Martin Helmer

Postdoctoral Fellow.
Department of Mathematical Sciences, University of Copenhagen.

Department of Mathematical Sciences
University of Copenhagen
Universitetsparken 5
DK-2100 Copenhagen, Denmark
+45 50318467
m.helmer@math.ku.dk
martin-helmer.com
Martin-Helmer

Summary of Mathematical Interests

My primary interest is to construct computational and theoretic tools to aid in understanding algebraic geometry and its applications. Broadly I am interested in algebraic geometry (theoretical, computational, and applied) and in related topics in computer algebra. I am particularly interested in practical methods in intersection theory, polynomial system solving and combinatorial algebraic geometry.

Academic Positions

2017–Present **Postdoctoral Fellow**, *Department of Mathematical Sciences*, University of Copenhagen.
- Postdoc Mentor: Elisenda Feliu

2015–2017 **NSERC Postdoctoral Fellow and Visiting Assistant Professor**, *Department of Mathematics*, University of California, Berkeley.
- Postdoc Mentor: Bernd Sturmfels

Publications

Carlos Améndola, Nathan Bliss, Isaac Burke, Courtney R. Gibbons, Martin Helmer, Serkan Hoşten, Evan D. Nash, Jose Israel Rodriguez, Daniel Smolkin. The Maximum Likelihood Degree of Toric Varieties. (2017). To Appear in *Journal of Symbolic Computation*.

Martin Helmer and Bernd Sturmfels. Nearest Points on Toric Varieties. To appear in *Mathematica Scandinavica*, 2017.

Martin Helmer. Computing characteristic classes of subschemes of smooth toric varieties. *Journal of Algebra*, Volume 476, 2017, Pages 548-582, ISSN 0021-8693.

Martin Helmer (with Appendix by Martin Helmer and Éric Schost). A Direct Algorithm to Compute the Topological Euler Characteristic and Chern-Schwartz-MacPherson Class of Projective Complete Intersection Varieties. *Theoretical Computer Science*, Volume 681, 2017, Pages 54-74, ISSN 0304-3975.

Martin Helmer. Computing the Chern-Schwartz-MacPherson Class of Complete Simplical Toric Varieties. *Springer Proceedings in Mathematics & Statistics book series (PROMS)*, volume 198 (ACA 2015), pp 207-217, July 2017.

Martin Helmer. Algorithms to compute the topological Euler characteristic, Chern-Schwartz-Macpherson class and Segre class of projective varieties. *Journal of Symbolic Computation*, 73, page 120-138, 2016.

Martin Helmer. An algorithm to compute certain Euler characteristics and Chern-Schwartz-MacPherson classes. Proceedings of the 2014 Symposium on Symbolic-Numeric Computation, pp. 130-131. ACM, 2014.

PL Buono, Martin Helmer, and Jeroen SW Lamb. On the zero set of G-equivariant maps. *Mathematical Proceedings of the Cambridge Phil. Soc.*, volume 147, page 735. Cambridge Univ. Press, 2009.

Ramiro Liscano, John Khalil Jacoub, Anand Dersingh, Jinfu Zheng, Martin Helmer, Charles Elliott, and Ali Najafizadeh. Network performance of a wireless sensor network for temperature monitoring in vineyards. In Proceedings of the 8th ACM Symposium on Performance evaluation of wireless ad hoc, sensor, and ubiquitous networks, pp. 125-130. ACM, 2011.

Submitted Preprints

Martin Helmer, Bernt-Ivar Nodland. Polar degrees and closest points in codimension two (2017). arXiv preprint arXiv:1711.02381.

Michael F Adamer, Martin Helmer. Euclidean Distance Degree for Chemical Reaction Networks (2017). arXiv preprint arXiv:1707.07650.

James Fullwood and Martin Helmer. On a projective bundle formula. (2016). arXiv preprint arXiv:1603.03553.

Education

2011–2015 **Ph.D Applied Mathematics**, *University of Western Ontario*, Canada.
- Advisor: Éric Schost

2009–2011 **M.Sc Mathematics**, *Queen's University*, Canada.

2005–2009 **B.Sc Applied Mathematics**, *University of Ontario Institute of Technology*, Canada.

Fellowships, Scholarships and Awards

2015–2017 **NSERC (Natural Sciences and Engineering Research Council of Canada) Postdoctoral Fellowship**, University of California, Berkeley, USA.

2016 **AMS Travel award for the Mathematics Research Communities Workshop on Algebraic Statistics.**, Snowbird, Utah, USA.

2012–2013 **Ontario Graduate Scholarship**, University of Western Ontario, Canada.

2011–2012 **Ontario Graduate Scholarship**, University of Western Ontario, Canada.

2010–2011 **Ontario Graduate Scholarship**, Queen's University, Canada.

2009–2010 **Ontario Graduate Scholarship**, Queen's University, Canada.

2008 **NSERC USRA**, University of Ontario Institute of Technology, Canada.

2007 **UOIT STAR Award**, University of Ontario Institute of Technology, Canada.

Software

2017 **EDPolytopeCD2**, a Macaulay2 software package to compute the Euclidean distance and polar degrees of a projective toric variety using combinatorial methods with improved performance in codimension two.
http://martin-helmer.com/Software/toricED_Codim2.html

2016 **EDPolytope**, a Macaulay2 software package to compute the Euclidean distance degree and polar degrees of a projective toric variety using combinatorial methods.
http://martin-helmer.com/Software/toricED.html

2015 **CharacteristicClasses**, *with Christine Jost*, a Macaulay2 built-in software package. Computes the Segre class, Chern-Schwartz-MacPherson class and Euler characteristic of a given subscheme of certain smooth toric varieties.
http://www.math.uiuc.edu/Macaulay2/doc/Macaulay2-1.9.2/share/doc/Macaulay2/CharacteristicClasses/html/

2014 **char-class-calc**, a Sage program to compute the Segre class, Chern-Schwartz-MacPherson class and Euler characteristic of a projective variety.
https://github.com/Martin-Helmer/char-class-calc

Teaching Experience (Instructor)

2016–2017 **Visiting Assistant Professor**.
Department of Mathematics, University of California, Berkeley.
- Spring Semester 2017:
  - Math 113: Introduction to Abstract Algebra
    - Course Homepage: https://math.berkeley.edu/~mhelmer/Teaching/math113_2017
  - Math 196: Honors Thesis
    - Supervised Siqi Zou's honors thesis: "Gröbner Basis Algorithms for Sudoku Solving"

- Fall Semester 2016:
  - Math 143: Elementary Algebraic Geometry
    - Course Homepage: https://math.berkeley.edu/~mhelmer/Teaching/math143
- Spring Semester 2016:
  - Math 113: Introduction to Abstract Algebra
    - Course Homepage: https://math.berkeley.edu/~mhelmer/Teaching/math113

Conference Talks

Dec 12, 2017 **Open Source Computer Algebra Research Conference at the Max Planck Institute for Mathematics in the Sciences**, *Leipzig, Germany*.
Effective Intersection Theory

Aug 3, 2017 **SIAM Conference on Applied Algebraic Geometry**, *Atlanta, USA*.
Nearest Points on Toric Varieties

Jan 5, 2017 **Joint Math Meetings: Algebraic Statistics Special Session**, *Atlanta, USA*.
Topological Invariants and the Maximum Likelihood Degree of a Toric Variety

Dec 7, 2015 **Fields Institute Thematic Program on Computer Algebra: Workshop on Algebra, Geometry and Proofs in Symbolic Computation**, *Toronto, Canada*.
Algorithms to Compute Characteristic Classes of Subschemes of Certain Toric Varieties

Aug 3, 2015 **SIAM Conference on Applied Algebraic Geometry**, *Daejeon, South Korea*.
Algorithms for the Computation of Chern-Schwartz-MacPherson Classes and the Euler Characteristic

July 22, 2015 **Applications of Computer Algebra Conference (ACA) 2015**, *Kalamata, Greece*.
Algorithms to Compute Chern-Schwartz-Macpherson and Segre Classes and the Euler Characteristic

July 30, 2014 **Symbolic-Numeric Computation Conference (SNC) 2014**, *Shanghai, China*.
An Algorithm to Compute Certain Euler Characteristics and Chern-Schwartz-MacPherson Classes

July 9, 2014 **Applications of Computer Algebra Conference (ACA) 2014**, *Bronx, New York*, USA.
Algorithms to Compute Chern-Schwartz-Macpherson and Segre Classes and the Euler Characteristic

Seminar Talks

Jan 13, 2017 **Algebra and Number Theory seminar**, *University of California*, Santa Cruz.
Nearest Points on Toric Varieties

Sept 28, 2016 **Algebra, Geometry, and Number Theory seminar**, *University of Saskatchewan*, Saskatoon.
Nearest Points on Toric Varieties

Feb 24, 2016 **Algebraic Statistics Seminar**, *Illinois Institute of Technology*, Chicago.
Finding Nearest Points on Toric Varieties

Feb 24, 2016 **Algebraic Geometry Seminar**, *University of Chicago*.
Algorithms to Compute Characteristic Classes of Subschemes of Certain Toric Varieties

Nov 27, 2015 **Geometry Seminar**, *University of Hong Kong*.
Algorithms to Compute Characteristic Classes of Subschemes of Certain Toric Varieties

Nov 18, 2015 **Algebra-Geometry-Combinatorics Seminar**, *San Francisco State University*.
Algorithms to Compute Characteristic Classes of Subschemes of Certain Toric Varieties

Nov 10, 2015 **Commutative Algebra and Algebraic Geometry Seminar**, *University of California, Berkeley*.
Algorithms to Compute Chern-Schwartz-Macpherson Classes

Sept 21, 2015 **Applied Algebra Seminar**, *University of California, Berkeley*.
Algorithms to Compute Topological Invariants of Subschemes of Smooth Toric Varieties

Mar 16, 2015 **Geometry and Topology Seminar**, *University of Western Ontario*.
Algorithms to Compute Chern-Schwartz-Macpherson and Segre Classes and the Euler Characteristic

Feb 9, 2015 **Queen's Algebraic Geometry Seminar**, *Queen's University*, Kingston.
Algorithms to Compute Chern-Schwartz-Macpherson Classes

June 27, 2014 **LIP6 - Université Paris 6, PolSys Seminar**, *Université Pierre-et-Marie-Curie*, Paris.
Algorithms to Compute Chern-Schwartz-Macpherson and Segre Classes and the Euler Characteristic

Service

2016–2017 **Co-organizer**, *with Corey Harris*, Minisymposium on Euclidean Distance Degree.
2017 SIAM Conference on Applied Algebraic Geometry, Atlanta, Georgia

2016 **Co-organizer**, *with David Dynerman*, Berkeley Applied Algebra Seminar.

2016 **Referee**, *Transactions of the AMS (American Mathematical Society)*.

2015 **Referee**, *Sixth International Conference on Mathematical Aspects of Computer and Information Sciences (MACIS)*.

Posters

April 26, 2014 **East Coast Computer Algebra Day (ECCAD) 2014**, *Duke University*, Durham.
Algorithms to Compute Chern-Schwartz-Macpherson and Segre Classes and the Euler Characteristic

Other Teaching Experience

2012–2015 **Teaching Assistant**.
Department of Applied Mathematics, University of Western Ontario.

- Tutorials for AM2415: Applied Mathematical Methods for Electrical and Software Engineering I
- Tutorials for AM2413: Applied Mathematical and Numerical Methods for Mechanical Engineering
- Tutorials for AM1413: Applied Mathematics for Engineers I
- Tutorials for AM1411: Linear Algebra for Engineers

2011 **Math Education Researcher**.
Department of Mathematics and Statistics, Queens University, Kingston, Canada.

- Researched the effective use of electronic learning resources in the undergraduate calculus curriculum. Supervised by Peter Taylor.

2011 **Teaching Assistant**.
Department of Mathematics and Statistics, Queens University, Kingston, Canada.

- Tutorials for Math 224: Applied Mathematics for Civil Engineers