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Gabe Cunningham

Education

- 2007–2012 **Ph.D., Mathematics**, *Northeastern University*, Boston, MA.
Thesis: *Internal and External Invariance of Abstract Polytopes*. Advisor: Egon Schulte
- 2001–2005 **B.S., Mathematics**, *Massachusetts Institute of Technology*, Cambridge, MA.

Research interests

Discrete geometry, combinatorics, combinatorial and finite group theory. I work in the area of abstract polytopes on extremal problems (“Find the smallest abstract polyhedron with p -gonal faces meeting q at each vertex”), classification problems (“Describe all 3-orbit skeletal polyhedra”), and properties of combinatorial and algebraic constructions applied to polytopes (“Determine the structure of the smallest regular 4-polytope that covers the pyramid over a polyhedron”).

Publications

1. *Open problems on k -orbit polytopes* (with Daniel Pellicer), *Discrete Mathematics*, **341** (2018), no. 6, 1645–1661.
2. *Tight chiral polyhedra*, *Combinatorica* **38** (2018), no. 1, 115–142.
3. *Non-flat regular polytopes and restrictions on chiral polytopes*, *The Electronic Journal of Combinatorics* **24** (2017), no. 3, #P3.59 .
4. *Internal and external duality in abstract polytopes* (with Mark Mixer), *Contributions to Discrete Mathematics* **12** (2017), no. 2.
5. *Classification of tight regular polyhedra* (with Daniel Pellicer), *Journal of Algebraic Combinatorics* **43** (2016), no. 3, 665–691.
6. *Tight orientably-regular polytopes* (with Marston Conder), *Ars Mathematica Contemporanea* **8** (2015), 68–81.
7. *Symmetry type graphs of polytopes and maniplexes* (with María Del Río Francos, Isabel Hubard, and Micael Toledo), *Annals of Combinatorics* **19** (2015), 243–268.
8. *Chiral extensions of chiral polytopes* (with Daniel Pellicer), *Discrete Mathematics* **330** (2014), no. 1, 51–60.
9. *Minimal equivelar polytopes*, *Ars Mathematica Contemporanea* **7** (2014), no. 2, 299–315.
10. *Variance groups and the structure of mixed polytopes*, *Rigidity and Symmetry*, *Fields Inst. Comm.*, **70**, Springer, New York (2014), 97–116.
11. *Constructing self-dual chiral polytopes*, *European Journal of Combinatorics* **33** (2012), no. 6, 1313–1323.

12. *Self-Dual, Self-Petrie Covers of Regular Polyhedra*, *Symmetry* **4** (2012), no. 1, 208–218.
13. *Mixing chiral polytopes*, *Journal of Algebraic Combinatorics* **36** (2012), no. 2, 263–277.
14. *Mixing regular convex polytopes*, *Discrete Mathematics* **312** (2012), no. 6, 763–771.
15. *Discovery of patterns in LZ-78 text discrimination* (with M. Malyutov), *Computational Technologies in Electrical and Electronics Engineering (SIBIRCON)*, 2010 IEEE Region 8 International Conference on, pp. 28–33, 11-15 July 2010.

Talks

- July 2018 **Open problems on k-orbit polytopes**, *Symmetries in Graphs, Maps, and Polytopes*, Morelia, Mexico.
- January 2018 **Small polyhedra with prescribed symmetry**, *Northeastern University Pick My Brain Seminar*, Boston, MA.
- August 2017 **Non-flat regular polytopes and restrictions on chiral polytopes**, *Symmetries of Discrete Structures in Geometry*, at *Casa Matemática Oaxaca*, Oaxaca, Mexico.
- July 2017 **The search for small polytopes**, *2da Escuela en Simetrías de Estructuras Combinatorias (2nd Course on Symmetries in Combinatorial Structures)*, Cuernavaca, Mexico.
- November 2015 **Tight chiral polyhedra**, *AMS Special Session on Geometry and Combinatorics of Polytopes*, New Brunswick, NJ.
- March 2014 **The search for tight polytopes**, *Northeastern University Discrete Geometry Seminar*, Boston, MA.
- April 2013 **Orbit graphs and face-transitivity of k-orbit polytopes**, *AMS Special Session on Combinatorial Geometry of Polytopes*, Boston, MA.
- November 2012 **Minimal equivelar polytopes**, *MIT Combinatorics Seminar*, Cambridge, MA.
- November 2012 **Minimal equivelar polytopes**, *Northeastern University Seminar in Geometry, Algebra, Singularities, and Combinatorics*, Boston, MA.
- May 2012 **Constructing abstract regular polytope with external symmetries**, *UMass Boston Mathematics Colloquium*, Boston, MA.
- February 2012 **Abstract polyhedra with specified face-types**, *Graduate Student Seminar at Northeastern University*, Boston, MA.
- January 2012 **Constructing abstract regular polytopes with external symmetries**, *WPI Mathematics Colloquium*, Worcester, MA.
- January 2012 **Constructing self-dual and self-Petrie polyhedra**, *AMS Special Session on Combinatorial Geometry of Polytopes at the Joint Meetings of the AMS*, Boston, MA.
- October 2011 **Constructing self-dual chiral polytopes**, *Workshop on Symmetry in Graphs, Maps and Polytopes at the Fields Institute*, Toronto, Canada.
- May 2011 **Polytopes, mixing, and self-duality**, *Tapas Seminar at Northeastern University*, Boston, MA.
- February 2011 **Classical polytope constructions applied to abstract polytopes**, *Graduate Student Seminar at Northeastern University*, Boston, MA.
- May 2010 **Chiral polytopes**, *Tapas Seminar at Northeastern University*, Boston, MA.

Awards and Honors

- 2007–2012 **University Excellence Fellowship**, *Northeastern University*.
Summer 2011 **Ling Ma Fellowship**, *Northeastern University*.
2010–2011 **Best Mathematics TA Award**, *Northeastern University*.

Teaching Experience

2012–Present **Lecturer**, *University of Massachusetts Boston*.

Classes taught:

- Calculus 1
- Calculus 2
- Multivariable and Vector Calculus
- Linear Algebra.

2007–2012 **Instructor**, *Northeastern University*.

Classes taught:

- Interactive Mathematics
- Calculus 1 for Business and Economics
- Calculus 1 for Science and Engineering
- Calculus 2 for Science and Engineering
- Calculus 3 for Science and Engineering
- Differential Equations & Linear Algebra.

Service

Referee for:

- *Combinatorica*
- *Contributions to Algebra and Geometry*
- *European Journal of Combinatorics*
- *Journal of Algebra*
- *Journal of Algebraic Combinatorics*

20 reviews written for MathReviews

April 2018 Co-organizer of AMS Special Session on Polytopes and Discrete Geometry

Fall 2018 Course Coordinator for Calculus 1. Provided support and resources to 12 instructors, including 3 new instructors.