

Martin Helmer

Postdoctoral Fellow.

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Summary of Mathematical Interests

My primary interest is to construct computational and theoretic tools to aid in understanding algebraic geometry and its applications. This includes real and combinatorial algebraic geometry and practical methods in intersection theory.

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

Submitted Preprints

Corey Harris and Martin Helmer. Segre Class Computation and Practical Applications. arXiv preprint arXiv:1806.07408 (2018).

Elisenda Feliu and Martin Helmer. Multistationarity for Fewnomial Chemical Reaction Networks. arXiv preprint arXiv:1807.02991 (2018)

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

James Fullwood and Martin Helmer. On the Euler characteristic of a relative hypersurface. arXiv preprint arXiv:1603.03553 (2018).

Publications

Martin Helmer, Bernt Ivar Utstøl Nødland. Polar degrees and closest points in codimension two. *Journal of Algebra and Its Applications* (2017): 1950095

Martin Helmer and Bernd Sturmfels. Nearest Points on Toric Varieties. *Mathematica Scandinavica*, Volume 122.2, page 213-238, 2018.

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). *Journal of Symbolic Computation*, 2018.

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 Simplicial 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 Bueno, 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.

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, PoISys 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