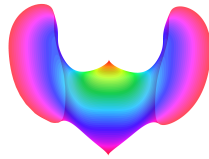


Dani Brake



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146 Hayes-Healey

University of Notre Dame

Notre Dame, IN 46556

Professional Academic Experience

2014 - **Postdoctoral Research Associate**

Applied and Computational Mathematics and Statistics,

University of Notre Dame, Notre Dame

Department of Mathematics, North Carolina State University, Raleigh

Applications of numerical algebraic geometry

Mentor – Jonathan Hauenstein

note: research group moved

2013 **Postdoctoral Researcher**

Department of Mathematics, Colorado State University, Fort Collins

Real numerical algebraic geometry.

Mentor – Dan Bates

2007 - 2012 **Graduate Research Assistant, Graduate Teaching Assistant**

Department of Mathematics, Colorado State University, Fort Collins

Advisors – Vakhtang Putkaradze, Tony Maciejewski

Education

2012 **Doctor of Philosophy, Mathematics**

Colorado State University, Fort Collins,

Applied Mathematics

Advisors: Vakhtang Putkaradze (Mathematics)

Tony Maciejewski (Electrical & Computer Engineering)

2009 **Master of Science, Mathematics**

Colorado State University, Fort Collins,

Applied Mathematics

Advisor: Vakhtang Putkaradze

2004 **Bachelor of Arts, Liberal Arts**

Colorado State University, Fort Collins

- Minor in Mathematics

Extended Research Visits

Fall 2009 **Research Assistant**

Huygens Laboratorium, Universiteit Leiden, Holland

Mentor – Martin Van Hecke

Courses Taught

Advanced Scientific Computing, Notre Dame, Spring 2017

Scientific Computing, Notre Dame, Fall 2014, Spring 2015, Fall 2015, Spring 2016, Fall 2016

Math Methods II, Notre Dame, Fall 2015

Calculus I for Life and Management Sciences, North Carolina State, Summer 2015

Computational Math for Life & Management Sciences, North Carolina State, Summer 2015

Calculus III for Scientists and Engineers, Colorado State, Fall 2013, Fall 2010

Calculus I for Scientists and Engineers, Colorado State, Fall 2008

Calculus I for Biological Scientists, Colorado State, Fall 2007, Spring 2008, Summer 2009

Students

Undergraduate research mentees at Notre Dame

Michael Padala – Porting Bertini_real to Windows under Cygwin

Pierce Cunneen – Visualizing curves and surfaces in Python

Elizabeth Sudkamp – Documentation, symbolics for Bertini_real

Patrick Tinsley – Senior project, AI for *Asteroids*

Software Products

Bertini 2

github.com/bertinireal/b2

Homotopy continuation polynomial system solver with Python bindings, scripting, and symbolic engine. Collaborative NSF-funded project.

Bertini_tropical

danielthebrake.org/tropical

Matlab software for decomposing real and complex tropical curves in any number of dimensions. Interfaces with Bertini for numerical solving.

Bertini_real – Software for real algebraic sets.

bertinireal.com

Console software for performing numerical cellular decomposition of real algebraic curves and surfaces, with singularities, in any dimension.

Paramotopy – Parameter homotopies in parallel.

paramotopy.com

Command line software for rapidly solving discretized parametrized polynomials

Grants

NSF DMS 1547743

"Workshop on Software and Applications of Numerical Algebraic Geometry"

September 1, 2015 - August 31, 2016

\$19,020 PI: Hauenstein, co-PI: **Brake**, Sommese, and Wampler

Publications

Accepted / Appeared

- D. Brake, J. Hauenstein, A. Murray, D. Myszka, C. Wampler. "The complete solution of Alt-Burmester synthesis problems for four-bar linkages." *ASME JMR*, 2016.
- D. Brake, J. Hauenstein, A. Liddell. "Validating the Completeness of the Real Solution Set of a System of Polynomial Equations." *ISSAC*, Waterloo, Canada. July 2016.
- D. Brake, J. Hauenstein, A. Liddell. "Decomposing Solution Sets of Polynomial Systems Using Derivatives." *ICMS*, Berlin, Germany. July 2016.
- D. Brake, D. Bates, V. Putkaradze, A.A. Maciejewski. "Workspace Multiplicity and Fault Tolerance of Cooperating Robots." Accepted to *Mathematical Aspects of Computer and Information Sciences (MACIS)*, Berlin, Germany. November 2015.
- D. Brake, J. Hauenstein, A. Sommese. "Numerical Local Irreducible Decomposition." *MACIS*, Berlin, Germany. November 2015.
- D. Bates, D. Brake, W. Hao, J. Hauenstein, A. Sommese, C. Wampler. "Bertini_real: Software for One- and Two-Dimensional Real Algebraic Sets." *International Congress on Mathematical Software (ICMS)*, Seoul, South Korea. August 2014.
- D. Bates, D. Brake, J. Hauenstein, A. Sommese, C. Wampler. "On Computing a Cell Decomposition of a Real Surface Containing Infinitely Many Singularities." *ICMS*, Seoul, South Korea. August 2014.
- D. Brake, V. Putkaradze. "Reduced Systems for Intrinsic Localized Modes on an Infinite Oscillator Array." *Nonlinear Theory and Its Applications (NOLTA), IEICE*, 2013.
- D. Brake, H. Xu, A. Hollowell, G. Balakrishnan, C. Hains, M. Marconi, V. Putkaradze. "Intrinsic Localized Modes in Two-Dimensional Vibrations of Crystalline Pillars and Their Application for Sensing." *Journal of Applied Physics*, 2012.
- D. Brake, V. Putkaradze. "Simplified Models for Intrinsic Localized Mode Dynamics." *NOLTA 2012*, Palma de Mallorca, Spain, October 2012.
- D. Brake, V. Putkaradze. "Intrinsic Localized Modes in Two-Dimensional Vibrations of Crystalline Pillars." *NOLTA 2011*, Kobe, Japan, September 2011.
- D. Brake, D. J. Bates, V. Putkaradze, and A. A. Maciejewski. "Illustration of Numerical Algebraic Methods for Workspace Estimation of Cooperating Robots After Joint Failure." *IASTED Technology Conferences*, Pittsburg, PN USA, November 2010.

Submitted

- D. Brake, J. Hauenstein, C. Vinzant. "Algorithms for Computing Complex and Real Tropical Curves." Submitted 2016.
- D. Brake, D. Bates, W. Hao, J. Hauenstein, A. Sommese, C. Wampler. "Bertini_real: Software for Real Algebraic Sets." Submitted 2015.

Presentations

- “Regularizing Numerical Cell Decompositions”. *JMM 2017*, Atlanta. January 2017.
- “Regularizing Numerical Cell Decompositions”. *AMS Fall Sectional*, Denver. October 2016.
- “Printing Algebraic Geometry”. *Bertini Workshop*, Notre Dame. May 2016.
- “The Development of Bertini 2”. *Bertini Workshop*, Notre Dame. May 2016.
- “The Complete Solution of Alt-Burmester Synthesis Problems for Four-bar Linkages”. *AMS Spring Sectional*, UGA. March 2016.
- “Numerical Local Irreducible Decomposition”. *MACIS*, Berlin. November 2015.
- “Workspace Multiplicity and Fault Tolerance of Cooperating Robots”. *MACIS*, Berlin. November 2015.
- “Applications of Monodromy”. *Algebraic Geometry Seminar*, NC State. October 2015.
- “Applications of Monodromy”. *Geometry Seminar*, Texas A&M. October 2015.
- “Advances in Software in Numerical Algebraic Geometry”. *SIAM Algebraic Geometry*, Daejeon, Korea. August 2015.
- “Applications of Real Algebraic Varieties to Tropical Geometry”. *AMA Meeting*, Colorado College. April 2015.
- “3D Printing Mathematical Surfaces”. *Notre Dame Research Symposium*, Notre Dame. April 2015. [First place in poster competition.](#)
- “Parametrized Polynomial Systems, and Real Numerical Algebraic Geometry”. *Applied Math Seminar*, University of Notre Dame. March 2015.
- “Applications of Real Algebraic Varieties”. *AMS Spring Sectional*, Michigan State University. March 2015.
- “Numerical challenges to decomposition of algebraic surfaces”. *Seminar at the School for Computing*, DePaul University. January 2015.
- “Numerically decomposing algebraic surfaces with an infinite number of singularities”. *Topology, Geometry, & Data Seminar*, Ohio State University. November 2014.
- “Printing Algebraic Surfaces with Singularities”. *AMS Fall Western Sectional*, San Francisco State University. October 2014.
- “Bertini_real: software for real algebraic sets”. *Solving Polynomial Equations*, The Simons Institute for the Theory of Computing. October 2014.
- “Bertini Real: real algebraic curve and surface cellular decomposition software”. *International Congress of Mathematical Software*, Hanyang University. August 2014.
- “Bertini_real – Numerical surface decomposition”. *Postdoctoral Research Symposium*, NC State University. May 2014.

- “Bertini_real – Numerical surface decomposition”. *East Coast Computer Algebra Day*, Duke University. April 2014. [First place in poster competition.](#)
- “A study in multistability, and criticality of real algebraic sets”. *Symbolic Computation*, North Carolina State University. April 2014.
- “From polynomials to 3D printing – How to print an algebraic surface”. *SUM Series*, North Carolina State University. February 2014.
- “Paramotopy: Parallel parameter homotopy through Bertini”. *SIAM AG13*. Colorado State University. August 2013.
- “Simplified models for Intrinsic Localized Mode dynamics”. *NOLTA 2012*. Palma de Mallorca, Spain. October 2012.
- “Nano oscillator array intrinsic localized mode pinning and travel”. *DTRA Technical Review*, Washington, DC. July 2012.
- “Nanocrystal detectors – simulation and analysis”. *Greenslopes Seminar*. Colorado State University. February 2012.
- “Intrinsic localized modes in nanocrystalline arrays”. *NOLTA Workshop 2011*, Kyoto, Japan. December 2011.
- “ILM formation in arrays of nonlinearly coupled bidirectional crystal oscillators”. *DTRA Technical Review 2011*, Washington, DC. July 2011.
- “Workspace estimation of cooperating robots after joint failure”. *SIAM Conference on Dynamical Systems, DS2011*, Snowbird. May 2011.
- “Vibrating crystals, failing robots, and Polysaurus”. *Greenslopes Seminar*, Colorado State University. April 2011.
- “Illustration of numerical algebraic methods for workspace estimation of cooperating robots after joint failure”. *Greenslopes Seminar*, Colorado State University. October 2010.
- “Foam elasticity”. *Greenslopes Seminar*, Colorado State University. February 2010.

Computer skills

Languages

Modern C++, C, Matlab, Python

Libraries

MPI, OpenMP, MPFR, Eigen, Boost.Spirit, Boost.Python

Scientific & Tools

Bertini, Maple, Excel, Git, Subversion, Eclipse, GDB, Valgrind, Jenkins, Doxygen

3D Printing

Slic3r, Cura, Simplify3D, OpenSCAD, Meshmixer

Systems

Linux/Unix, Windows, Mac, Apache Server

General

Photoshop, GIMP, Inkscape, Blender, Ableton Live

Service & Honors

Session Organizer *SIAM AG17*, Atlanta, August 2017

- Applications of Numerical Algebraic Geometry in Math, Science, and Engineering

Panel Member *Mentoring*, Notre Dame, January 2017

- Graduate student ethics training

Session Co-organizer *JMM 2017*, Atlanta, January 2017

- Theory and Applications of Numerical Algebraic Geometry (Special Session #62)

Session Co-organizer *ICMS 2016*, Berlin, July 2016

- Software for Numerically Solving Polynomial Systems.

Session Co-organizer *SIAM AN16*, Boston, July 2016

- Structured Polynomial Equations and Applications.

Conference Co-organizer *Software and Applications of Numerical Algebraic Geometry*

- Notre Dame, May 2016

Postdoc Focus Group *Notre Dame*, 2014 - 2015

First Place *Notre Dame Research Symposium*, 2015

- Poster Competition

Minisymposium Co-organizer *SIAM AG 15*, Daejeon, Korea, 2015

- Software and Applications in Numerical Algebraic Geometry.

Science Fair Judge *Indiana Regional Science Fair*, 2015

Tutor and Assistant *Riverbend Math Center*, 2014 - 2015

- Free tutor and teacher for students of all ages.

Session Co-organizer *AMS Fall Western Sectional*, San Francisco, 2014

- Computational Algebraic Geometry and Applications in Science and Engineering.

Museum Display *South Bend Center for History*, 2014 - 2015

"150 Years of Science at Notre Dame"

- 3D printed models of singular surfaces.

Poster Judge *NCSU Undergraduate Research Symposium*, 2014

Best Poster Award *East Coast Computer Algebra Day*, 2014

Poster and Presentation Judge *Colorado State University*, 2013

"Celebrate Undergraduate Research and Creativity"

Trail Worker *Volunteers for Outdoor Colorado*, 2013

Boy Scout Volunteer *Troop 96, Longs Peak Council*, 1993 - 2013

- Plant flags at American veteran's graves for Memorial Day.
- Attend advancement ceremonies.

Math Day Volunteer *Colorado State University*, 2006 - 2012

- Administer and grade PROBE exam.

Graduate Student Representative *Colorado State University*, 2011 - 2012,
Mathematics Department

- Graduate student liaison on graduate committee; coordinated recruitment day.

Eagle Scout Troop 96, *Longs Peak Council*, 1997

- Leadership training, held all leadership positions. Once an Eagle, always an Eagle.

Professional Interests

Numerical algebraic geometry

Local geometry

Real algebraic varieties

High performance computing

Tropical geometry

Numerical analysis

3D Printing

Scientific software

Personal Interests

Bicycling, hiking, skiing

Year-round camping

Organic agriculture, cooking

More 3D Printing

Cosplay

Video and board gaming

References

Dan Bates, *Associate Professor*

Colorado State University, bates@math.colostate.edu

Jonathan Hauenstein, *Associate Professor*

University of Notre Dame, hauenstein@nd.edu

Vakhtang Putkaradze, *Centennial Professor*

University of Alberta, putkarad@ualberta.ca

Andrew Sommese, *Duncan Professor of Mathematics*

University of Notre Dame, sommese@nd.edu

Nick Trefethen, *Professor*

University of Oxford, trefethen@maths.ox.ac.uk