

# DANI BRAKE, PHD

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## PROFILE

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- Expert in formulating and numerically solving polynomial systems in science and engineering
- Programming proficiency in a spectrum of languages for a variety of applications
- Strong leader for team-oriented collaborative research
- 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

## EDUCATION

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<b>COLORADO STATE UNIVERSITY</b>	Fort Collins, CO
Doctor of Philosophy, Mathematics	December 2012
Dissertation: Homotopy Continuation Methods, Intrinsic Localized Modes, and Cooperative Robotic Workspaces	
Coursework in numerical methods, PDEs, geometric mechanics, kinematics, and robotics	
<b>COLORADO STATE UNIVERSITY</b>	Fort Collins, CO
Master of Science, Mathematics	May 2009
Thesis: Simulation and Irreversibility in Fluid Suspended Particle Interactions	
<b>COLORADO STATE UNIVERSITY</b>	Fort Collins, CO
Bachelor of Arts, Liberal Arts	December 2004
Minor in Mathematics, History	

## RESEARCH EXPERIENCE

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<b>UNIVERSITY OF NOTRE DAME</b>	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
- Decompose real curves in 20 variables, and real surfaces in 8 variables.
- Supervise undergraduate research projects in scientific software development.

NORTH CAROLINA STATE UNIVERSITY  
Postdoctoral Research Associate  
Mathematics

Raleigh, NC  
January 2014 – July 2014

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

COLORADO STATE UNIVERSITY  
Postdoctoral Fellow  
Mathematics

Fort Collins, CO  
January 2013 – December 2013

- Design and implement software for computing real algebraic curves and surfaces.
- Teach Calculus courses for scientists and engineers.

## SOFTWARE PROJECTS

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- Bertini 2. C++ and Python library for numerically solving polynomial 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 / PRESENTATIONS

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- 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 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.

## TECHNICAL SKILLS & PROFESSIONAL ACTIVITIES

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**Programming Languages:** Proficient in templated C++ and Matlab, decent with Python  
**C/C++ Libraries:** Boost.Spirit, Boost.Multiprecision, Boost.Python, GMP, MPFR, Arduino

**Parallel Libraries:** MPI, OpenMP

**Dev Tools:** Doxygen, Jenkins, Autotools, Git

**3d Printing:** Design using my own software, OpenSCAD, Blender. Operate FFF printers

**Professional Affiliations:** SIAM, AMS

**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