joan Bruna, Vincent Lostanlen, Muawiz Chaudhary, Matthew J. Hirn, Edouard Oyallon, Sixhin Zhang, Carmine Cella and Michael Eickenberg.
Kymatio: Scattering Transforms in Python.
Journal of Machine Learning Research, volume 21, number 60, pages 1–6, 2020.
Code: `Kymatio`.

21. Nathan Brugnone*, Alex Gonopolskiy*, Mark Moyle, Manik Kuchroo, David van Dijk, Kevin R. Moon, Daniel Colon-Ramos, Guy Wolf†, Matthew Hirn† and Smita Krishnaswamy†.
Coarse Graining of Data via Inhomogeneous Diffusion Condensation.
In *Proceedings of the 2019 IEEE International Conference on Big Data*, pages 2624–2633, 2019.
Code: `condensation`.

20. Kevin R. Moon*, David van Dijk*, Zheng Wang*, Scott Gigante*, Daniel Burkhardt, William Chen, Kristina Yim, Antonia van den Elzen, Matthew J Hirn, Ronald R Coifman, Natalia B Ivanova, Guy Wolf† and Smita Krishnaswamy†.
Visualizing Structure and Transitions for Biological Data Exploration.
Nature Biotechnology, volume 37, pages 1482-1492, 2019.
Code: `PHATE`.

19. Feng Gao, Matthew Hirn, Michael Perlmutter and Guy Wolf.
Geometric wavelet scattering on graphs and manifolds.
In *Proceedings of SPIE 11138, Wavelets and Sparsity XVIII*, San Diego, California, August 2019.

18. Feng Gao*, Guy Wolf and Matthew Hirn†.
Geometric Scattering for Graph Data Analysis.
Proceedings of the 36th International Conference on Machine Learning, Proceedings of Machine Learning Research, volume 97, pages 2122–2131, 2019.
Code: `geo-scattering-graph-data`.

17. Xavier Brumwell*, Paul Sinz*, Kwang Jin Kim, Yue Qi and Matthew Hirn†.
Steerable Wavelet Scattering for 3D Atomic Systems with Application to Li-Si Energy Prediction.
In *NeurIPS Workshop on Machine Learning for Molecules and Materials*, 10 pages, 2018.
Contributed spotlight talk (only 9 out of 49 papers received a spotlight talk).

16. Michael Perlmutter*, Guy Wolf and Matthew Hirn†.
Geometric Scattering on Manifolds.
Extended abstract in *NeurIPS Workshop on Integration of Deep Learning Theories*, 5 pages, 2018.
Contributed spotlight talk (only 3 out of 40 papers receive a spotlight talk).
Longer version available on arXiv.

15. Nicholas F. Marshall* and Matthew J. Hirn†.
Time-coupled diffusion maps.
Applied and Computational Harmonic Analysis, volume 45, number 3, pages 709–728, 2018.

14. Michael Eickenberg, Georgios Exarchakis, Matthew Hirn, Stéphane Mallat and Louis Thiry.
Solid Harmonic Wavelet Scattering for Predictions of Molecule Properties.

The Journal of Chemical Physics, volume 148, issue 24, 241732 (9 pages), 2018.
Editor's pick.
Code: `Kymatio`.

13. Michael Eickenberg, Georgios Exarchakis, Matthew Hirn and Stéphane Mallat.
Solid Harmonic Wavelet Scattering: Predicting Quantum Molecular Energy from Invariant Descriptors of 3D Electronic Densities.
Advances in Neural Information Processing Systems 30, pages 6540–6549, 2017.
Code: `Kymatio`.

12. Matthew J. Hirn, Stéphane Mallat, and Nicolas Poilvert.
Wavelet scattering regression of quantum chemical energies.
Multiscale Modeling and Simulation, volume 15, number 2, pages 827–863, 2017.
Code: `ScatNet-QM-2D`.

11. Ariel Herbert-Voss, Matthew J. Hirn, and Frederick McCollum.
Computing minimal interpolants in $C^{1,1}(\mathbb{R}^d)$.
Revista Matemática Iberoamericana, volume 33, number 1, pages 29–66, 2017.
Code: `C-1-1-Interpolation`.

10. Tobias Welp*, Guy Wolf, Matthew Hirn and Smita Krishnaswamy†.
A Diffusion-based Condensation Process for Multiscale Analysis of Single Cell Data.
In *ICML Workshop on Computational Biology*, 5 pages, New York, June 24, 2016.

9. Matthew J. Hirn*, Nicolas Poilvert, and Stéphane Mallat†.
Quantum Energy Regression using Scattering Transforms.
arXiv:1502.02077, 2015.

8. Matthew J. Hirn and Erwan Le Gruyer.
A general theorem of existence of quasi absolutely minimal Lipschitz extensions.
Mathematische Annalen, volume 359, number 3-4, pages 595–628, 2014.

7. Ronald R. Coifman and Matthew J. Hirn.
Diffusion maps for changing data.
Applied and Computational Harmonic Analysis, volume 36, number 1, pages 79–107, 2014.
Code: `Diffusion Maps for Changing Data`.

6. 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.

5. 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.

4. Matthew J. Hirn.
The number of harmonic frames of prime order.
Linear Algebra and Its Applications, volume 432, number 5, pages 1105–1125, 2010.

3. 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.

2. 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.

1. Matthew J. Hirn.
The refinability of step functions.
Proceedings of the American Mathematical Society, volume 136, number 3, pages 899–908, 2008.

INVITED TALKS

CONFERENCE AND WORKSHOP TALKS

32. SPIE Wavelets and Sparsity XVIII.
Session on Applications of Frames and Transforms in Neural Networks.
San Diego, California.
Geometric wavelet scattering transforms on graphs and manifolds.
August 14, 2019

31. Fitting Smooth Functions to Data.[1]
University of Texas at Austin.
Fitting $C^{1,1}(\mathbb{R}^n)$ Functions to Data
August 8, 2019

30. International Congress on Industrial and Applied Mathematics.
Mini-symposium on Molecular simulation: dynamics, statistics, learning, and high performance computing.
Universitat de València.
Statistically Robust Multi-Reference Alignment with Wavelet Invariants.
July 16, 2019

29. International Congress on Industrial and Applied Mathematics.
Mini-symposium on Machine Learning for Materials.
Universitat de València.
Learning Material Properties with Multiscale Wavelet Scattering Transforms.
July 15, 2019

28. Third International Conference on Mathematics of Data Science.
City University of Hong Kong.
Learning on graphs and manifolds with geometric wavelet scattering transforms.
June 22, 2019

27. Understanding Many-Particle Systems with Machine Learning 2nd Reunion.
Institute for Pure and Applied Mathematics, UCLA.
Learning with Wavelet Scattering Transforms: Recent Results and Future Directions.
June 12, 2019

26. Scientific Computing Across Scales: Quantum Systems in Cold-matter Physics and Chemistry.
Fields Institute, University of Toronto.

[1] This five day conference consisted of ten lectures by Fields Medalist Charles Fefferman, in addition to five invited lectures on complementary topics delivered by leading experts in the field. I delivered one of the five invited lectures on a complementary topic.

Multiscale Machine Learning for Quantum Many Particle Physics with Wavelet Scattering Transforms.
April 23, 2019

25. AMS Fall Central Sectional Meeting.
Special Session on Extensions-Interpolation-Shape Matching in $\mathbb{R}^d$, Symmetry-Invariance, Algorithms and Related Topics.
University of Michigan.
Fitting Smooth Functions to High Dimensional Data.
October 21, 2018

24. Understanding Many-Particle Systems with Machine Learning 1st Reunion.
Institute for Pure and Applied Mathematics, UCLA.
Solid Harmonic Wavelet Scattering for Prediction of Molecular Properties.
June 14, 2018

23. Understanding Many-Particle Systems with Machine Learning 1st Reunion.[2]
Institute for Pure and Applied Mathematics, UCLA.
Introduction to Understanding Many-Particle Systems with Machine Learning.
June 11, 2018

22. 7th International Conference on Computational Harmonic Analysis.
Vanderbilt University.
Multiscale machine learning for many particle physics with wavelet scattering transforms.
May 15, 2018

21. The Mathematics of Deep Learning.
Institute for Advanced Study, Hong Kong University of Science and Technology.
Three dimensional deep learning and many body physics.
January 8, 2018

20. Geometry and Topology of Data.
Institute for Computational and Experimental Research in Mathematics, Brown University.
Transferring diffusion based manifold learning to trajectories and time varying data.
December 11, 2017

19. Big Data driven Materials Science.
Centre Européen de Calcul Atomique et Moléculaire, EPFL.
Solid Harmonic Wavelet Scattering.
September 11, 2017

18. The 9th Applied Inverse Problems Conference.
Session on Inverse Problems and Low Complexity Models.
Zhejiang University.
Deep Wavelet Scattering: Towards Mathematical Understanding of Convolutional Networks through Physics, Probability and Manifolds.
June 1, 2017

17. First International Conference on Mathematics of Data Science.
Hong Kong Baptist University.
Learning Many Body Physics with Multiscale, Multilayer Machine Learning Architectures.
March 20, 2017

[2]This was an evening lecture presented to the entire congregation at Lake Arrowhead, which consisted of researchers from three separate IPAM long programs.

16. Understanding Many-Particle Systems with Machine Learning Culminating Workshop.
Institute for Pure and Applied Mathematics, UCLA.
Scattering Transform Kernels.
December 13, 2016

15. Understanding Many-Particle Systems with Machine Learning Tutorials.
Institute for Pure and Applied Mathematics, UCLA.
Wavelet Tutorial, Part II.
September 14, 2016

14. Understanding Many-Particle Systems with Machine Learning Tutorials.
Institute for Pure and Applied Mathematics, UCLA.
Wavelet Tutorial, Part I.
September 13, 2016

13. Understanding Many-Particle Systems with Machine Learning Opening Day.[3]
Institute for Pure and Applied Mathematics, UCLA.
Multiscale Machine Learning.
September 12, 2016

12. The 11$^{\text{th}}$ American Institute of Mathematical Sciences (AIMS) Conference on Dynamical Systems, Differential Equations and Applications.
Special Session on Harmonic Analysis and Partial Differential Equations.
Orlando, Florida.
Deep Wavelet Scattering for Quantum Energy Regression.
July 1, 2016

11. American Physical Society March Meeting 2016.[4]
Session on Predicting and Classifying Materials via High-Throughput Databases and Machine Learning.
Baltimore, Maryland.
Deep Wavelet Scattering for Quantum Energy Regression.
March 15, 2016

10. 8$^{\text{th}}$ Whitney Problems Workshop.
CIRM, Luminy, France.
Computing Minimal Interpolants in $C^{1,1}(\mathbb{R}^d)$ (with A. Herbert-Voss and F. McCollum).
October 22, 2015

9. PASC15 Conference.
Minisymposium on Big Data Analytics for Novel Materials Discovery.
ETH Zürich.
Quantum Energy Regression by Scattering Transforms.
June 1, 2015

8. Foundations of Computational Mathematics Conference 2014.
Workshop A2: Computational Harmonic Analysis, Image and Signal Processing.
Universidad de la República.
High dimensional learning rather than computing in quantum chemistry.
December 12, 2014

[3]This lecture was one of four given during the opening day retreat, and was meant to set the stage for the semester long program on "Understanding Many-Particle Systems with Machine Learning."

[4]This was a 36 minute invited talk at the March APS meeting, which requires a nomination by the session organizers. It was the only invited talk for this session.

7. 5th International Conference on Computational Harmonic Analysis.
   Vanderbilt University.
   Minimal $C^{1,1}$ extensions.
   May 23, 2014
6. Statistics, Mathematics, and Applications.
   Fréjus, France.
   Diffusion maps for changing data.
   September 3, 2013
5. Workshop on Whitney type extension and trace problems.
   Fields Institute, University of Toronto.
   A general theorem of existence of quasi absolutely minimal Lipschitz extensions.
   August 28, 2012
4. Operator Algebras, Frames, and Undergraduate Research: A Conference in Honor of the 70th Birthday of David R. Larson.
   Texas A&M University.
   Diffusion maps for changing data.
   July 21, 2012
3. Fourth Whitney Problems Workshop.
   College of William and Mary.
   Wells' construction of interpolants in $C^{1,1}(\mathbb{R}^n)$.
   August 4, 2011
2. Mini-Conference in Harmonic Analysis on the Occasion of John Benedetto's 70th Birthday.
   University of Maryland, College Park.
   Harmonic frames of prime order.
   August 21, 2009
1. Graduation Conference 2009.
   University of Maryland, College Park.
   Frame based kernel methods for hyperspectral imagery data.
   May 1, 2009

Seminar Talks

29. RWTH-Aachen University
    Group Seminar of Prof. Holger Rauhut
    Understanding convolutional neural networks through signal processing: From signals to manifolds to graphs
    November 5, 2020
28. Purdue University.
    Mathematical Data Science Seminar
    Understanding convolutional neural networks through signal processing: From signals to manifolds to graphs
    October 19, 2020
27. Pennsylvania State University.
    Computational and Applied Mathematics Colloquium.
    Multiscale invariant representations for learning on high dimensional data.
    March 2, 2020

26. Lawrence Berkeley National Lab.
Multiscale Machine Learning for Quantum Many Particle Physics with Wavelet Scattering Transforms.
January 6, 2020

25. University of Notre Dame.
Statistics Seminar.
Invariant Data Representations with Multiscale Mathematical Models for ConvNets.
October 1, 2019

24. Michigan State University.
NSCL/FRIB Nuclear Theory Seminar.
Machine Learning for Quantum Many-Particle Physics.
November 13, 2018

23. Michigan State University.
ACRES REU Seminar Series.
Computational Harmonic Analysis and Data Science.
June 6, 2018

22. RWTH-Aachen University.
Center for Computational Engineering Science Seminar.
Multiscale Machine Learning and Many Body Physics.
September 18, 2017

21. Shanghai Jiao Tong University.
Applied Math Seminar.
Multiscale Machine Learning and Many Body Physics.
June 6, 2017

20. Johns Hopkins University.
Data Analysis Seminar.
Learning Many Body Physics with Multiscale, Multilayer Machine Learning Architectures.
March 8, 2017

19. Michigan State University.
Physical Chemistry Seminar.
High Dimensional Learning Rather than Computing in Quantum Chemistry.
November 17, 2015

18. Michigan State University.
Computer Science and Engineering Lecture Series.
High Dimensional Learning Rather than Computing in Quantum Chemistry.
October 9, 2015

17. Michigan State University.
Applied Math Seminar.
Quantum Energy Regression by Scattering Transforms.
September 11, 2015

16. University of Minnesota.
Mathematics Colloquium.
Interpolation for Physical Big Data.
February 26, 2015

15. City College of New York.
Mathematics Colloquium.
Interpolation for Physical Big Data.
February 18, 2015

14. Yale University.
Applied Mathematics Seminar.
High Dimensional Learning rather than Computing in Quantum Chemistry.
February 4, 2015

13. Michigan State University.
Mathematics Colloquium.
Interpolation for Physical Big Data.
January 16, 2015

12. Institut Henri Poincaré.
Analyse non-linéaire et EDP seminar.
Minimal $C^{1,1}$ Extensions.
April 15, 2014

11. École normale supérieure.
Sierra group meeting.
Diffusion based manifold learning (joint talk with Guy Wolf).
October 23, 2013

10. Cornell University.
REU Smorgasbord Seminar.
Diffusion geometry for high dimensional data.
July 3, 2013

9. Yale University.
Analysis Seminar.
Quasi absolutely minimal Lipschitz extensions.
February 21, 2013

8. Cornell University.
Analysis Seminar.
New developments in the theory of absolutely minimal Lipschitz extensions.
December 3, 2012

7. Kansas State University.
Mathematics Colloquium.
Diffusion maps for changing data.
November 29, 2012

6. University of Houston.
Image Analysis Seminar.
Diffusion maps for changing data.
November 5, 2012

5. Vanderbilt University.
Computational Analysis Seminar.
Diffusion maps for changing data.
October 17, 2012

4. University of Maryland.
   Norbert Wiener Center Seminar.
   Diffusion maps for changing data.
   October 2, 2012

3. Bell Labs.
   Mathematics Colloquium and Informal Seminar.
   Diffusion maps for changing data.
   July 26, 2012

2. Duke University.
   Applied Mathematics Seminar.
   Diffusion maps for changing data.
   January 23, 2012

1. École Normale Supérieure de Cachan, Antenne de Bretagne, France.
   Groupe de travail "applications des mathématiques,"
   Minimal interpolants in $C^{1,1}(\mathbb{R}^n)$.
   December 7, 2011