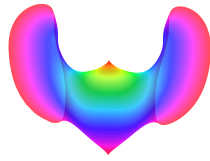


# Danielle Amethyst Brake

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University of Wisconsin - Eau Claire



## Professional Experience

- 2017 - **Assistant Professor**  
*Department of Mathematics,*  
University of Wisconsin Eau Claire
- 2014 - 2017 **Postdoctoral Research Associate**  
*Department of 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
- Fall 2009 **Research Assistant**  
*Huygens Laboratorium,* Universiteit Leiden, Holland  
Mentor – Martin Van Hecke
- 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

## Courses Taught

**Programming for Data Science**, DS710, UWEC, Fall 2017, Spring 2018, Fall 2018

**Mathematical Modeling I**, Math354, UWEC, Spring 2018

**Discrete Mathematics**, Math314, UWEC, Spring 2018

**Topological Data Analysis – Independent Study**, Math399, UWEC, Fall 2017

**Probability and Mathematical Statistics**, Math345, UWEC, Fall 2017

**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 – UWEC

Sarah Ericson & Dan Hessler – Application of machine learning to NAG

Foong Wong & David Bachmeier – A 3D printed gallery of algebraic surfaces

### Undergraduate research mentees – Notre Dame

Michael Padala – Porting Bertini\_real to Windows under Cygwin

Pierce Cunneen – Importing data from Bertini\_real to Python

Elizabeth Sudkamp – Documentation, symbolics for Bertini\_real

Nicole Ho – Porting Bertini\_real visualization to Python

Chris Lembo – Documentation, examples, and videos for Bertini\_real

Travis Wert – User-supplied critical point sets

Sam Cavender – Usability and tuning of Bertini\_real

Alex Sievern – Porting Bertini\_real to the CMake build system

## Software Products

### Bertini 2

[github.com/bertiniteam/b2](https://github.com/bertiniteam/b2)

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

### Bertini\_tropical

[danibrake.org/tropical](http://danibrake.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](http://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](http://paramotopy.com)

Command line software for rapidly solving discretized parametrized polynomials

## Shows and displays

- MAA Wisconsin Spring Sectional 2018. *UWEC*. 3D model gallery
- Geekcon 2017. *UWEC*. Makerspace and 3D model gallery
- **Museum Display** *South Bend Center for History*, 2014 - 2015  
 “150 Years of Science at Notre Dame”  
 - 3D printed models of singular surfaces.

## Selected Presentations

- “Numerical challenges to successful decomposition of real algebraic surfaces”. *SIAM AG17*, Atlanta. August 2017.
- “Regularizing Numerical Cell Decompositions”. *JMM 2017*, Atlanta. January 2017.
- “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.
- “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”. *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.

## Publications

### Accepted / Appeared

- D. Brake, D. Bates, W. Hao, J. Hauenstein, A. Sommese, C. Wampler. “Bertini\_real: Software for Real Algebraic Sets.” *ACM ToMS*, 2017.
- 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

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- D. Brake, J. Hauenstein, C. Vinzant. "Algorithms for Computing Complex and Real Tropical Curves." Submitted 2016.

## 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

## Computer skills

### Languages

Modern C++, C,  
Matlab, Python, R

### 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

**MakeUWEC Faculty Mentor** *UWEC*, November 2017 -

**Minisymposium Organizer** *SIAM AN18*, Portland, July 2018  
- Numerical Algebraic Geometry

**Session Organizer** *ICMS 2018*, Notre Dame, July 2018  
- Computational Algebraic Geometry

**LGBTQ Advisory Board Member** *UWEC*, September 2017 -

**PC Member** *MACIS2017*, Vienna, November 2017

**Session Organizer** *SIAM AG17*, Atlanta, August 2017  
- Applications of Numerical Algebraic Geometry in Math, Science, and Engineering

**Conference Co-organizer** *Polynomials, kinematics and robotics – a conference honoring Charles Wampler*  
- Notre Dame, June 2017

**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.

**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.

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## Professional Interests

Numerical algebraic geometry  
Local geometry  
Real algebraic varieties  
High performance computing

Tropical geometry  
Numerical analysis  
3D Printing  
Scientific software

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## Personal Interests

Bicycling, hiking, skiing  
Year-round camping  
Organic agriculture, cooking

More 3D Printing  
Cosplay  
Video and board gaming

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## References

**Dan Bates**, *Associate Professor*  
US Naval Academy

**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