

# Danielle Amethyst Brake, PhD

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[danielleamethyst.org](http://danielleamethyst.org)

## PROFILE

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- Expert in numerically solving polynomial systems in science and engineering
- Programming proficiency in a spectrum of languages for a variety of applications, focused on command line mathematical software, and visualization -- especially of curves and surfaces
- Strong leader and teacher for team-oriented collaborative research projects
- Independent problem solver, working effectively with limited supervision
- Clear written and oral communication and presentation skills for explaining complex processes, disseminating scientific results, and documenting

## TECHNICAL SKILLS & PROFESSIONAL ACTIVITIES

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**Programming Languages:** Modern C++, Matlab, Python, R

**C/C++ Libraries:** Boost.Spirit, Boost.Multiprecision, Boost.Python, GMP, MPFR, Arduino

**New C++ features Danielle is excited about using:** Fold expressions, constexpr if, concepts to eliminate SFINAE?

**Parallel Libraries:** MPI, OpenMP, OpenACC

**Dev Tools:** Doxygen, Sphinx, Jenkins, Autotools, Git, PlantUML, Inkscape

**3d Printing:** Bertini\_real, OpenSCAD, Blender. Mathematical art using FDM printers

**Professional Affiliations:** Society for Industrial and Applied Mathematics, American Mathematical Society

**Honors & Awards:** Eagle Scout, 1997

**Service:** Co-organize workshops in numerical algebraic geometry, and organize sessions at conferences

**Volunteer Activities:** Math tutoring at Riverbend Math Center, judging science fairs, litter pickup

**Conferences:** C++ Now 2017. SIAM Applied Algebraic Geometry 2013, 2015, 2017, 2019 (planned). International Congress for Mathematical Software 2014, 2016, 2018 (planned). NSF SI<sup>2</sup> 2017, SIAM AN18 (planned).

**Upcoming:** *June 2018* -- Applications of Polynomial Systems at TCU. *July 2018* -- International Congress of Mathematical Software. *Fall 2018* -- Semester on Nonlinear Algebra at ICERM, Brown University.

## PROFESSIONAL EXPERIENCE

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### UNIVERSITY OF WISCONSIN - EAU CLAIRE

Eau Claire, WI

Assistant Professor

August 2017 - Present

Department of Mathematics

- Undergraduate research: Machine learning and Numerical algebraic geometry -- marries Tensorflow & Bertini in Python. A Gallery of algebraic surfaces -- uses Bertini\_real to compute and 3d print singular surfaces.
- Teaching: Programming for Data Science (R and Python), and Intro to Probability and Statistics.
- Service: LGBT Advisory Board, Faculty sponsor for MakeUWEC, Scholarship committee, and more.

### UNIVERSITY OF NOTRE DAME

Notre Dame, IN

Postdoctoral Research Associate

August 2014 - Present

Applied and Computational Mathematics and Statistics

- Lead developer for GPL3 C++ / Python library project, Bertini 2.
- Develop and implement algorithms for numerical algebraic geometry for faster solving of larger polynomial systems. Verifying completeness of real and complex solution sets.
- Compute and 3d print real algebraic surfaces and curves in high dimensions using my own software.
- Supervise undergraduate research projects in scientific software development.
- Teach Scientific Computing, Advanced Scientific Computing, and Mathematical Methods II.

### Postdoctoral Research Associate

January 2014 – July 2014

Mathematics - North Carolina State University, Raleigh, NC

- Parallelize surface decomposer Bertini\_real for faster computational results.
- Turn output of decomposition software into 3d printable format.
- Teach Calculus, Scientific Computing for biology and finance majors.

### Postdoctoral Fellow

Fort Collins, CO

Mathematics - Colorado State University

January 2013 – December 2013

- Design and implement Bertini\_real, for computing real algebraic curves and surfaces.
- Teach Calculus III for scientists and engineers.

## EDUCATION

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### COLORADO STATE UNIVERSITY

Fort Collins, CO

Doctor of Philosophy, Mathematics

December 2012

Dissertation: Homotopy Continuation Methods, Intrinsic Localized Modes,  
and Cooperative Robotic Workspaces

Coursework: numerical methods, PDEs, geometric mechanics, kinematics, robotics, and more

### COLORADO STATE UNIVERSITY

Fort Collins, CO

Master of Science, Mathematics

May 2009

Thesis: Simulation and Irreversibility in Fluid Suspended Particle Interactions

### COLORADO STATE UNIVERSITY

Fort Collins, CO

Bachelor of Arts, Liberal Arts

December 2004

Minor in Mathematics, History

## SELECTED SOFTWARE PROJECTS

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- [Bertini 2](#). C++ and Python library for numerically solving polynomial systems.
- [Bertini tropical](#). Matlab suite for numerically computing real and complex tropical curves.
- [Bertini real](#). Console software for computing high-dimensional algebraic curves and surfaces.
- [Paramotopy](#). Parallel software for solving parameterized polynomial systems.

## SELECTED PUBLICATIONS

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- D. Brake, D. Bates, W. Hao, J. Hauenstein, A. Sommese, C. Wampler. "[Algorithm 976: Bertini\\_real: Numerical Decomposition of Real Algebraic Curves and Surfaces](#)." 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, C. Vinzant. "[Algorithms for computing complex and real tropical curves](#)." Submitted May 2016.
- 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.