Daniel J. Bates

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Education

Ph.D. in mathematics, University of Notre Dame, South Bend, IN, May 2006.

Thesis adviser: Andrew Sommese

Thesis title: Theory and applications in numerical algebraic geometry

M.S. in mathematics, University of Notre Dame, South Bend, IN, May 2003.

B.A. *summa cum laude* in mathematics (minor in computer science), The College of Wooster, Wooster, OH, May 2001.

Current Research Interests

Numerical analysis/scientific computing (including software development and parallel computing)

Computational (especially numerical) algebraic geometry

Optimal control theory

Enumerative geometry (particularly fewnomial theory)

Related Work Experience

Postdoctoral Associate, Institute for Mathematics & its Applications (IMA), University of Minnesota, Fall 2006 – present.

Visiting Scholar, University of Notre Dame, Summer 2006 – present.

Research Assistant to Duncan Chair of Mathematics, University of Notre Dame, Spring 2003 – Spring 2004.

Applied Mathematics Research Experience, The College of Wooster.

2001: *Materials Testing Lab Job Scheduling* at Goodyear Tire and Rubber Company.

1999: *Determining Cost-Minimizing Order Schedules by using Economic Order Quantity (EOQ) Analysis* at United Titanium, Inc.

Louisiana State University REU 2000 (braid theory group), Summer 2000.

Project Title: *The Faithfulness of the Bureau Representation for n=4*

Project Adviser: Neal Stoltzfus

Consultant regarding manufacturing scheduling, Smith Dairy, Orrville, OH, 1999–2000.

Publications*

Appeared or accepted

(1) Solution of polynomial systems derived from differential equations (with E. Allgower, A. Sommese, and C. Wampler), *Computing*, 76(1–2): 1–10, 2006.

(2) A numerical-symbolic algorithm for computing the multiplicity of a component of an algebraic set (with C. Peterson and A. Sommese), *J. Complexity*, 22(4):475–489, 2006.

(3) Finding all real points of a complex curve (with Y. Lu, A. Sommese, and C. Wampler), to appear in *Contemporary Math.*
(4) Multiprecision path tracking (with J. Hauenstein, A. Sommese, and C. Wampler), to appear in *SIAM J. of Num. Anal.*
(5) Applications of Numerical Terracini's Lemma (with C. Peterson and A. Sommese), to appear in the *IMA Volume on Algorithms in Algebraic Geometry.*
(6) Software for numerical algebraic geometry: a paradigm and progress towards its implementation (with J. Hauenstein, A. Sommese, and C. Wampler), to appear in the *IMA Volume on Software in Algebraic Geometry.*
(7) A numerical algebraic geometry approach to nonlinear constrained optimal control (with I. Fotiou and P. Rostalski), accepted to the 2007 IEEE Conference on Decision and Control.
(8) Bounds on the number of real solutions to polynomial equations (with F. Bihan and F. Sottile), to appear in *Int. Math. Res. Not.*

Submitted

(9) Computing the genus of a curve numerically (with C. Peterson, A. Sommese, and C. Wampler), *Submitted.*
(10) An optimal control application in power electronics using numerical algebraic geometry (with A. Beccuti, I. Fotiou, and M. Morari), *Submitted.*

*Preprints of these papers may be found on my website. Several more papers are currently in preparation.

Software Developed

- *Bertini: Software for Numerical Algebraic Geometry*, with J. Hauenstein, A. Sommese, and C. Wampler. Available at http://www.nd.edu/∼sommese/bertini.
- Proprietary software for Goodyear (2001) and United Titanium, Inc. (1999).

External funding

- NSF grant, $22,530 (anticipated), for ICNAG conference.
- IMA grant, $4,000, for ICNAG conference.

Conferences organized

- Interactions of Classical and Numerical Algebraic Geometry (ICNAG), University of Notre Dame, May 20–23, 2008, with S. DiRocco, G.M. Besana, and C.W. Wampler.

Presentations

- *A new method of real root-finding using Gale duality*, AMS Sectional Meeting, DePaul University, October 2007 (invited).
- *Numerical algebraic geometry in control theory*, International Conference on Applications of Computer Algebra, Oakland University, July 2007 (invited).
- *Introduction to Bertini: a software package for numerical algebraic geometry*, IMA Workshop on Software for Algebraic Geometry, October 2006 (invited).
- *The numerical computation of the multiplicity of a component of an algebraic set*, IMA Workshop on Algorithms in Algebraic Geometry, September 2006 (invited).
- *Using Bertini*, AMS Sectional Meeting, University of Notre Dame, March 2006 (invited).
- *Berini: A new software package for computations in numerical algebraic geometry*, Workshop on Approximate Commutative Algebra during the Special Semester on Gröbner Bases, Johannes Kepler Institute (Linz, Austria), February 2006 (invited).

- *Numerical methods for polynomial systems*, Cleveland State University, February 2006 (invited colloquium).
- *Adaptive precision in homotopy continuation*, Joint Mathematics Meetings, San Antonio, January 2006 (invited).
- *Symbolic representation of polynomial systems for efficient manipulation and evaluation*, International Conference on Applications of Computer Algebra, Nara Women's University (Nara, Japan), August 2005 (invited).
- *Solving boundary value problems with homotopy continuation*, Midwest Numerical Analysis Conference, University of Iowa, May 2005.
- *Bertini: An implementation of Numerical Algebraic Geometry Techniques* (poster), University of Notre Dame Center for Applied Mathematics Graduate Student Research Poster Session, April 2005.
- *Advantages of parsing polynomials into straight-line programs*, AMS Sectional Meeting, Northwestern University, October 2004 (invited).
- *Polynomials in practice*, Graduate Student Seminar, University of Notre Dame, September 2004.
- *A small dose of polynomial history and culture*, Graduate Student Seminar, University of Notre Dame, April, 2004.
- *Numerical issues in the field of numerical algebraic geometry*, University of Notre Dame Center for Applied Mathematics Graduate Student Research Workshop, March 2004.
- *The basics of numerical algebraic geometry*, Graduate Student Seminar, University of Notre Dame, May 2003.
- Many seminar talks at the University of Notre Dame.

Other Conferences and Workshops Attended

- SNC 2007 (Symbolic-Numeric Computation), University of Western Ontario, July 2007.
- All workshops of the IMA Thematic Year on Applications of Algebraic Geometry, University of Minnesota (IMA), 2006.
- MAGIC 2005 (Midwest Algebra, Geometry, and their Interactions Conference), University of Notre Dame, October 2005.
- Workshop on Geometry and Symmetry in Numeric Computation, Colorado State University, August 2005.
- 4th International Conference on Automatic Differentiation, University of Chicago, July 2004.
- FoCM '02 (Foundations of Computational Mathematics), University of Minnesota, August 2002.

Computer skills

Proficient with C, shell scripting, Maple, html, several numerical libraries, make, lex/yacc, office applications, and various other languages and development tools. Significant experience with C++, Matlab, perl, MPI, cvs, and various other languages and applications.

Teaching and Advising Experience

Instructor, *Foundations of Elementary Mathematics*, University of Minnesota, Fall 2007.

Collaborative learning course aimed at exposing junior and senior elementary education majors to "advanced" mathematics (including proofs). Responsible for only section during Fall 2007. Partially redesigned course to better suit the needs and interests of future elementary educators. Responsible for design of all course material (including exams) and all lectures.

REU Assistant, University of Notre Dame, Summer 2006.

Lectured and aided several students in the development of path-tracking software in Maple for an

REU organized by Professor Andrew Sommese.

Instructor, *Principles of Calculus*, University of Notre Dame, Fall 2004.

Terminal calculus course for special admissions students. Responsible for total redesign of course, including content and syllabus. Only instructor of course during Fall 2004. Responsible for design of all course material (including exams), all lectures, and all grading.

Instructor, *Calculus I*, University of Notre Dame, Summer 2003.

Calculus course for business majors. Only instructor of course during Summer 2003. Responsible for design of all course material (including exams), all lectures, and all grading.

Teaching Assistant, *Calculus II*, University of Notre Dame, Fall 2002.

Calculus course for engineers. Responsible for weekly homework sessions for four sections as well as office hours and exam grading.

Substitute Instructor, various courses, University of Notre Dame, Summer 2004 – Spring 2006.

Courses included calculus for business majors, probability and statistics for engineers, and graduate level numerical analysis. Also undergraduate level numerical analysis at the University of Minnesota in Fall 2006.

Grader and Tutor, various courses, The College of Wooster, 1997–2001.

Tutor for most undergraduate level courses offered at Wooster. Grader for all levels of calculus and linear algebra.

Pedagogical Training

"Striving for Excellence in Teaching" Certificate, received Fall 2005.

Department of Mathematics Teaching Seminar, University of Notre Dame.

Chair and Panelist, 2005 and 2006.

Participant, 2002 and 2003.

Participant, *How to Teach Mathematics and Science at the College Level* course, Summer 2004.

Honors and Awards in Mathematics

Arthur J. Schmitt Foundation Fellowship, Fall 2001–Summer 2004, Fall 2005–Spring 2006.

Center for Applied Mathematics Fellowship, University of Notre Dame, Spring 2005.

Melcher P. Fobes Award for excellence in mathematics, The College of Wooster, Spring 2000.

"Meritorious" team award in COMAP Modeling Competition, 1999.

Service

Member, Graduate Student Union Council, University of Notre Dame, Fall 2002–Spring 2005.

Member, University Parking Appeals Board, University of Notre Dame, Fall 2002–Spring 2005.

Member, University *ad hoc* Parking Committee, University of Notre Dame, Fall 2002–Spring 2005.

Member, Department Graduate Recruiting Committee, University of Notre Dame, Spring 2005.

Member, Department Webpage Committee, University of Notre Dame, Fall 2004–Spring 2006.

Judge, Northern Indiana Regional Science Fair, Spring 2003 and Spring 2004.

Many leadership and service positions in various organizations, The College of Wooster, 1997–2001.

Memberships

Society for Industrial and Applied Mathematics (SIAM).

American Mathematical Society (AMS).

Phi Beta Kappa.

References

Professor Andrew Sommese
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