

# Curriculum Vitae: Kevin R. Vixie

## Contact Information

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## Education

**PhD** Mathematics 12/2001

Dissertation Title: **Signals and Hidden Information**

Advisor: **Andrew M. Fraser**

Portland State University – Systems Science Program

**BS** Mathematics 6/1984

Advisors: **Thomas M. Thompson and Kenneth Wiggins**

Walla Walla University – Department of Mathematics

## Employment (since 1992)

**Affiliate Associate Professor** Washington State University, Physics and Astronomy,  
8/2022 – present

**Co-Founder/Co-Leader** iSciMath Project and Institute, January 2020 – present

**Co-Founder/Co-Leader** iSciLabs, January 2022 – September 2022

**Co-Founder/Leader** Complexity, Data and Learning Group, January 2020 – January  
2022

**Founder and Co-leader** TradeSmith Labs, September 2018 - September 2019

**Lead Mathematician and Co-Founder** Sailfan Research, September 2014 - April 2017

**Associate Professor** Washington State University, Mathematics and Statistics, 8/2008 –  
present

**Research Scientist** New Mexico Consortium, 1/2008 – 8/2008

**Member of Technical Staff** Los Alamos National Laboratory, 11/2001 – 8/2008

**Graduate Research Assistant** Los Alamos National Laboratory, 3/1998 – 11/2001

**Graduate Research Assistant** Portland State University, 1/1996 – 3/1998

**Senior Research Associate** Oregon Health Science University, 6/1992 – 12/1995

**Research Interests** 1) Geometric Analysis defined rather broadly to be geometric measure theory with pieces of harmonic and variational analysis as well as PDEs and hard analysis with an interest in geometry in high and infinite dimensions – e.g. concentration of measure, random projections, and 2) prototyping algorithms implementing ideas from 1) for data analysis challenges.

## Publications

- 1 *The generalization of Mathematical Description* (KRV), Proceedings of the 1997 International Institute for General Systems Studies, San Marcos, Texas. In a special issue of *Advances in Systems Science and Applications*, edited by Jeffrey Forrest, p66-71. ([.pdf](#)) ([.ps](#))
- 2 *Persistence and Recurrence in Atmospheric Circulation*, (Andrew M. Fraser, KRV, Richard Smith, and Padhraic Smyth), conference paper at Interface97 held in Houston, Texas May 14-17, 1997. Published in *Computing Science and Statistics*, 1998 pages 121-125. ([.ps](#))
- 3 *The Bispectral Aliasing Test: A Clarification and Some Key Examples*, (KRV, Murray Wolinsky, and David Sigeiti). Conference paper at the *International Symposium on Signal Processing and its Applications* August 22-25, 1999, Brisbane, Australia. Published in the book *Proceedings of the Fifth International Symposium on Signal Processing and Its Applications, 1999. ISSPA '99.*, vol. 1 p255 - 258. ([.pdf](#))
- 4 *Detection of aliasing in deterministic signals* (KRV, David E. Sigeiti and Murray Wolinsky) ([.pdf](#)) ([.ps](#))
- 5 *Signals and Hidden Information* (KRV) Ph.D. Dissertation, 2001 ([.pdf](#)) ([.ps](#))
- 6 *Standard 2D Test Objects for Radiographic Inversion Studies* (T. Asaki and KRV), 2002 LA-UR-02-3978 ([.pdf](#))
- 7 *SVD Analysis for Radiographic Object Reconstruction I: Initial Results*, (Thomas J. Asaki and KRV) 2002 LA-UR-01-6534 ([.pdf](#))
- 8 *SVD Analysis for Radiographic Object Reconstruction II: Null Space Enhancements*, (T. Asaki and KRV), 2002 LA-UR-03-5937 ([.pdf](#))
- 9 *Incorporating invariants in Mahalanobis distance based classifiers: Application to Face Recognition*(Andrew M Fraser, Nicolas Hengartner, KRV and Brendt E. Wohlberg) Proceedings of the IJCNN Portland, Oregon, July 2003. In *Proceedings of the International Joint Conference on Neural Networks, 2003*, vol. 4 p3118-3123. ([.pdf](#)) ([.ps](#))
- 10 *Classification modulo invariance, with application to face recognition* (Andrew M Fraser, Nicolas Hengartner, KRV and Brendt E. Wohlberg), *Journal of Computational and Graphical Statistics*, v 12, p. 829-852, December 2003. ([.pdf](#))
- 11 *SVD Analysis for Radiographic Object Reconstruction III: Total variation regularization*, (Thomas J. Asaki and KRV) 2004 LA-UR-04-7076 ([.pdf](#))
- 12 *Variational Analysis, PDEs and Image Analysis: the big picture and a sampling of details* (Nathan D. George and KRV) Proceedings of “Contemporary Problems in Mathematical Physics”, December 2004 [website](#), ([.ps](#))
- 13 *Information extraction from muon radiography data*, (K. Borozdin, T. Asaki, R. Chartrand, N. Hengartner, G. Hogan, C. Morris, W. Priedhorsky, R. Schirato, L. Schultz, M. Sottile, KRV, B. Wohlberg and G. Blanpied) in ISAS/CITSA 2004: International Conference on Cybernetics and Information Technologies, Systems and Applications and 10th International Conference on Information Systems Analysis and Synthesis, Vol 2,

- Proceedings : Communications, Information and Control Systems, Technologies and Applications, pp. 27–30, 2004 ([.pdf](#))
- 14 *Nonlinear regularizations of TV based PDEs for image processing* (Andrea Bertozzi, John Greer, Stanley Osher and KRV), in “Nonlinear Partial Differential Equations and Related Analysis”, Contemporary Mathematics vol. 371, Edited by GQ Chen, G Gasper, and J Jerome. p.29-40, March 2005, LAUR-04-8435 ([.pdf](#))
  - 15 *Abel inversion using total-variation regularization*, (T. J. Asaki, R. Chartrand, KRV and B. Wohlberg) , Inverse Problems, no. 21, pp. 1895-1903, 2005 ([.pdf](#))
  - 16 *Defensible metrics and merit functions* (KRV and Thomas J. Asaki), 2005 LA-UR-04-8498. ([.pdf](#))
  - 17 *Abel inversion using total-variation regularization: Applications* (Thomas J. Asaki, Patrick R. Campbell, Rick Chartrand, Collin E. Powell, KRV and Brendt E. Wohlberg), Inverse Problems in Science and Engineering, V14, n8, December 2006, 873-885 ([.pdf](#))
  - 18 *Sparse Radiographic Tomography and System Identification Imaging from Single View, Multiple Time Sample Density Plots* (Thomas J. Asaki, Erik M. Bollt and KRV), Computational Methods in Applied Mathematics, V6, n4, 2006 p. 354-366 ([.pdf](#))
  - 19 *Invariant Template Matching with Tangent Vectors* (Brendt E. Wohlberg and KRV) “Optical Engineering”, March 2007, 46(3) 037006, ([.pdf](#))
  - 20 *Optimizing the tracking efficiency for cosmic ray muon tomography* (J.A. Green, C. Alexander, T. Asaki, J. Bacon, G. Blanpied, K. Borozdin, A. Canabal-Rey, M. Cannon, R. Chartrand, D. Clark, C. Espinoza, E. Figueroa, A. Fraser, M. Galassi, J. Gomez, J. Gonzales, A. Green, N. Hengartner, G. Hogan, A. Klimenko, P. McGaughey, G. McGregor, J. Medina, C. Morris, K. Mosher, C. Orum, F. Pazuchanics, W. Priedhorsky, A. Sanchez, A. Saunders, R. Schirato, L. Schultz, M. Sossong, M. Sottile, J. Tenbrink, R. Van de Water, KRV, B. Wohlberg), “Nuclear Science Symposium Conference Record”, 2006 [website](#) ([.pdf](#))
  - 21 *Algorithm for Model Validation: Theory and applications* (D. Sornette, A.B. Davis, K. Ide, KRV, V. Pisarenko, and J.R. Kamm), PNAS 2007 104(16): 6562-6567 ([.pdf](#))
  - 22  *$L^1$  TV computes the flat norm for boundaries* (Simon P. Morgan and KRV), Abstract and Applied Analysis, Volume 2007 (2007), Article ID 45153, 14 pages ([link](#))
  - 23 *Some properties of minimizers for the Chan-Esedoglu  $L^1$ TV functional.* (KRV), ([.pdf](#))
  - 24 *Review of “Deblurring Images: Matrices, Spectra and Filtering”* (KRV) SIAM Review, December 2007 Vol 49 No. 4 pp. 722-725 ([.pdf](#))
  - 25 *Graduated adaptive image denoising: local compromise between total variation and isotropic diffusion* (Pete Schultz, Erik M. Bollt, Rick Chartrand, Selim Esedoglu and KRV), Advances in Computational Mathematics, Online - July 2008 (Journal - 2009, pages 61-85) ([.pdf](#))
  - 26 *A gradient descent solution to the Monge-Kantorovich problem* (Rick Chartrand, KRV, Brendt E. Wohlberg, and Erik M. Bollt) Applied Mathematical Sciences, Vol. 3, 2009, no. 22, 1071-1080, ([.pdf](#))
  - 27 *Multiscale Flatnorm for Shapes and Images* (KRV, Keith Clawson, Thomas J. Asaki, Gary Sandine, Simon P. Morgan, and Brandon Price). *Applied Mathematical Sciences*, vol 4, 2010 no 14, 667 - 680. ([.pdf](#))
  - 28 *Image Denoising by Regularization on Characteristic Graphs* (Thomas J. Asaki, Pavlo Cherepanov, Matthew Sottile and KRV). *Applied Mathematical Sciences*, Vol. 4, 2010,

- no. 52, 2541 - 2560. (.pdf)
- 29 *Flash radiography with 24 GeV/c protons* ( C. L. Morris, E. Ables, K. R. Alrick, M. B. Auferheide, P. D. Barnes Jr., K. L. Buescher, D. J. Cagliostro, D. A. Clark, D. J. Clark, C. J. Espinoza, E. N. Ferm, R. A. Gallegos, S. D. Gardner, J. J. Gomez, G. A. Greene, A. Hanson, E. P. Hartouni, G. E. Hogan, N. S. P. King, K. Kwiatkowski, R. P. Liljestrand, F. G. Mariam, F. E. Merrill, D. V. Morgan, K. B. Morley, C. T. Mottershead, M. M. Murray, P. D. Pazuchanics, J. E. Pearson, J. S. Sarracino, A. Saunders, J. Scaduto, A. E. Schach von Wittenau, R. A. Soltz, S. Sterbenz, R. T. Thompson, KRV, M. D. Wilke, D. M. Wright, and J. D. Zumbro) *Journal of Applied Physics*, Vol 109, number 10, 2011 (.pdf)
  - 30 *There Are Thin Minimizers of the  $L^1$  TV Functional* (Benjamin Van Dyke and KRV). *Abstract and Applied Analysis* Volume 2012 (2012), Article ID 930978, doi:10.1155/2012/930978 (.pdf)
  - 31 *Simplicial Flat Norm with Scale* (Sharif Ibrahim, Bala Krishnamoorthy, and KRV) *Journal of Computational Geometry* Vol 4, number 1, 2013 .pdf (*arXiv preprint* May 2011. .pdf)
  - 32 *Cone Monotonicity: Structure Theorem, Properties, and Comparisons to Other Notions of Monotonicity* (Heather Van Dyke, KRV, Tom J. Asaki) *Abstract and Applied Analysis* Volume 2013, Article ID 134751, 8 pages, 2013. doi:10.1155/2013/134751. (.pdf)
  - 33 *Nonasymptotic Densities for Shape Reconstruction* (Sharif Ibrahim, Kevin Sonnanburg, Thomas J. Asaki, and KRV) *Abstract and Applied Analysis* Volume 2014, Article ID 341910, .pdf (See also the poster: (.pdf) presented at the 2010 SIAM conference on imaging.)
  - 34 *Geometry from Derivatives: from Edges to Tubes* (KRV) in *Proceedings of the Conference to Honor Tom Thompson and Ken Wiggins*.
  - 35 *Flat Norm Decomposition of Integral Currents* (Sharif Ibrahim, Bala Krishnamoorthy, and KRV) *Preprint* <http://arxiv.org/abs/1411.0882>
  - 36 *Some Minimal Shape Decompositions Are Nice* (KRV) (exposition of the paper *Flat Norm Decomposition of Integral Currents*) <http://arxiv.org/abs/1504.04839>
  - 37 *A energy-based interaction model for population opinion dynamics with topic coupling* (Hossein Noorazar, Matt Sottile and KRV) <http://arxiv.org/abs/1607.06806>
  - 38 *A Lower Bound for the Reach of Flat Norm Minimizers* (Enrique Alvarado and KRV) <http://arxiv.org/abs/1702.08068>
  - 39 *Cubical Covers of Sets in  $\mathbb{R}^n$*  (Laramie Paxton and KRV) <https://arxiv.org/abs/1703.02775>
  - 40 *Loss of community identity in opinion dynamics models as a function of inter-group interaction strength* ( Hossein Noorazar, Matthew Sottile, and KRV) <https://arxiv.org/abs/1708.03317>.
  - 41 *Median Shapes* (Yunfeng Hu, Matthew Hudelson, Bala Krishnamoorthy, Altansuren Tumurbaatar, and KRV) <https://arxiv.org/abs/1802.04968>.
  - 42 *A Singular Integral Measure for  $C^{1,1}$  and  $C^1$  Boundaries* (Laramie Paxton and Kevin R. Vixie) <https://arxiv.org/abs/1809.04266>
  - 43 *From classical to modern opinion dynamics* Hossein Noorazar, Kevin R. Vixie, Arghaven Talebanpour, and Yunfeng Hu) <https://arxiv.org/abs/1909.12089>
  - 44 *The Maximum Distance Problem and Minimal Spanning Trees* (Enrique G. Alvarado, Bala Krishnamoorthy and KRV) <https://arxiv.org/abs/2004.07323>

- 45 *Evidence That Sharp Interfaces Suppress Recombination in Thick Organic Solar Cells* (Obaid Alqahtani, Seyed Mehrdad Hosseini, Thomas Ferron, Victor Murcia, Terry McAfee, KRV, Fei Huang, Ardalan Armin, Safa Shoaee, and Brian A. Collins) *ACS Applied Materials & Interfaces*, 2021 <https://pubs.acs.org/doi/10.1021/acsami.1c15570>
- 46 *Cycles Discovery: Metrics, Sparsity, and Needles in a Haystack* (Forbes, Michael M and Noorazar, Hossein and Sandine, Gary and KRV) *Cycles Magazine*, Vol 50, No.4, 2021 <https://journal.cycles.org/Issues/Vol50-No4-2021/>
- 47 *Lipschitz (non-)equivalence of the Gromov–Hausdorff distances, including on ultrametric spaces* (Vladyslav Oles, Kevin R. Vixie) *arXiv.org* <https://arxiv.org/abs/2204.10250>
- 48 *In and Around Geometric Analysis: An Invitation* (Kevin R. Vixie) (*free e-book, November 2023*) [Link to pdf of e-Book](#)

## Various Notes (drafts, etc.)

- 1 Notes from fall 1998 nonlinear control theory prep ([rough notes .pdf](#)) ([rough notes .ps](#))
- 2 Introductory notes I wrote for the 2002 Image analysis workshop ([notes .pdf](#))
- 3 Slides from my IPAM graduate Summer school short course. ([slides .pdf](#))
- 4 Notes from my GMT lectures at UCLA/IPAM spring of 2007. See the links at the end of the 2007 Data Sciences Summer School GMT course [expanded bibliography page](#) for pdf's of the notes. They are hand written, in color with lots of figures.

## Talks

- 1 IIGSS Meeting San Marcos Texas, 1997
- 2 AMS/MAA New Orleans, January 2001
- 3 Snowbird, SIAM Dynamical Systems, May 2001
- 4 Snowbird, SIAM Dynamical Systems, May 2001
- 5 2 talks, Boston, SIAM Imaging Science, March 2002
- 6 2+ talks, LANL Radiography workshop, Aug 2002 ([vixie .pdf](#)) ([asaki .pdf](#))
- 7 LANL Image Analysis Workshop December 2002 ([.pdf](#))
- 8 National Academy of Sciences workshop on Massive Data Streams, December 13, 2002
- 9 Duke University, January 2003
- 10 IJCNN 2003, Portland, Oregon, July 20-24, 2003
- 11 Clarkson University, September 2003
- 12 LACSI, Santa Fe NM October 2003
- 13 LANL, Kamm LDRD-DR review June 2004
- 14 Clarkson University, September 2004 ([.pdf](#)) ([.ps](#)) ([.supplement](#))
- 15 Banff International Research Station, Banff, Alberta October 2004 ([.pdf](#))
- 16 ISR Division, December 2004 ([.pdf](#))
- 17 UMinn/IMA, December 2004
- 18 AMS/MAA, Atlanta January 2005 ([.pdf](#))
- 19 Short Course (3 lectures), IPAM Graduate Summer School 2005, ([part 1](#)) ([part 2](#)) ([part 3](#)) ([.pdf](#)) ([video of part 1](#)) ([video of part 2](#)) ([video of part 3](#))
- 20 AMS Meeting Bard College, October 2005 ([.pdf](#))
- 21 Short Course (5 lectures), Clarkson University, January 2006 ([.pdf days 1-3](#)) ([.pdf days 4-5](#))

- 22 EP Differentials Shape Retreat, Santa Fe, July 2006 ([Link](#))
- 23 Colorado State University Workshop, Sept 2006 - 2 talks  
DDMA Overview Lecture [.pdf](#)  
Geometric Analysis Lecture [.pdf](#)
- 24 DDMA Lecture Series Short Course, Sept 2006 ([.pdf lectures 1-3](#)) ([.pdf lectures 4-5](#))
- 25 DDMA Geometric Analysis Lectures. Continuing lecture series on geometric analysis. October 2006 – present.
- 26 Course in “Geometric Measure Theory”, UCLA/IPAM/LANL, spring 2007
- 27 Lecture, Stan Osher’s Level Set Seminar series, 4/24/2007, “Questions and Answers in Geometric Measure Theory for data Analysis” (white Board talk)
- 28 IPAM, Random Shapes Program, Spring 2007, Lecture in “Workshop IV: Image Processing for Random Shapes: Applications to Brain Mapping, Geophysics and Astrophysics” ([slides and audio here](#))
- 29 Designed and co-taught a course “Geometric Measure theory”, CDDMA summer school, Summer 2007, ([Link](#))
- 30 Clarkson University, January 2008
- 31 Washington State University, March 2008
- 32 SIAM Imaging Science, San Diego July 2008
- 33 Walla Walla University, October 2008
- 34 University of Idaho, January 2009
- 35 Joint Mathematical Meetings, January 2010
- 36 SIAM Imaging Science Meeting, April 2010
- 37 DOE Applied Mathematics Meeting, May 2010; [link to my talk](#)
- 38 PCMI Summer school: 21 Lectures, June-July 2010, [Link to archive page](#)
- 39 CGAD Summer School: I gave several lectures on reach and curvatures measures as well as an introduction to geometric measure theory, July 9-27, 2012, [Link to 2012 CGAD Summer School archive](#)
- 40 University of Alabama: I gave an invited colloquium talk. April, 2013
- 41 Conference to Honor Tom Thompson and Ken Wiggins: I gave one of the talks. May, 2013
- 42 AMS Sectional Meeting, Las Vegas, Nevada, April 2015
- 43 WSU 2016 Data Science Day, April 2016
- 44 WSU 2017 Data Science Day, April 21, 2017 *Data Driven Geometric Measure Theory*
- 45 WSU Analysis Seminar, February 10, 2016, *Regular sets, Cubical Covers and Set Approximation*
- 46 WSU Analysis Seminar, September 7, 2016, *Applications of analysis and geometric measure theory*
- 47 WSU Analysis Seminar, October 19, 2016, *Open Problems and Conjectures in Geometric Analysis*
- 48 WSU Analysis Seminar, February 8, 2017, *When Linear Approximations Work*
- 49 WSU Analysis Seminar, February 15, 2017, *Favorite Analysis Problems: I*
- 50 WSU Analysis Seminar, September 13, 2017, *Concentration of Measure, Again – With Pictures*
- 51 WSU Analysis Seminar, September 20, 2017, KRV and Enrique Alvarado, *Why Learn*

*Analysis + Seven Short Courses: An Invitation*

- 52 WSU Analysis Seminar, February 7, 2018, *Approximation, Cones, and The Implicit Function Theorem*
- 53 WSU Analysis Seminar, February 14, 2018, *Median Shapes: A Guided Tour*
- 54 WSU Analysis Seminar, April 25, 2018, KRV and Enrique Alvarado, *An Invitation to Varifolds + An Announcement*
- 55 WSU Physics and Astronomy Colloquium Talk, October 19, 2023, *Shattered Sets and Fractal Stories* <https://www.youtube.com/watch?v=w3z6wzhcvE0>

## Conferences and Workshops

- **2001 SIAM Dynamical Systems Conference at Snowbird:** Organized 2 Special Sessions on Hidden Markov Models and their applications. One result of these special sessions was a book, authored by Andrew M. Fraser, on Hidden Markov Modeling for dynamical systems.
- **2002 SIAM Imaging Sciences conference in Boston:** Organized 3 Special Sessions on Dynamics and Radiography.
- **2002 LANL Radiography Analysis and Simulation Tools Workshop:** On organizing committee. I gave 2 talks.
- **2002 LANL Image Analysis Workshop:** Organizer of the 2002 workshop on Image Analysis at LANL. I also gave a tutorial.
- **IPAM RIPS Program:** The DDMA team sponsored a RIPS team from the summer 2003 until the summer of 2007.
- **2004 IPAM Multiscale Geometric Analysis Program:** I was a Program Fellow for this program and was in residence during part of the program.
- **2005 IPAM Graduate Summer School:** Organizing Chair and short course lecturer. “Intelligent Extraction of Information from Graphs and High Dimensional Data”. July 11-29, 2005.
- **2007 IPAM Random Shapes Program:** I was a Senior Fellow at the program, spending the entire three month duration at IPAM. I interacted with various participants and members of the UCLA mathematics community, taught a course in geometric measure theory, and gave an invited lecture in one of the program workshops.
- **2007 CDDMA Graduate Summer School:** Helped organize, led one research team, and taught a course in GMT. Summer 2007 (full summer).
- **2009 DCC Summer Research Program:** We had a research summer school at Washington State University our first summer here. 7 students were involved. Two papers and a poster as well as some talks were produced.
- **2010 PCMI Summer School:** I gave 21 lectures and assisted Tom Asaki in the Computational Laboratory piece, both in the Undergraduate Faculty Program (UFP) thread of the summer school which I was the technical lead for.
- **2011 ICIAM, Vancouver CA:** I organized 2 sessions based on the DOE Petascale Project I lead. You can click on the [link to session 1](#) and [session 2](#).
- **2012 CGAD Summer School on Geometry and Data:** I organized the summer school and gave several lectures in collaboration with Alex Meadows. Here is the URL for the summer school: [Archive 2012 Summer School Link](#)

- **2013 Conference to Honor Tom Thompson and Ken Wiggins:** Helped organize, and talked. <http://math.wallawalla.edu/conferences/TomAndKen/>
- **2016 JMM Special Session on Geometry, Analysis and Data:** Helped organize (with Bala Krishnamoorthy). ([Link](#))
- **2016 Data Science Day at WSU:** The A+D Group's 2016 Data Science day was organized with the help of a few students. It turned out to be very effective in getting interaction between participants. ([Link](#))
- **2017 Data Science Day and Linked Events:** I led the organization of the Analysis+Data Group's 2017 Data Science Day on April 21 as well as organization of 3 linked events on Sunday April 23. Laramie Paxton was my (extremely) able co-organizer. This time the number of students helping has grown significantly to about 10.
- **2018 Seminar on Geometric Measure Theory, Varifolds, and Their Applications:** I helped initiate and mentored my two most senior graduate students at the time, Laramie Paxton and Enrique Alvarado, as they led the organization of this event.
- **2024 Physics+Astronomy+Mathematics Data project Kickoff:** I led the organization (with Michael Forbes) of the working group aimed at generation of a steady, growing stream of problems at, and near, the interface(s) between these areas. This in turn is aimed at generating a steady stream of papers and grant proposals, as well as classes. This project involves about 6-8 faculty members in Mathematics and Physics and at 6-8 graduate students.

## Groups and Teams

### Data Driven Modeling and Analysis (DDMA) team:

- With Tom Asaki, I founded the team early 2002. Team grew to about 25 members at LANL and external institutions including Rice, UCLA, Duke, U Michigan, Montana State, U Minnesota and Clarkson.
- Initiated the DDMA workshops, in which we converge on some central location and generate prototype algorithms to solve a wide range of problems for diverse customers. Early 2005.
- Established the DDMA visiting speaker series, winter 2005. This series was put on hold due to difficulties in bringing visitors in and other mostly bureaucratic constraints.
- Established the DDMA lead team, summer 2005. This enabled the principal scientific lead members (Tom Asaki, Matt Sottile, Rick Chartrand and I) to focus the very large majority of our time on our research while still maintaining leadership and creative control on the innovations that characterize the DDMA team. The other member of the Lead team, Katharine Chartrand, was effectively our COO and was the reason we were able to be so effective, scientifically speaking.

### Data Challenge Cooperative:

- This was the reincarnation of the DDMA team at WSU. It was experimental and exploratory and helped us get a sense for what was sustainable at WSU. It was replaced by the *Center for Geometric Analysis and Data*.



## Center for Geometric Analysis and data: 2010-2013

- This center was independent of, but cooperative with and supportive to, both of the local universities. Our members are drawn from the faculty of WSU and of UI. We also had external members that play a key role in the center.
- **CGAD Visitor Program:** I started up the visitor program for the CGAD. We had such visitors as Chris Hedges (Pulitzer Winner, Journalist Author), Triet Le (Yale), Bob Hardt (Rice), Dana Mackenzie (Santa Cruz-freelance Science writer), and Harold Parks (OSU-Corvallis) visit WSU and the Center.
- In conjunction/cooperation with the **CGAD Visitor Program**, I helped organize the WSU Mathematics colloquium in 2011.

## Center for Geometric Analysis and Data: 2013-present

- The website can be found here: <http://geometricanalysis.org/>. Fall 2013 I reorganized the Center so that it is now comprised only of myself and my students.

## Sailfan Research: 2014 - 2017

- I was a co-founder with Matt Sottile who was on the DDMA lead team with me at Los Alamos.

## Analysis+Data Group: 2014-2018

- The website can be found here: <http://analysisplusdata.org/>. Spring 2014 I and 4 other mathematics faculty started a research and graduate education group. The group peaked at 7 faculty level members and over 20 students.

## Trade Smith Labs: 2018-2019

- 1 I was given a free hand in the establishment of a research lab for TradeSmith, a FinTech company, by its founder and CEO, Richard Smith.
- 2 Because of the freedom to follow enlightened models of organization and productivity, the lab was established quickly and efficiently and we soon creating value for the company and a place that the lab members loved being.
- 3 A year into this project, a not completely pleasant reorganization resulted in the founder and CEO selling his share of the company, after which he moved on to his next startup.
- 4 The experience was extraordinarily valuable in many ways, one of which was the inspiration (after returning to WSU) to establish the CDLG, centered at WSU in Pullman. This is described in the next section.

## Complexity, Data and Learning Group (CDLG): 2020-2022

- 1 Co-founded and co-led with Michael M. Forbes (Physics) and Bala Krishnamoorthy (Mathematics-Vancouver), with a handful of other strongly involved participants, including Matt Jockers (English), Brian Kraft (Office of Research), Geeta Dutta (Office of Research), Felix Munoz (Economics), Reza Safavi (Art), Kim Zentz (Urbanova), we were aiming at a revised, WSU centered, widely distributed reimagining of the Bell Labs/ Xerox PARC / Los Alamos type environment for innovation and research. This overarching project was not able to sustain through the effective shut-

- down 2020-2022, but we were able to sustain the main subproject – the iSciMath Project.
- 2 One of the main projects of this group was the Integrated Science and Mathematics (iSciMath) Project and this project is continuing. Currently Michael M. Forbes, Bala Krishnamoorthy, and KRV are leading this project, which aims at creating a truly silo-free, collision rich, environment for learning and research whose common language is mathematical in nature, but without a narrow focus on mathematics – i.e. equal participants in this environment includes (but is not restricted to) economists, engineers, chemists, biologists, mathematicians, and physicists.
  - 3 We have started the first of two ongoing seminars that will form part of the core of this project. A wider and wider group of people are choosing to become involved in the iSciMath project and this seminar, including faculty from physics, engineering, economics, mathematics, biology, and chemistry.
  - 4 Here is the white papers for the iSciMath project: [iSciMath White Paper](#)

## Integrated Science and Mathematics Project/Institute (iSciMath): 2020-present

- 1 Co-founded and co-led with Michael M. Forbes (Physics) and Bala Krishnamoorthy (Mathematics-Vancouver). Currently Michael M. Forbes, Bala Krishnamoorthy, and KRV are leading this project, which aims at creating a truly silo-free, collision rich, environment for learning and research whose common language is mathematical in nature, but without a narrow focus on mathematics – i.e. equal participants in this environment includes (but is not restricted to) economists, engineers, chemists, biologists, mathematicians, and physicists.
- 2 We now have a steady stream of new, graduate classes being taught in this program.
- 3 Here is the original white paper for the iSciMath project: [iSciMath White Paper](#)
- 4 Most recent innovation is a new Physics+Astronomy+Mathematics, Data Driven Working group. This was launched February 1, 2024.

## Funding From Grants and Contracts

- 150K\$** PI on a LANL LDRD-ER grant, 2001 150K\$ for work on face recognition.
- 500K\$** co-PI on a LANL LDRD-DR grant, 10/2002 – 9/2005 1.3M\$/year. The focus of this research is the use of rigorous methods for incorporating physics into the Validation and Verification of simulations. Our team’s part of the money was about 500K\$ in total. Jim Kamm was the PI.
- 1.1M\$** PI on a LANL LDRD-ER grant 10/2003 – 9/2006 360K\$/year for work on data analysis methods which factor out invariances for the purpose of recognition.
- 600K\$** co-PI on a LANL LDRD-DR grant 10/2003 – 9/2006 1.3M\$/year. The research was focused on developing muon radiography as a viable method of intra-diction of SNM at borders. The part our team is working on has to do with the data analysis end of things, in particular image reconstruction. Our part of the money will amount to about 550K\$ in total. Konstantin Borozdin is the PI.
- 400K\$** co-PI on a 200K\$ grant from the NSF Approaches to Combat Terrorism (ACT) program, for ”Intelligent Extraction of Information from Graphs and High-Dimensional Data”, the 2005 Graduate Summer School I Chaired. I raised another 200K\$ from the LANL Chief Science Officer for the summer school.

- 1.1M\$** PI on “Metrics and Regularizations for Data Analysis”, a winning 2005 LANL ASC WSR grant 380K\$/year for 3 years. The work is focused on development of new image metrics.
- 200K\$** NGA Contract for research. About 200K\$.
- 950K\$** PI on an LDRD-ER proposal, “Sharp characterization of minimizers (typically) involving interfaces in images”. Roughly 315K\$/year for FY 2006-2008. Co-PIs are Bill Allard (Duke) and Selim Esedoglu (Michigan). (Proposal [.pdf](#)) (Cover page [.pdf](#))
- 305K\$** Co-PI (Selim Esedoglu PI) NGA Hyperspectral Image Processing Contract, 2007-2008.
- 250K\$** Co-PI with Rick Chartrand. NGA Contract for research.
- Note on LANL Funding:** Due to high LANL overhead, X\$ (LDRD) are equivalent to about 0.7\*X\$ at a University. Due to a separate, even higher overhead, X\$ (LANL programmatic) is equivalent to about 0.5\*X\$ at a university. The WSR funds and the NGA funds fall into this second “less valuable” category. The average success rate for LDRD proposals is about 10%.
- 273K\$** PI on NSF Grant, *The Flat Norm for Shapes and Images*, award number 0914809. 2009-2012
- 1.2M\$** PI on DOE Petascale Grant, DE-SC0004096, *Geometric Analysis for Data Reduction and Structure Discovery*, May 15, 2010 – May 14, 2013.

## Student Mentoring

Student	Time Period	Currently at
Gary Sandine	1999-2002	<b>OIT at PSU</b>
Zeferino Andrade	2002 summer	
Neal Martin	2002-2003	<b>LANL</b>
John Greer	2003 summer	<b>NGA</b>
Triet Le	2003-2004 summers	<b>NGA</b>
Andrea Hawkins	2004 summer	<b>Mayo Clinic - Scottsdale</b>
Nathan George	2004-2005	<b>NDG Consulting</b>
Patrick Barrow	2005 summer	<b>Right Angle Tutoring</b>
Joe Kenney	2005 summer	<b>Some 3 letter agency?</b>
John Sieffert	2005 summer	
Valentina Staneva	2005 sum, 2006 spring	<b>eScience Institute, UW-Seattle</b>
Patrick Campbell	2002-2007	<b>Freelance Data Scientist and Artist</b>
William Meyerson	2007 summer	<b>Coverent</b>
David Bolme	2007 summer	<b>ORNL</b>
Abhishek Bhattacharya	2007 summer	<b>Indian Statistical Institute</b>
Djamila Auoada	2007 summer	<b>University of Luxembourg</b>
Kree Cole-McLaughlin	2007 summer	<b>Google</b>

Keith Clawson	2008-5/2010,1/2011-3/2013	<b>Palantir Technologies</b>
Sharif Ibrahim	6/2007, 9/2008-6/2014	Intel
Heather Moon	Jan 2010 - May 2013	<b>PhD Student in Physics, WSU</b>
Benjamin VanDyke	Jan 2010 - Jan 2012	<b>College of the Ozarks</b>
Eric D. Larson	May 2010 - May 2012	Intel
Josh Sackos	June 2011 - May 2013	<b>Freelance Engineer</b>
Abigail Higgins	June 2011 - May 2012	<b>Washington State University</b>
Josh Cruz	Jan 2012 - May 2013	<b>PhD from Duke 2020</b>
Josh Kaminsky	August 2013 - September 2017	<b>Johns Hopkins, Public Health</b>
Yunfeng Hu	August 2013 - May 2018	<b>Amazon</b>
Svetlana Lockwood	March 2013 - May 2015	<b>Raytheon</b>
Gary Sandine	August 2013 - September 2015	<b>OIT at PSU</b>
Daniel Dycus	January 2014 - June 2016	<b>Director of Winemaking, Blackbird</b>
Yufeng Cao	August 2014 - May 2019	
Vlad Oles	August 2014 - Summer 2019	<b>Postdoc, University of Idaho</b>
Enrique Alvarado	August 2014 - Summer 2021	<b>Postdoc, UC Davis</b>
Ritche Long	August 2014 - May 2016	
Altaa Tumurbaatar	August 2014 - May 2016	<b>Postdoc, Emory University</b>
Hossein Noorazar	August 2014 - July 2017	<b>Postdoc, WSU</b>
Justin Theriot	August 2016 - May 2017	<b>RiskLens</b>
Kellan Toman	August 2016 - May 2017	<b>Data Scientist at Microsoft</b>
Laramie Paxton	August 2016 - July 2018	<b>Freelance Educator, Wisconsin</b>
Katrina Sabochik	August 2018 - October 2021	<b>Tradesmith</b>
Jared Brannon	January 2021 - present	<b>PhD Student at WSU</b>
Edward Eskew	August 2020 - present	<b>PhD Student at WSU</b>
Rommel Cortez	January 2021 - present	<b>PhD Student at WSU</b>
Curtis Michels	September 2021 - present	<b>PhD Student at WSU</b>
Sandra Auttelet	January 2022 - present	<b>Undergraduate at WSU</b>
Jonah Campbell	August 2023 - present	<b>Undergraduate at WSU</b>
Ama Zucker	August 2023 - present	<b>Undergraduate at WSU</b>
Nolan Middleton	August 2023 - present	<b>Undergraduate at WSU</b>
Tavin Hartsell	January 2023 - present	<b>Undergraduate at WSU</b>
Blake Cecil	August 2023 - present	<b>PhD Student at WSU</b>
Liya Bouhkbinder	August 2023 - present	<b>PhD Student at WSU</b>

## Postdoc Mentoring

Postdoc	Time Period	Comments
Zhijun Qiao	2004	(now at <b>University of Texas-Pan Am</b> )
Rick Chartrand	2004-2005	(now at <a href="http://www.descarteslabs.com/">http://www.descarteslabs.com/</a> )
Chris Orum	2004-2007	(co-Mentored with Nick Hengartner)
Bryan Rasmussen	2006-2007	(Co-Mentored with Katharine Chartrand)
David Dreisigmeyer	2006-2008	(Co-Mentored with other DDMA members)
Simon Morgan	2007-2008	
Vlad Oles	2024 - present	(also at U Idaho working in Remote Sensing)

## Teaching Experience after Spring 2008

- Since 2019 I have been teaching pieces of analysis, nonlinear analysis, geometric measure theory, image and signal analysis, and information theory, often in collaboration with Michael Forbes (physics), now with a class design aimed at allowing both specializing students aimed at deeper mastery and students from other PhD Programs wanting to master the intuitive ideas and concepts to benefit from the classes. Here are some examples.
  - Spring 2021** Mathematics 589, *Linear and Nonlinear Analysis (with a view to use)* in which we ended up focusing mostly on Degree Theory.
  - Spring 2022** Mathematics 589, *Geometric Analysis with a View to Use* This was a broad introduction to linear and nonlinear analysis and was attended by 4 faculty members in addition to students from Physics, Computer Science, Economics and Mathematics (graduate and undergraduate).
  - Spring 2023** Mathematics 583 *Learning From Images and Signals*, taught in collaboration with Michael Forbes. This was a wide ranging theoretical and computational exploration of many topics in these areas.
  - Spring 2024** Mathematics 583, *Analysis of and on Rough Sets*, taught in collaboration with Michael Forbes, introducing students to the techniques and insights circulating around rectifiable sets and measures in Euclidean space, as well as fractals in Euclidean space.
- From 2008 to 2018, when I took a leave of absence to start an industrial research lab for a FinTech company, I taught a variety of classes in Linear and Non-linear Analysis, Geometry/Geometric Measure Theory, and Statistical Learning theory.
- See [Link to courses, past and current](#).

## Teaching Experience prior to Fall 2008

- 7th and 8th grade science and history (1 year).
- Extensive tutoring experience: Engineering, Mathematics, Physics.
- *Undergraduate Courses in Mathematics* Significant experience as full instructor for: a) Pre-calculus, b) Business Calculus, c) Calculus (all semesters), and d) Differential equations.
- *Pontrjagin Maximum Principle* fall 1998 at LANL. I gave lectures preparing a handful of staff members the nonlinear control theory short course at the 1999 AMS/MAA meetings in San Antonio.
- *Modern Analysis*: A course designed and taught with Gary Sandine at Los Alamos National Laboratory. Students were at or above the graduate student level. Course was very fast-paced, with 75 students covering topology for analysis, calculus in Banach spaces, and some nonlinear analysis. Spring 2000.
- *Dynamical Systems*: I helped teach this course as a follow-on to the Modern Analysis course above. Same type of audience. I gave several lectures. Summer 2000.
- 3 hour short course, *Metrics and Regularizations in Image Analysis* at the IPAM 2005 summer school. See links to slides and video above.
- 5 hour short course, *An Invitation to Geometry: Image Analysis, Geometric Analysis, and High-dimensional Geometry* Clarkson University, January 2006. See links above.
- 5 lecture short course, *An Invitation to Geometry: Image Analysis, Geometric Analysis,*

*and High-dimensional Geometry*, Los Alamos National Laboratory, September 2006. See links above.

- Lecture series at the graduate level at LANL on various topics in geometric analysis. Fall 2006 to present.
- 8 lecture course, *Geometric Measure Theory* at UCLA/IPAM with Video link to LANL, Spring 2007
- 16 lecture course, *Geometric Measure Theory* at the CDDMA 2007 summer school. I designed it and co-taught it with Simon P. Morgan and Peter F. Schultz.

## Other Experience and Activities

- Started the Proton Radiography Working group at LANL and ran it for 3 years. Part of this was folded into the DDMA team, the rest I handed off to others and then that part quietly died.
- Started the LANL Student Association Colloquium Series and ran this for 1.5 years. After I quit running it, it also ceased to exist (as did several other aspects of the Student association, when official lab entities got more involved).
- For more history and the meandering path taken to the present, see the *Acknowledgments* in the preamble of my dissertation ([.pdf](#)) ([.ps](#))

## References

Available Upon request