Jason Cantarella
Curriculum Vitae

Current Address

UGA Math Department, Boyd Graduate Research Center, Athens, GA 30602
jason.cantarella@gmail.com
Phone: (706) 542-2595
http://www.jasoncantarella.com

Employment History

Associate Head, Math Department, University of Georgia, 2016-Present.
Professor, University of Georgia, 2013-Present.
Associate Professor, University of Georgia. 2005-2013.
Assistant Professor, University of Georgia. 2002-2005.
NSF Postdoctoral Research Fellow and Assistant Professor, University of Georgia, Athens. 1999-2002.
NSF Postdoctoral Research Fellow, University of Massachusetts, Amherst. 1999-2000.

Education

Ph.D., Mathematics, University of Pennsylvania, 1999.
M.S., Mathematics, University of Pennsylvania, 1995.
B.A., Mathematics, Vassar College, 1993.
- Phi Beta Kappa.

Teaching

(1) Substantial work as Associate Head in computerizing mathematics department undergraduate program administration, including scheduling via integer programming, tracking teaching evaluations, and predicting enrollments from historical data.
(2) Faculty mentor for UGA VIGRE Geometry Group with a total of 30 undergraduates and 33 graduate students. Group included three summer undergraduate research experiences "Massively parallel computation of geometrically optimal knots", "Mathematics and Visualization", and "Geometric Flows for Plane Curves". See `http://tinyurl.com/y26ukl`.
(3) 6 Ph.D. students graduated (Harrison Chapman, Tom Needham, Michael Berglund, Matt Mastin, Chad Mullikin and Edward Ashton). Currently advising Ph.D. student: Erik Schreyer. Master's thesis advisor for Amelia Reeves.
(4) 6 Postdocs supervised (Nancy Wrinkle, Jason Parsley, Clayton Shonkwiler, Gary Iliev, Kyle Chapman, Philipp Reiter).
(5) Math Department McCay Award for contributions to research, teaching and service. 2011.
(6) SGA Faculty recognition award, 2010. Teaching award organized by student government to recognize "favorite professor" of an undergraduate student.
(7) Teacher Education Fellow (2003-2004) in University of Georgia mathematics department. Collaborated with Mathematics Education department to help develop effective courses for future K-12 math teachers.
(8) Project NExT Fellow, (Gold dot), 2000-2001.

Conference Organization and Scientific Advising

(1) Organizer, Simons Center for Geometry and Physics Workshop, "Symplectic and Algebraic Geometry in the Statistical Physics of Polymers", October 2015.
(2) Organizer, Georgia Topology Conference, 2013.
(3) Scientific Organizing Committee, Oberwolfach Workshop "Geometric Knot Theory", April 28th - May 4th, 2013.
(4) Scientific Organizing Committee, Issac Newton Institute Workshop "Topological Dynamics in the Physical and Biological Sciences", 16 July-21 December 2012.
(5) Scientific Organizing Committee, SouthEast Geometry Conference (various years).
(6) Organizer, "Geometry, Topology, and Physics 2008: A Conference in Honor of the 70th Birthday of Herman Gluck".

Publications

(1) Radius of Gyration, Contraction Factors, and Subdivisions of Topological Polymers.
with T. Deguchi, C. Shonkwiler, E. Uehara. Preprint. *arXiv:2004.06199*

(2) Computing the Conformal Barycenter.
with H. Schumacher. Preprint. *arXiv:2004.03958*

(3) Gaussian Random Embeddings of Multigraphs.
with T. Deguchi, C. Shonkwiler, E. Uehara. Preprint. *arXiv:2001.11709*

(4) Random Triangles and Polygons in the Plane.
with T. Needham, C. Shonkwiler. *American Mathematical Monthly*, 126 (2019), no. 2, p. 113-134.

(5) Open and closed random walks with fixed edgelengths in $\mathbb{R}^d$.
with K. Chapman, P. Reiter, C. Shonkwiler.
Journal of Physics A: Mathematical and Theoretical, 51 (2018), no. 43, p. 434002.

(6) Knot Fertility and Lineage.
with A. Henrich, E. Magness, O. O'Keefe, K. Perez, E. Rawdon, B. Zimmer.
Journal of Knot Theory and its Ramifications 26 (2017) no. 13, p. 1750093.

(7) Knot Probabilities in Random Diagrams.
with H. Chapman, M. Mastin.
Journal of Physics A: Mathematical and Theoretical 49 (2016) no. 40, p. 405001.

(8) A Fast Direct Sampling Algorithm for Equilateral Closed Polygons.
with B. Duplantier, C. Shonkwiler, and E. Uehara.
Journal of Physics A: Mathematical and Theoretical 49 (2016) no. 27, p. 275202.

(9) Rigid Origami Vertices: Conditions and Forcing Sets.
with Z. Abel, E. Demaine, D. Eppstein, T. Hull, J. Ku, R. Lang, and T. Tachi.
Journal of Computational Geometry 7 (2016) no. 1, p. 171-184.

(10) The Symplectic Geometry of Closed Equilateral Random Walks in 3-space.
with C. Shonkwiler. *Annals of Applied Probability* 26 (2016) no. 1, p. 549-596.

(11) The Expected Total Curvature of Random Polygons.
with A. Grosberg, R. Kusner, C. Shonkwiler. *American Journal of Mathematics* 137 (2015) no. 2, p. 411-438.

(12) The tight knot spectrum in QCD.
with R. Buniy, T. Kephart, E. Rawdon. *Physical Review D* 89 (2014), no. 5, p. 054513.

(13) Symmetric Criticality for Tight Knots.
with J. Ellis, J. Fu, M. Mastin. *Journal of Knot Theory and its Ramifications* 23 (2014) no. 2, p. 1450008-1–17.

(14) Probability Theory of Random Polygons from the Quaternionic Viewpoint.
with T. Deguchi, C. Shonkwiler. *Comm. Pure and Applied Mathematics* 67 (2014) no. 10, p. 1658–1699.

(15) Ropelength Criticality.
with J. Fu, R. Kusner, J. Sullivan. *Geometry and Topology* 18 (2014) no. 4, p. 1973-2043.

(16) The Shapes of Tight Composite Knots.
with A. LaPointe, E. Rawdon. *Journal of Physics A: Mathematical and Theoretical* 45 (2012), p. 1-19.

(17) The 27 Possible Intrinsic Symmetry Groups of Two-Component Links.
with J. Cornish, M. Mastin, J. Parsley. *Symmetry* 4 (2012) no. 1, p. 129-142.

(18) Intrinsic symmetry groups of links with 8 and fewer crossings.
with M. Berglund, M. Casey, E. Dannenberg, W. George, A. Johnson, A. Kelly, A. LaPointe, M. Mastin, J. Parsley, J. Rooney, R. Whitaker. *Symmetry* 4 (2012) no. 1, p. 143–207.

(19) Knot Tightening by Constrained Gradient Descent
with T. Ashton, M. Piatek, E. Rawdon. *Experimental Mathematics* 20 (2011) no. 1, p. 57–90.

(20) A new cohomological formula for helicity in $\mathbf{R}^{2k+1}$ reveals the effect of a diffeomorphism on helicity.
with J. Parsley. *Journal of Geometry and Physics* 60 (2010), p. 1127-1155.

(21) Criticality for the Gehring Link Problem.
with J. Fu, R. Kusner, J. Sullivan, and N. Wrinkle. *Geometry and Topology* 10 (2006), p. 2055-2115.

(22) Visualizing the tightening of knots.
with M. Piatek and E. Rawdon.
VIS '05: Proceedings of the conference on Visualization '05, 575-582, IEEE Computer Society, 2005.

(23) A Fast Octree-Based Algorithm for Computing Ropelength.
with T. Ashton. *Physical and Numerical Models in Knot Theory*, Series on Knots and Everything Vol. 36. World Scientific Press (2005), p. 323–341.
(24) On Comparing the Writhe of a Smooth Curve to the Writhe of an Inscribed Polygon.
SIAM Journal of Numerical Analysis 42 (2005) no. 5, p. 1846–1861.
(25) An Energy-Driven Approach to Linkage Unfolding.
with E. Demaine, H. Iben, and J. O'Brien.
SCG '04: Proceedings of the twentieth annual symposium on Computational Geometry
ACM Press, 2004. p. 134–143.
(26) Upper Bounds for Ropelength as a function of Crossing Number.
with X.W. Faber, C. Mullikin. *Topology and its Applications* 135 (2003) no. 1-3, p. 253-264.
(27) The Second Hull of a Knotted Curve.
with G. Kuperberg, R. Kusner, J. Sullivan. *American Journal of Mathematics* 125 (2003) no. 6, p. 1335-1348.
(28) Vector Calculus and the Topology of Domains in 3-Space.
with D. DeTurck and H. Gluck. *American Mathematical Monthly* 109 (2002) no. 5.
(29) Circles Minimize Most Knot Energies.
with A. Abrams, J. Fu, M. Ghomi, R. Howard. *Topology* 42 (2002) no. 2, p. 381–394.
(30) On the Minimum Ropelength of Knots and Links.
with R. Kusner, J. Sullivan. *Inventiones Mathematicae* 150 (2002) no. 2, p. 257–286.
(31) Upper Bounds for Writhe and Helicity.
with D. DeTurck and H. Gluck. *Proceedings of the Conference in Honor of the 70th Birthday of Joan Birman*, Jane Gilman, Xiao-Song Lin, William Menasco, eds., International Press, AMS/IP Series on Advanced Mathematics (2002).
(32) The Biot-Savart Operator for Application to Knot Theory, Fluid Dynamics, and Plasma Physics.
with D. DeTurck and H. Gluck. *Journal of Mathematical Physics* 42 (2001), no. 2, p. 876–905.
(33) A General Mutual Helicity Formula.
Proceedings of the Royal Society: A 456 (2000), no. 2003, p. 2771–2779.
(34) Isoperimetric Problems for the Helicity of Vector Fields and the Biot-Savart and Curl Operators.
with D. DeTurck, H. Gluck, and M. Teytel. *Journal of Mathematical Physics* 41 (2000), no. 8, p. 5614-5641.
(35) The Spectrum of the Curl Operator on Spherically Symmetric Domains.
with D. DeTurck, H. Gluck, and M. Teytel. *Physics of Plasmas* 7 (2000), no. 7, p. 2766-2775.
(36) The Influence of Geometry and Topology on Helicity.
with D. DeTurck, H. Gluck, and M. Teytel. In *Magnetic Helicity in Space and Laboratory Plasmas*, American Geophysical Union, Geophysical Monograph Series 111, ed. Pevtsov, Canfield, & Brown. 1999.
(37) Nontrivial Embeddings of Polygonal Intervals and Unknots in 3-Space.
with H. Johnston, *Journal of Knot Theory and its Ramifications* 7 (1998), no. 8, p. 1027-1039.
(38) Tight Knot Values Deviate From Linear Relation.
with R. Kusner and J. Sullivan, *Nature* 392 (1998), p. 237.

Released Software

(1) `ridgerunner 2.0.0` with Eric Rawdon, Michael Piatek, last release July 2012.
- ridgerunner is a fast code for finding approximately tight configurations of knotted curves in space using the method of constrained gradient descent. Several papers have been published using ridgerunner data, and the images and movies generated have been published in the art magazine *Cabinet*, and showed in several gallery shows of mathematical art.

(2) `plCurve 7.5.2` with Ted Ashton and Harrison Chapman, GPL, last release October 2016.
- plCurve is a fast code for handling polygonal curves in space, including computing their HOMFLY polynomials, as well as different kinds of geometric data, and generating random polygons.

(3) `liboctrope 2.0.0` with Ted Ashton, GPL, last release July 2012.
- A fast code for computing the self-contacts of tubes around space polygons.

(4) `tsnnls 2.3.4` with Michael Piatek and Eric Rawdon, LGPL, last release November 2016.
- Tsnnls is a linear algebra solver for the sparse non-negative least squares problem. It is used in fields from CAD to geology, including firmware for biology lab equipment, finite-element analysis (Tsplines, Inc.) and the construction of a fish-finding sonar (Atlantide Consulting).

(5) `vecttools 1.2.2`, GPL, last release July 2012.
- A collection of utility codes for various curve theory tasks, including generating seamless triangulated tubes around closed or open space polygons, reconstructing curves from curvature and torsion, splining polygonal curves, and computing writhe.

(6) `Perl Encyclopedia of Triangle Centers`, no license.
- The Perl ETC is used to compute triangle centers in the popular *GeoGebra* system.

Grants and Funding

Simons Collaboration Grant, #524120. 2017-2022. ($42,000)
NSF TUES-1 Grant, DUE-12-45540. 2013-2016. ($174,696)
Simons Collaboration Grant, #284066. 2013. ($35,000)
University of Georgia STEM Education Minigrant, 2012-2013.
University of Georgia Faculty Summer Research Grant, 2012.
University of Georgia ICE Development Grant, 2010.
Conference on Applications of Geometry to Topology and Physics, DMS-08-16502. ($19,900)
University of Georgia VIGRE grant, (co-PI) DMS-07-38586. 2008-2013. ($3,819,865)
NSF REU Site Grant, (co-PI) DMS-06-49242. 2007-2010. ($369,142)
University of Georgia ICE Project Grant, 2006.
University of Georgia VIGRE Grant, (co-PI) DMS-00-89927. 2000-2005. ($2,451,334)
Pittsburgh Supercomputing Center Grant, (with Eric Rawdon) DMS-03-0005P. 2003-2004.
NSF Individual Investigator Grant, (with Joseph H.G. Fu) DMS-02-04862. 2002-2005. ($203,992)
University of Georgia Research Foundation, Faculty Research Grant. 2002-2003.
NSF Postdoctoral Research Fellowship, DMS-99-02397. 1999-2002. ($90,000)

Selected (Recent) Domestic Invited Talks

Joint Mathematical Meetings 2020, Denver, CO.
AMS Special Session on Applications and Computations in Knot Theory
IMA workshop, Biology, Analysis, Geometry, Energies, Links, June 2019.
Georgia Southern University, Colloquium, February 2019.
Western Kentucky University, Math Symposium Keynote Speaker, November 2018.
Bryn Mawr College, Colloquium and PACT Seminar, October 2018.
33rd Summer Conference on Topology and its Applications, July 2018.
AMS Spring Eastern Section Meeting, April 2018.
AMS Special Session on Topology of Biopolymers
Colorado State University, Colloquium, September 2017.
AMS Spring Southeastern Sectional Meeting, March 2017.
AMS Special Session on Knot Theory and its Applications
Joint Mathematical Meetings 2017, Atlanta, GA.
MAA Invited Address.
NSF Poster Session for Funded Education Projects.
AMS Central Sectional Meeting, October 2016.
AMS Special Session on Knotting in Physical Systems.
UnKnot Conference, Denison University, August 2016.
Colorado State University, Algebraic Combinatorics Seminar, June 2016.
AMS Southeastern Sectional Meeting, March 2016.
AMS Special Session on Algebraic Structures in Knot Theory.
Joint Mathematical Meetings 2015, Seattle, WA.
NSF Poster Session for Funded Education Projects.
Simons Center for Geometry and Physics, October 2015.
Symplectic and Algebraic Geometry in the Statistical Physics of Polymers Workshop
MathFest, August 2015, Washington DC.
Invited paper session: What can a mathematician do with a 3d printer?
FRAGMENT seminar, Colorado State University, March 2015.
University of Tennessee, Geometry/Topology Seminar, January 2015.

Washington and Lee University, Colloquium, November 2014.
AMS Southeastern Sectional Meeting, November 2014.
AMS Special Session on Knot Theory and Its Applications
Mills College, Colloquium, October 2014.
Holy Names University, Colloquium, October 2014.
AMS Western Sectional Meeting, October 2014.
AMS Special Session on Applications of Knot Theory to the Entanglement of Biopolymers
Vassar College, Colloquium, October 2014.

Selected (Recent) International Invited Talks

Ochanomizu University, "Polymers and Networks via Topology and Entanglement", August 2019.
Banff International Research Station Workshop: The Topology of Nucleic Acids: Research at the Interface of Low-Dimensional Topology, Polymer Physics and Molecular Biology, March 2019.
"Polymers Meet Topology" Workshop, Tokyo Institute of Technology, January 2019.
Tezuka Lab Seminar, Tokyo Institute of Technology, October 2018.
Ochanomizu University, "Knots and Polymers in Tokyo", August 2017.
IMS Workshop, "Program on Data Sciences: Bridging Mathematics, Physics, and Biology", Singapore, June 2017.
ICTP Workshop, "Knots and Links in Biological and Soft Matter Systems", Trieste, September 2016.
GELATO '15 Workshop, University of Basel, Switzerland, August 2015.
CanaDAM '15, University of Saskatchewan, June 2015.