



David Haws

Education

- 2009 **Ph.D.**, *University of California, Davis*.
Mathematics
- 2004 **B.S.**, *University of California, Davis*.
Mathematics and Computer Science

Doctoral thesis

- Title *Matroid Polytopes: Algorithms, Theory, and Applications*
Advisor Jesús De Loera

Positions Held

- July 2009 -
Current Postdoctoral Scholar, University of Kentucky, Department of Statistics.

Research Interests

Computational biology, phylogenetics, polytopes, Bayesian networks, statistical processes, matroids, algebraic statistics.

Publications

Jing Xi, Ruriko Yoshida, and David Haws. Estimating the number of zero-one multi-way tables via sequential importance sampling. arXiv:1108.5939v2, 2011.

Christopher L. Schardl, Stefan G. Amyotte, Zhiqiang An, Kalina Andreeva, Elissaveta G. Arnaudova, Charles T. Bullock, Patrick Calie, Nikki Charlton, Murray Cox, Randy D. Dinkins, Mark L. Farman, Damien J. Fleetwood, Simona Florea, Anthony E. Glenn, Ulrich Güdener, Daniel R. Harris, David C. Haws, Uljana Hesse, Walter Hollin, Jerzy W. Jaromczyk, Jolanta Jaromczyk, Richard D. Johnson, Anar K. Khan, Eckhard Leistner, Adrian Leuchtmann, Chunjie Li, JinGe Liu, Jinze Liu, Miao Liu, Wade Mace, Neil Moore, Padmaja Nagabhyru, Donal O'Sullivan, Birgitt Oeser, Juan Pan, Daniel G. Panaccione, Jan Schmid, Kathryn K. Schweri, Barry Scott, Ulrike Steiner, Koya Sugawara, Johanna Takach, Eiji Tanaka, Paul Tudzynski, Christine R. Voisey, Jennifer S. Webb, Ella V. Wilson, Ruriko Yoshida, Carolyn A. Young, and Zheng Zeng. Chemical engineering by plant symbionts to enhance niche adaptation: A 12-genome comparison reveals dynamic alkaloid loci. *Submitted to Science*, 2011.

Milan Studeny, David Haws, Raymond Hemmecke, and Silvia Lindner. Polyhedral approach to statistical learning graphical models. *To appear in the Proceedings of the Second CREST-SBM International Conference "Harmony of Grobner Bases and the Modern Industrial Society."*, 2011.

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- J. Xi, S. Wei, F. Zhou, R. Yoshida, and D. Haws. Semigroups and sequential importance sampling for multiway tables and beyond. Submitted to *J. of Multivariate Analysis*, available at <http://arxiv.org/abs/1108.2311>, 2011.
- M. Studeny and D. Haws. On polyhedral approximations of polytopes for learning bayes nets. Technical Report 2303, Research Report Academy of Sciences of the Czech Republic, Institute of Information Theory and Automation, 2011.
- D. Haws, A. Martin Del Campo, and R. Yoshida. Degree bounds for a minimal markov basis for the three-state toric homogeneous markov chain model. *To appear in the Proceedings of the Second CREST-SBM International Conference "Harmony of Grobner Bases and the Modern Industrial Society."*, Available at <http://arxiv.org/abs/1108.0481>, 2011.
- D. Haws, P. Huggins, E. O'Neill, D. Weisrock, and R. Yoshida. A support vector machine based test for incongruence between sets of trees in tree space. *submitted to Systematic Biology*, 2011.
- S. Cheung, D. Haws, R. Yoshida, and J. Zhao. Approximation techniques in solving optimal camera placement problems. *submitted to ICCV*, 2011.
- D. Haws, T. Hodge, and R. Yoshida. Optimality of the neighbor joining algorithm and faces of the balanced minimum evolution polytope. *Bulletin of Mathematical Biology. Published on-line DOI: 10.1007/s11538-011-9640-x*, available at <http://arxiv.org/abs/1004.2073>, 2011.
- P.M. Huggins, W. Li, D. Haws, T. Friedrich, J. Liu, and R. Yoshida. Bayes estimators for phylogenetic reconstruction. *Systematic Biology*, 60(4):528–540, 2011.
- E. Arnaudova, D. Haws, P. Huggins, J. Jaromczyk, N. Moore, C. Schardl, and R. Yoshida. Statistical phylogenetic tree analysis using differences of means. *Front. Psychiatry*, available at <http://arxiv.org/abs/1004.2101>, 1(47), 2010.
- J. De Loera, D. Haws, J. Lee, and A. O'Hair. Computation in multicriteria matroid optimization, journal of experimental algorithmics. *Journal of Experimental Algorithmics*, 9, 2009.
- J. De Loera, D. Haws, and M. Koppe. Ehrhart polynomials of matroid polytopes and polymatroids. *Journal of Discrete and Computational Geometry*, eprint [arXiv:0710.4346](http://arxiv.org/abs/0710.4346), 2008.
- J. De Loera, D. Haws, R. Hemmecke, P. Huggins, and R. Yoshida. A computational study of integer programming algorithms based on barvinok's rational functions. *The Journal of Discrete Optimization*, 2:135–144, 2005.
- J. De Loera, D. Haws, R. Hemmecke, P. Huggins, B. Sturmfels, and R. Yoshida. Short rational functions for toric algebra and applications. *The Journal of Symbolic Computation*, 38(2):959–973, 2004.
- J. De Loera, D. Haws, R. Hemmecke, P. Huggins, and R. Yoshida. Three kinds of integer programming algorithms based on barvinok's rational functions. In D. Bienstock and G. Nemhauser, editors, *Integer Programming and Combinatorial Optimization: 10th International IPCO Conference*, pages 244–255. Springer, 2004.

Selected Talks

- September 2011 Volumes and Tangent Cones of Matroid Polytopes, AMS Fall Southeastern Section Meeting, Winston-Salem, North Carolina. Event: Algebraic and Geometric Aspects of Matroids.
- March 2011 Optimality of the Neighbor Joining Algorithm and Faces of the Balanced Minimum Evolution Polytope, Institute of Information Theory and Automation, Prague, Czech Republic.
- November 2010 Optimality of the Neighbor Joining Algorithm and Faces of the Balanced Minimum Evolution Polytope, University of Kentucky.
- May 2010 Ehrhart Polynomials, h^* -vectors, and triangulations of matroid polytopes, The 23rd Cumberland Conference on Combinatorics, Graph Theory, and Computing.
- April 2010 Ehrhart Polynomials, h^* -vectors, and triangulations of matroid polytopes, Texas A&M. *University of Kentucky, Department of Statistics*

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- April 2010 Faces of the Balanced Minimum Evolution Polytope, AMS Sectional Meeting 1057, Session: Advances in Algebraic Statistics.
- April 2010 Computation in Multicriteria Matroid Optimization, AMS Sectional Meeting 1057, Session: Matroid Theory.
- April 2008 Ehrhart Polynomials, h^* -vectors, and triangulations of matroid polytopes, CombinaTexas, University of Texas, El Paso.
- July 2006 Minimum Weight Triangulation, Workshop on Geometric and Topological Combinatorics, International Congress of Mathematics Satellite Workshop, Alcalá de Henares, Spain.
- November 2003 Software for the Algebraic Manipulation of Lattice Points Inside Polyhedra, Southern California Conference on Undergraduate Research, University of California, Irvine, CA.
- July 2003 Software for the Algebraic Manipulation of Lattice Points Inside Polyhedra, Joint Summer Research Conference on Integer Points in Polyhedra, Snowbird, UT.

Selected Posters

- May 2011 A Support Vector Machine Based Test for Incongruence Between Sets of Trees in Tree Space, 16th Annual EPScoR conference, Louisville, KY.
- July 2010 Statistical Phylogenetic Tree Analysis Using Differences of Means, ISMB Boston, MA.
- June 2009 Computation in Multicriteria Matroid Optimization, Mixed Integer Programming Workshop Series, University of California, Berkeley.
- November 2008 Experimental Investigations in Non-linear Matroid Optimization, Mixed-Integer Non-Linear Optimization: Algorithmic Advances and Applications, IMA University of Minnesota.
- March 2008 Volumes of Matroid Polytopes, AMS Sectional Meeting, California State University, Sacramento.
- August 2006 Finding Minimum Weight Triangulations, Workshop on Geometric and Topological Combinatorics, Alcalá de Henares, Madrid, Spain.

External Funding

Title **Geometry of gene cophylogenies as relates to genome evolution and speciation**
Source (period) NIH Research Project Grant Program (R01) from the Joint DMS/BIO/NIGMS Math/Bio Program. Grant number: 1R01GM086888-01. Award Document Number: RGM086888A. (July 1st, 2008 to June 30th, 2013).

Principal Investigator R. Yoshida

Role Postdoc

Amount \$1,000,000 for direct cost. (\$400,000 for indirect cost)

Efforts One summer and one academic month.

Title **Techniques for sampling and estimation of multiway contingency tables**
Under Review NSF DMS-Statistics, Submitted Nov 7, 2011.

Principal Investigator R. Yoshida

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Role Co-PI

Teaching Experience

Instructor

Spring 2011 STA 624, Applied Stochastic Processes (graduate course), University of Kentucky.

Co-Instructor

Fall 2011 STA 703, Advanced Probability (graduate course), University of Kentucky.

Associate Instructor

Spring 2009 Math 17C, Calculus for BioSci, University of California, Davis.
Summer 2008 Math 21C, Vector Calculus, University of California, Davis.
Winter 2008 Math 16A, Short Calculus, University of California, Davis.
Spring 2007 Math 21C, Vector Calculus, University of California, Davis.

Teaching Assistant

Spring 2011 CS 685-001/PPA 784-003/STA 695-001, (graduate course) Phylogenetic Analysis and Molecular Evolution, University of Kentucky
Fall 2009 CS 685-001/PPA 784-003/STA 695-001, (graduate course) Phylogenetic Analysis and Molecular Evolution, University of Kentucky
Fall 2007 Math 115a, Number Theory, University of California, Davis.
Winter 2007 Math 21C, Vector Calculus, University of California, Davis.

Fellowships

VIGRE Fellowship Fall 2003-Spring 2004. Fall 2004-Spring 2005. Fall 2008.
VIGRE Summer Research July-August 2006. August 2007.
Graduate Student Researcher Fall 2007. Winter 2009.

Mentoring

Fall 2009 Mentored one graduate student. Completed paper "Bayes Estimators for Phylogenetic Reconstruction".
Spring - Fall 2011 Mentored five graduate students. Completed paper "Semigroups and sequential importance sampling for multiway tables and beyond." Assisted in completion of second paper (not an author). Now working on a grant proposal related to these topics.

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Advisors

Thesis Advisor Jesús De Loera
Postdoctoral Ruriko Yoshida
Advisor

Service

October 2011 Organized mini-symposium "Applications in mathematical biology" at SIAM Conference on Applied Algebraic Geometry, North Carolina State University, Raleigh, NC.
Fall 2004-Fall 2006 Graduate Student Association Representative for the department of mathematics.

Software

GeneOut Gene Outlier. Software for "A support vector machine based test for incongruence between sets of trees in tree space."
MOCHA Matroid Optimization: Combinatorial Heuristics and Algorithms. See <https://projects.coin-or.org/Mocha>.
LattE Developed with De Loera, Haws, Hemmecke, Huggins, and Tauzer. Software to count the number of lattice points in a rational polyhedra via Barvinok's cone decomposition. Available at <http://www.math.ucdavis.edu/latte>.
Additional Software See <https://github.com/dchaws> for other miscellaneous software.

Skills

Unix, Mac, and Windows.
Programming with C/C++, Perl, R, Matlab, Maple, bash shell. Experience with Adobe Photoshop and Illustrator and Microsoft Office.