Harrison Chapman

Curriculum Vitæ

University of Georgia
Department of Mathematics
Boyd Graduate Studies Research Center
Athens, GA 30602

Phone: (706) 542-2619
Email: hchapman@uga.edu
Homepage: http://hchapman.github.io/

Education

Ph.D. Mathematics, University of Georgia, 6th year (ABD), expected May 2017.
- Advisor: Jason Cantarella.

M.S. Mathematics, University of Georgia, 2015.

B.A. Mathematics and Computer Science, Bowdoin College, 2011.
- Cum laude
- Honors in Mathematics (advisor: Thomas Pietraho)

Awards

B.J. Ball Scholarship, 2016

UGA VIGRE Research Fellowship, 2012—2013, Summer 2014

Bowdoin Faculty Scholar, 2007

Teaching

University of Georgia

1. Instructor, Calculus for Science and Engineering I (MATH2250).
   Spring 2014, Spring 2016, Fall 2016
2. Instructor, Precalculus (MATH1113).
   Fall 2013, Fall 2015
3. Graduate assistant for Topology Qualifying Exam problem session (volunteer).
   Summer 2016
4. Writing Intensive Program (WIP) teaching assistant for a lab and robotics-focused Calculus I (MATH2250).
   Fall 2015
5. Graduate assistant, Online Precalculus (MATH1113E).
   This was a course for all of the University System of Georgia.
   Fall 2014–Spring 2015
6. Recitation instructor, Analytic Geometry and Calculus (MATH2200).
   Fall 2011, Spring 2012, Fall 2014
7. Grading:

   Introduction to Higher Mathematics (MATH 3200): Fall 2011, Fall 2013

   Graph Theory (MATH/CS 4690/6690): Spring 2012

   Modern Algebra and Geometry (MATH 4000): Spring 2012

Publications

1. Markov chain sampling of random knot diagrams. In preparation.
   with A. Rechnitzer.
   We demonstrate a Markov Chain Monte Carlo sampler on the space of knot shadows and prove that it is ergodic. This provides a new way to uniformly sample knot diagrams and computationally enumerate the class of knot diagrams.

2. Slipknotting in knot diagrams. In preparation.
   I apply pattern theorem results to knot diagrams to show that slipknots of any topological type appear almost surely in different classes of knot diagrams. Namely, I show that diagrams of unknots contain slipknots, a result which remains a conjecture for other models of knotting.

3. Asymptotic laws for random knot diagrams. *Submitted* 2016.
   Preprint: `arXiv:1608.02638`.
   I show a pattern theorem result for knot diagrams and use it to both prove the Frisch-Wasserman-Delbrück conjecture for the model of knot diagrams and show that symmetries of knot diagrams are statistically insignificant.

4. Knot probabilities in random diagrams.
   with J. Cantarella, M. Mastin.
   J. Phys. A: Math. Theor. 49 (2016), no. 40, p. 405001.
   DOI: `10.1088/1751-8113/49/40/405001`.
   Preprint: `arXiv:1512.05749`.
   We compute the exact probability that a random diagram of n crossings has a given knot type (for $n \leq 10$) by directly enumerating and classifying the knot diagrams of n crossings. Our enumeration method is based on identifying knot diagrams with a class of embedded 4-regular planar graphs.

5. A Group-theoretic Approach to Human Solving Strategies in Sudoku.
   with M. Rupert (Mentor: E. Arnold).
   Colonial Academic Alliance Undergraduate Research Journal (2012) vol 3, article 3.
   Paper produced during an NSF REU at James Madison University in 2010. We quantify the data of Sudoku board states by considering which numbers cannot *go in a given cell and consider how a typical player's solving strategies are a group acting on this set of states.*

6. On orbital varieties of type A.
   Advisor: T. Pietraho. Honors thesis (2011). Bowdoin College.
   Thesis on the Smith conjecture on orbital varieties of nilpotent orbits in the Lie group GL_n. Outlines the correspondence between Young tableaux and orbital varieties and concludes with conditions for which certain shapes of Young tableaux will admit orbital varities which are not Smith.

Software

1. *LiveFit*. C++. Augmented reality projectile-tracking demonstration for use in calculus classes.
   `https://github.com/hchapman/LiveFit`

2. `plCurve`. C and Python. Piecewise-linear curve and link diagram library.
   with T. Ashton, J. Cantarella, M. Mastin. *My primary contribution has been a Python interface to the C library code.*
   `http://www.jasoncantarella.com/wordpress/software/plcurve/`

3. *Reverb*. Java and C. An Android app which uses PulseAudio to control volume and audio streams on Linux computers.
   `https://github.com/hchapman/reverb`

External Talks

1. Joint Mathematics Meetings 2017,
   MAA Invited Paper Session on Random Polygons and Knots.
   Slipknotting in the Knot Diagram Model. Atlanta GA, January 2017.

2. Piedmont College, Annual Math and Physics Lecture,
   Random knots in physics and biology. Demorest GA, November 2016.

3. 28^{th} International Conference on Formal Power Series and Algebraic Combinatorics,
   Asymptotic laws for knot diagrams. Vancouver BC, July 2016.

4. IU Bloomington, Graduate Student Topology and Geometry Conference 2016,
   Asymptotic laws for knot diagrams. Bloomington IN, April 2016.

5. Joint Mathematics Meetings 2016,
   MAA Session on Mathematical Modeling in the Undergraduate Classroom.
   A robotics-based calculus class. Seattle WA, January 2016.

6. Joint Mathematics Meetings 2016,
   AMS Session on General Topics.
   Asymptotic laws for knot diagrams. Seattle WA, January 2016.

7. Tulane University, Geometry Seminar,
   Asmyptotic laws for knot diagrams. New Orleans LA, October 2015.

8. CSU Fullerton, AMS Fall Western Sectional Meetings 2015,
   Special Session on Algebraic and Combinatorial Structures in Knot Theory.
   Asymptotics of random knot diagrams. Fullerton CA, October 2015,

9. University of Memphis, AMS Fall Southeastern Sectional Meetings 2015,
   Special Session on Topological Combinatorics.
   Asymptotics of random knot diagrams. Memphis TN, October 2015.

10. University of British Columbia, Discrete Math Seminar,
    Asmyptotic laws for knot diagrams. Vancouver BC, September 2015.

11. Simon Fraser University, Discrete Math Seminar,
    Asmyptotic laws for knot diagrams. Burnaby BC, September 2015.

12. University of Saskatchewan, PIMS-USASK Graduate Summer School on Applied Combinatorics,
    Knot diagrams and blossom trees. Saskatoon SK, May 2015.

13. University of Nevada, AMS Spring Western Sectional Meetings,
    Special Session on Inverse Problems and Related Mathematical Methods in Physics.
    Random knot diagrams. Las Vegas NV, April 2015.

14. Joint Mathematics Meetings,
    AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs.
    Packets, Solving Symmetries, and Sudoku. New Orleans LA, January 2011.

15. The Ohio State University, Young Mathematicians Conference,
    Packets, Solving Symmetries, and Sudoku. Columbus OH, August 2010.

Internal Talks

1. University of Georgia, Geometry Seminar,
   Patterns in knot diagrams. Athens GA, August 2016.
2. University of Georgia, Geometry Seminar,
   The quantum harmonic oscillator. Athens GA, October 2015.
3. University of Georgia, Geometry Seminar,
   Asmyptotic laws for knot diagrams. Athens GA, September 2015.
4. University of Georgia, Graduate Student Seminar,
   How to count (a quick glance at analytic combinatorics). Athens GA, September 2015.
5. University of Georgia, Mock AMS Conference,
   Asymptotics of knot and link diagrams. Athens GA, July 2015.
6. University of Georgia, Graduate Student Seminar,
   Virtual Knot Theory. Athens GA, February 2015.
7. University of Georgia, Geometry Seminar,
   Random Planar Diagrams. Athens GA, January 2014.
8. University of Georgia, Graduate Student Topology Seminar,
   The Poincaré homolgy sphere as the link of a singularity. Athens GA, November 2014.
9. University of Georgia, Research Group on Minimal Surfaces,
   Discrete Ricci Flow. Athens GA, November 2014.
10. University of Georgia, Mock AMS Conference,
    The Tropical Grassmannian. Athens GA, June 2014.
11. University of Georgia, Mock AMS Conference,
    Hope for slackers: Playing games to prove theorems. Athens GA, June 2013.
12. University of Georgia, Mock AMS Conference,
    The Classification of Surfaces. Athens GA, June 2012.
13. University of Georgia, VIGRE Research Group on Minkowski's Geometry of Numbers,
    Vinogradov's generalization of a theorem of Aubry-Thue. Athens GA, March 2012.

Workshops

1. Graphs and Surfaces: Algorithms, Combinatorics, and Topology.
   CIRM, Marseille, France, May 2016.
2. Symplectic and Algebraic Geometry in the Statistical Physics of Polymers.
   Simons Center for Geometry and Physics, Stony Brook NY, October 2015.
3. PIMS-USASK Graduate Summer School in Applied Combinatorics.
   University of Saskatchewan, Saskatoon SK, May 2015.