

CHRISTOPHER J. HILLAR

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EDUCATION

University of California, Berkeley, Berkeley, CA, 2001 – 2005

- Ph.D. Mathematics (advisor: Bernd Sturmfels)
- Thesis Topic: Solving Polynomial Systems with Special Structure

Yale University, New Haven, CT, 1996 – 2000

- Graduated Cum Laude.
- B.S. Intensive Mathematics (with distinction in the major), B.S. Computer Science (with distinction in the major)

Honors/Awards:

- **NSA Young Investigators Grant** (Mathematics) 2008 – 2010
- **NSF Postdoctoral Fellowship** (Mathematics) 2005 – 2008
- **NSF Graduate Research Fellowship** (Mathematics) 2001 – 2004
- **John DeForest Prize** for excellence in pure and applied mathematics 2000
- **Anthony Stanley Memorial Prize** for excellence in mathematics 1998, 1999
- **National Macintosh Quake Champion** 1999

EXPERIENCE

Mathematical Sciences Research Institute, Berkeley, CA, June 2009 – June 2011

MSRI NSF Institutes Postdoc and NSA Young Investigator

Mathematical Sciences Research Institute, Berkeley, CA, January 2009 – May 2009

Research Member and NSA Young Investigator

Texas A&M University, College Station, TX, Fall 2005 – Summer 2008

Visiting Assistant Professor and NSF Postdoctoral Fellow

- Organized the Texas A&M Algebra and Combinatorics Seminar.

Art Institute at San Francisco, San Francisco, CA, Fall 2004 – Spring 2005

Instructor

- Taught a class titled *Data Structures*, covering basic computer algorithms with programming component in C++. Topics included *Discrete Mathematics*, *Trees*, *Sorting*, *Hashing*, *Graph Theoretical Algorithms*.

College of William and Mary, Williamsburg, VA, Summer 1999, 2002

Matrix Analysis and its Applications

- (1999) One of eight U.S. undergraduates selected to participate in intensive research experience. NSF-funded, eight week program involved one-on-one interaction with research faculty to solve open problems.
- (2002) Served as graduate mentor to the students selected to participate in above program. Lectured, supervised research, and collaborated on several projects.

Southwest Texas State University (SWT), San Marcos, TX, Summers 1997, 1998

Teaching Assistant and Supervisor

- Supervised and taught gifted high school students selected for Intensive Summer Honors Math Program. Topics included *Abstract Algebra*, *Number Theory*, *Analysis*, *Discrete Mathematics*.

RESEARCH INTERESTS

Computational mathematics, combinatorics, matrix analysis, mathematical neuroscience, structured polynomial systems

PUBLICATIONS

24. (with G. Isely and F. Sommer) *Sparse coding and compressed sensing*, in preparation.
23. (with S. Sullivant) *Finiteness theorems for infinite dimensional polynomial rings and applications*, submitted.
22. (with Lek-Heng Lim) *Most tensor problems are NP-hard*, in preparation.
21. (with M. Aschenbrenner) *An Algorithm for finding symmetric Gröbner bases in infinite dimensional rings*, in preparation.
20. (with T. Windfeldt) *Fibonacci identities and graph colorings*, *Fibonacci Quart.*, **46/47** (2008/2009), 220–224.
19. *Sums of polynomial squares over totally real fields are rational sums of squares*, *Proc. Amer. Math. Soc.*, **137** (2009), 921–930.
18. (with D. Rhea) *Automorphisms of finite abelian groups*, *Amer. Math. Monthly*, **114** (2007), 917–923.

17. (with J. Nie) *An elementary and constructive solution to Hilbert's 17th Problem for matrices*, Proc. Amer. Math. Soc., 136 (2008), 73-76.
16. (with T. Windfeldt) *An algebraic characterization of uniquely vertex colorable graphs*, J. Comb. Th. Ser. B., 98 (2008), 400-414.
15. (with T. Windfeldt) *Minimal generators for symmetric ideals*, Proc. Amer. Math. Soc., 136 (2008), 4135-4137.
14. (with S. Armstrong) *Solving symmetric word equations in positive definite letters*, J. Lond. Math. Soc., 76 (2007), 777-796.
13. *Advances on the the Bessis-Moussa-Villani trace conjecture*, Lin. Alg. Appl., 426 (2007), 130-142.
12. (with L. Levine) *Polynomial recurrences and cyclic resultants*, Proc. Amer. Math. Soc., 135 (2007), 1607-1618.
11. (with M. Aschenbrenner) *Finite generation of symmetric ideals*, Trans. Amer. Math. Soc., 359 (2007), 5171-5192.
10. *Cyclic resultants*, J. Symb. Comp., 39 (2005), 653-669; erratum, ibid. 40 (2005).
9. (with C. R. Johnson). *On the positivity of the coefficients of a certain polynomial defined by two positive definite matrices*, J. Stat. Phys., 118 (2005), 781-789.
8. (with D. L. Rhea). *A result about the density of iterated line intersections in the plane*, Comp. Geom.: Theory Appl., 33 (2006), 106-114.
7. *Appendix to the article "New coins from old: computing with unknown bias,"* by E. Mossel and Y. Peres, Combinatorica, 25 (2005), 707-724.
6. *Logarithmic derivatives of solutions to linear differential equations*, Proc. Amer. Math. Soc., 132 (2004), 2693-2701.
5. (with C. R. Johnson). *Symmetric word equations in two positive definite letters*, Proc. Amer. Math. Soc., 132 (2004), 945-953.
4. (with C. R. Johnson, Y. Harel, J. Groves, P. Rault). *Absolutely flat idempotents*, Electron. J. Linear Algebra, 10 (2003), 190-200.
3. (with C. R. Johnson). *Positive eigenvalues of generalized words in two Hermitian positive definite matrices*, in: Novel Approaches to Hard Discrete Optimization (P. Pardalos and H. Wolkowicz, eds.), Fields Institute Communications 37, 2003, pp. 111-122.
2. (with C. R. Johnson). *Eigenvalues of words in two positive definite letters*, SIAM J. Matrix Anal. Appl., 23 (2002), 916-928.
1. (with C. R. Johnson and I. M. Spitkovsky). *Positive eigenvalues and two-letter generalized words*, Electron. J. Linear Algebra, 9 (2002), 21-26.

TALKS

- *Polynomial recurrences and cyclic resultants*, MIT Combinatorics Seminar, April 15, 2009.
- *Rational sums of squares and applications*, AMS Special Session on Concrete Aspects of Positive Polynomials, AMS Sectional Meetings, UIUC, Illinois, March 27, 2009.
- *Grobner basis in infinite dimensional polynomial rings*, NCSU Symbolic Computation Seminar, Raleigh, NC, October 15, 2008.
- *Positive semidefinite matrix word equations*, Texas A&M Algebraic Geometry Seminar, College Station, TX, September 15, 2008.
- *Sums of squares over totally real fields are rational sums of squares*, MTNS 2008, Blacksburg, Virginia, August 1, 2008
- *Algorithms for finding Grobner basis in infinite dimensional polynomial rings*, ISSAC 2008, Linz, Austria, July 23, 2008
- Four Part Lecture Series: *Grobner Bases and Applications*, University of Copenhagen, Department of Mathematical Sciences, April 6 – May 16, 2008.
- *Advances on the Bessis-Moussa-Villani trace conjecture*, AMS Special Session on Global Optimization and Operations Research Applications, AMS Joint Meetings, San Diego, CA, January 9, 2008.
- *Rational sums of squares*, NCSU Symbolic Computation Seminar, Raleigh, NC, October 24, 2007.
- *Algebraic characterization of uniquely colorable graphs*, Texas A&M Algebra and Combinatorics Seminar, April 6, 2007.
- *Algebraic characterization of uniquely colorable graphs*, UC Davis Discrete Mathematics & Representation Theory Seminar, March 2, 2007.
- *Advances on the BMV trace conjecture*, IMA Annual Program Year Workshop: Optimization and Control, University of Minnesota, January 16, 2007.
- *Finite generation of symmetric ideals*, FPSAC 2006, San Diego, California, June 19, 2006.
- *Finite generation of symmetric ideals*, RISC Algorithmic Combinatorics Seminar, Hagenberg, Austria, May 31, 2006.
- *Finite generation of symmetric ideals*, Technische Universitat, Kaiserslautern, Germany, May 24, 2006.
- *Finite generation of symmetric ideals*, Special Semester on Groebner Bases, Linz, Austria, March 28, 2006.
- *Advances on the Bessis-Moussa-Villani trace conjecture*, Texas A&M University, Jan 19, 2006.
- *Reconstructing dynamical systems from their zeta functions*, AMS Special Session: Solving Polynomial Systems, 2004 Fall AMS Central Section Meeting, October 24, 2004
- *Finite generation of symmetric ideals*, UC Berkeley Combinatorics Seminar, October 4, 2004
- *New coins from old: computing with unknown bias*, UC Berkeley Combinatorics Seminar, May 10, 2004
- *Cyclic resultants*, FPSAC 2004, Vancouver, Canada, June 29, 2004 (poster)

- *Cyclic resultants*, UC Berkeley Commutative Algebra Seminar, Nov 18, 2003
- *Words in two positive definite letters*, UC Berkeley Combinatorics Seminar, April 29, 2002
- *Absolutely flat idempotents*, Southern California Matrix Meeting, Nov 16 2002
- *Symmetric word equations*, Southern California Matrix Meeting, Nov 3 2001

CONFERENCES

- *ISSAC 2008: International Symposium on Symbolic and Algebraic Computation*, July 20 – 23, 2008.
- *MTNS2008: Mathematical Theory of Networks and Systems*, July 28 – August 1, 2008.
- *IMA Annual Program Year Workshop: Non-Linear Computational Geometry*, May 29 – June 2, 2007.
- *Banff Workshop on Contemporary Schubert Calculus and Schubert Geometry*, March 18 – 23, 2007.
- *IMA Annual Program Year Workshop: Optimization and Control*, January 16 – 20, 2007
- *Banff Workshop on Positive Polynomials and Optimization*, October 7 – 12, 2006.
- *IMA Annual Program Year Workshop: Algorithms in Algebraic Geometry*, September 18 – 22, 2006.
- *18th Annual Formal Power Series and Algebraic Combinatorics conference*, June 19 – 23, 2006.
- *Special Semester on Groebner Bases*, Johannes Kepler University, Linz, Austria, Feb 16 – July 6, 2006.
- *17th Annual Formal Power Series and Algebraic Combinatorics conference*, June 20 – 25, 2005.
- *Fall AMS Central Section Meeting*, October 23 – October 24, 2004
- *2004 Park City Mathematics Institute research program: geometric combinatorics*, July 11 – July 31, 2004.
- *16th Annual Formal Power Series and Algebraic Combinatorics conference*, June 28 – July 02, 2004.
- *MSRI Summer School: triangulations of point sets*, July 21 – 31, 2003.
- *GROSTAT VI and International School on Algebraic Statistics*, February 17 – February 20, 2003.

HOBBIES

- Life-long soccer player
- Texas hold ‘em aficionado
- Rock Climbing
- Creating problems:
(*American Mathematical Monthly*: 11422, 11321, 11288, 11231, 11204, 11123, 11098, 10928, 10723
Mathematics Magazine: 1775, 1750, 1684)

BIOGRAPHICAL SKETCH

In the summer of my junior year in high school, I was invited to attend two math programs for talented students – one at the Rose Hulman Institute for Technology and the other at Southwest Texas State University (SWT). The two environments provided a rigorous introduction to the world of mathematics outside of my high school curriculum. The next two summers, I returned to SWT and served as a counselor and teacher to a new group of SWT Honors students. A rewarding aspect of this program is that it is very successful at gathering a diverse student population with mathematics as a common bond.

As an undergraduate at Yale, I had the opportunity to serve as editor-in-chief of the Yale Scientific magazine. With my leadership, the nearly defunct publication underwent a revitalization that has been maintained to this day. In the summer of 1999, I was selected to attend the College of William and Mary REU (research experiences for undergraduates). This productive encounter with research mathematicians resulted in four journal publications. I continue to collaborate with my REU advisor Charles R. Johnson.

In the spring of 2001, I accepted an NSF graduate research fellowship to attend the University of California, Berkeley. Within the first year, I had found a Ph.D. advisor, many good friends, and experienced first-hand the breadth and excitement of the Berkeley mathematical community. The numerous Berkeley colloquia and seminars and the proximity of MSRI (Mathematical Sciences Research Institute) have given me the opportunity to form many friendships with colleagues in my field. In the summer of 2002, I returned to the College of William and Mary as a mentor and advisor to a group of undergraduate researchers.

I completed my Mathematics Ph.D. in 2005, my advisor being Bernd Sturmfels. Recently, I also finished an NSF postdoctoral fellowship at Texas A&M University (under the supervision of Frank Sottile). I was involved in a research group working on questions of reality in the Schubert calculus. I also maintained my own research program on the various projects outlined in my NSF research proposal.

Currently, I am funded by an NSA Young Investigators Grant and an NSF Joint Institutes Postdoctoral Fellowship through MSRI that involves both mathematics and theoretical neuroscience (my research mentor is Friedrich Sommer at the Redwood Center for Theoretical Neuroscience). My vision is to nurture a cross-disciplinary research interaction between MSRI, UC Berkeley Neuroscience (specifically the Redwood Center), and UCB Mathematics.