

**THOMAS C. HULL**  
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## Education

### University of Rhode Island

- Ph.D. Mathematics (1997)  
advisor: Nancy Eaton, dissertation: *Some Problems in List Coloring Bipartite Graphs*
- M.S. Mathematics (1993)

### Hampshire College

- B.A. (1991) Mathematics and Philosophy

## Research Interests

Combinatorics, graph theory, and discrete geometry, especially as applied to origami (paper folding).

## Teaching Experience

**Associate Professor**, Western New England University, Dept. of Mathematics (Sept 2008–present)

### Undergraduate courses taught:

**Calculus I, II, III** (Hughes-Hallett and Briggs et al. text; derivative and integration gateway exams; group homework; *Mathematica* labs, MyMathLab assignments)

**Linear Algebra** (Andrilli & Hecker text; taught in computer classroom in discovery-based manner with emphasis on learning proof-writing; take-home exams; *Mathematica* used extensively)

**Modern Aspects of Geometry** (Stillwell text; Euclidean, spherical, hyperbolic, and projective geometries; GeoGebra, Spherical Easel used; final project paper and presentation)

**Creative Problem Solving** (Zeitz text; focus on different tactics and tools for problem-solving and for communicating solutions; regular in-class presentations; final project paper and presentation)

**Graph Theory** (Chartrand & Zhang and Trudeau texts; inquiry-based with assigned proof presentations)

**Combinatorics** (Mazur text; 9 students; problem presentations by students at the start of every class)

**Real Analysis** (Schumacher text and Marsden-Hoffman text; inquiry-based with required readings and assigned proof presentations; take-home exams)

**Real Analysis II** (Marsden-Hoffman and Wilcox-Myers texts; inquiry-based with required readings and assigned problem presentations; topics included Lebesgue measure and integration)

**Complex Analysis** (Marsden text; inquiry-based with required reading assignments)

**Senior Research Projects** (advised 12 year-long projects 2009–present; major paper drafting, HRUMC presentations; 9 projects were expository, 3 projects were original research, 1 publication with Ginepro)

**Independent Student Research** (advised 8 undergraduate students in original research projects 2013–present, with 3 published papers (Ginepro, Urbanski) and 1 paper in development (McLaren))

### Master of Arts for Mathematics Teachers (MAMT) courses taught:

All courses emphasized proof-writing with in-class group work and regular presentation of solutions.

**Discrete Mathematics** (Ensley & Crawley and belcastro texts; inquiry-based learning class; readings and presentations required)

**Creative Problem Solving** (Polya and Zeitz texts; daily problem activities to emphasize problem-solving strategies and communication of solutions; final project paper and presentation)

**Calculus Revisited** (Marsden & Tromba text; extensive group projects on textbooks from the calculus reform movement)

**Geometry Revisited** (Stillwell and Sibley text; GeoGebra, Spherical Easel, and other software used extensively)

**Analysis** (Schumacher text with supplements on Lebesgue integral; student presentation intensive)

**Algebraic Structures** (Judson text; covered groups, rings, fields, and some Galois Theory; weekly assigned problem presentations)

**Fractals and Topology** (Barnsley's *Superfractals* text; taught in computer classroom with extensive use of *Mathematica*)

**Origami in Mathematics and Education** (Hull text; activity-driven class with emphasis on conjecture and proof-building; final project paper and presentation)

**Project Associate Professor**, University of Tokyo, Graduate School of Arts and Sciences (Nov.–Dec. 2015)  
Taught intensive, 3-day graduate class: Mathematical Methods in Origami

**Assistant & Associate Professor**, Merrimack College, Dept. of Mathematics (Sept. 1997–May 2008)  
Courses taught: Discrete Mathematics, Calculus for Business, Precalculus, Calculus I, II, III, Topics in Geometry, Combinatorics, Abstract Algebra, Introduction to Real Analysis, Combinatorial Geometry

**Visiting Assistant Professor**, University of Cincinnati, Dept. of Mathematical Sciences (2002–2003)  
Courses taught: Honors Calculus I, II, and III, Calculus III *Mathematica* Lab, Finite Mathematics.

**Mathematics Instructor**, The Math Circle, Harvard and Northeastern University (Fall 2000)

## Summer Teaching Experience

**Lead Instructor**, MathILy (serious Mathematics Infused with Levity), at Bryn Mawr College (2013–2018)  
MathILy is a 5-week summer enrichment program for talented high-school students. Taught intensive courses on linear algebra, proof techniques, generating functions, projective geometry, finite difference calculus, complex analysis, dynamical systems, computational geometry, and origami mathematics.

**Staff**, Hampshire College Summer Studies in Mathematics (Junior Staff 1991–1994, Senior Staff 1998–2009)  
HCSSiM is a six-week enrichment program for talented high-school students. Taught many subjects, including proof techniques, graph theory, group theory, generating functions, fractal geometry, projective geometry, discrete dynamical systems, set theory, automata theory, Markov chains, and origami mathematics.

## Research Publications (Math)

- Rigid foldability is NP-hard, with H. Akitaya, E. Demaine, T. Horiyama, J. Ku, and T. Tachi, submitted.
- [Minimal forcing sets for 1D origami](#), with M. Damian, E. Demaine, M. Dulieu, R. Flatland, H. Hoffman, J. Lynch, and S. Ramaswami, submitted.
- [Self-foldability of monohedral quadrilateral origami tessellations](#), with T. Tachi, in Bolitho et al. (eds.), *Origami7: Proc. of the 7th International Meeting on Origami Science, Mathematics, and Education*, Tarquin (2018), 521–532.
- [Rigid foldability of the augmented square twist](#), with M. Urbanski, in Bolitho et al. (eds.), *Origami7: Proc. of the 7th International Meeting on Origami Science, Mathematics, and Education*, Tarquin (2018), 533–543.
- Self-foldability of rigid origami, with T. Tachi, *ASME Journal of Mechanisms & Robotics*, Vol. 9, No. 2 (2017), 021008-021017. [doi:10.1115/1.4035558](https://doi.org/10.1115/1.4035558)
- [Double-line rigid origami](#), with T. Tachi, in Proceedings of the 11th Asian Forum on Graphic Science, August 6–10 (2017), Tokyo, Japan, H. Suzuki (ed.)
- Box Pleating is Hard, with H. Akitaya, K. Cheung, E. Demaine, T. Horiyama, J. Ku, T. Tachi, R. Uehara, in Akiyama et al. (eds) *Discrete and Computational Geometry and Graphs. JCDCGG 2015. Lecture Notes in Computer Science*, Vol. 9943, Springer (2016), 167-179. [doi:10.1007/978-3-319-48532-4\\_15](https://doi.org/10.1007/978-3-319-48532-4_15)
- [Rigid origami vertices: conditions and forcing sets](#), with Z. Abel, J. Cantarella, E. Demaine, D. Eppstein, J. Ku, R. Lang, and T. Tachi, *Journal of Computational Geometry*, Vol. 7, No. 1 (2016), 171–184.
- [Zero-area reciprocal diagram of origami](#), with E. Demaine, M. Demaine, D. Huffman, D. Koschitz, T. Tachi, Proceedings of the IASS Annual Symposium 2016 "Spatial Structures in the 21st Century," September 26–30 (2016), Tokyo, Japan, K. Kawaguchi, M. Ohsaki, T. Takeuchi (eds.)

- [Locked rigid origami with multiple degrees of freedom](#), with Z. Abel and T. Tachi, in Miura et al. (eds.), *Origami<sup>6</sup>: Proc. of the 6th International Meeting on Origami Science, Mathematics, and Education*, AMS (2015), 131–138.
- [Rigid flattening of polyhedra with slits](#), with Z. Abel, R. Connelly, E. D. Demaine, M. L. Demaine, A. Lubiw, and T. Tachi, in Miura et al. (eds.), *Origami<sup>6</sup>: Proc. 6th Int. Meeting on Origami Science, Mathematics, and Education*, AMS (2015), 109–117.
- [Symmetric colorings of polypolyhedra](#), with sarah-marie belcastro, in Miura et al. (eds.), *Origami<sup>6</sup>: Proc. 6th Int. Meeting on Origami Science, Mathematics, and Education*, AMS (2015), 21–31.
- [Coloring connections with counting mountain-valley assignments](#), in Miura et al. (eds.), *Origami<sup>6</sup>: Proc. 6th Int. Meeting on Origami Science, Mathematics, and Education*, AMS (2015), 3–10.
- [Minimum forcing sets for Miura folding patterns](#), with B. Ballinger, M. Damian, D. Eppstein, R. Flatland, and J. Ginepro, *ACM-SIAM Symposium on Discrete Algorithms (SODA15)*, (2015), 136–147.
- [Counting Miura-ori foldings](#), with J. Ginepro, *Journal of Integer Sequences*, Vol. 17 (2014), Article 14.10.8.
- [The flat vertex fold sequences](#), with E. Chang, in Wang-Iverson et al. (eds.), *Origami<sup>5</sup>: Fifth International Meeting of Origami in Science, Mathematics, and Education*, A K Peters (2011), 599–607.
- [Solving cubics with creases: the work of Beloch and Lill](#), *American Mathematical Monthly*, Vol. 118, No. 4 (2011), 307–315.
- [Configuration spaces for flat vertex folds](#), in Lang (ed.), *Origami<sup>4</sup>: Fourth International Meeting of Origami Science, Mathematics, and Education*, AK Peters, (2009), 361–370.
- [Folding regular heptagons](#), in *Homage to a Pied Puzzler*, Pegg et al., ed., AK Peters (2009), 181–191.
- [Counting mountain-valley assignments for flat folds](#), *Ars Combinatorica*, Vol. 67 (2003), 175–188.
- [The combinatorics of flat folds: a survey](#), in Hull (ed.), *Origami<sup>3</sup>: Third International Meeting of Origami Science, Mathematics, and Education*, A K Peters (2002), 29–38.
- [Modelling the folding of paper into three dimensions using affine transformations](#), with s-m. belcastro, *Linear Algebra and its Applications*, Vol. 348 (2002), 273–282.
- [Classifying frieze patterns without using groups](#), with s-m. belcastro, *The College Mathematics Journal*, Vol. 33, No. 2 (2002), 93–98.
- [Defective list colorings of planar graphs](#), with N. Eaton, *Bulletin of the Institute of Combinatorics and its Applications*, Vol. 25 (1997), 79–87.
- [A note on “impossible” paperfolding](#), *American Mathematical Monthly*, Vol. 103, No. 3 (1996), 242–243.
- [On the mathematics of flat origamis](#), *Congressus Numerantium*, Vol. 100 (1994), 215–224.

### Research Publications (Science)

- [Topological Kinematics of Origami Metamaterials](#), B. Liu, J. Silverberg, A. Evans, C. Santangelo, R. Lang, T. Hull, and I. Cohen, *Nature Physics*, Vol. 14, 2018, 811–815.
- [Origami structures with a critical transition to bistability arising from hidden degrees of freedom](#), J. Silverberg, J. Na, A. Evans, T. Hull, C. Santangelo, R. Lang, R. Hayward, and I. Cohen, *Nature Materials*, Vol. 14, (2015), 389–393.
- [Programming reversibly self-folding origami with micro-patterned photo-crosslinkable polymer trilayers](#), J. Na, A. Evans, J. Bae, M. Chiappelli, C. Santangelo, R. Lang, T. Hull, and R. Hayward, *Advanced Materials*, Vol. 27, No. 1 (2015), 79–85.
- [Using origami design principles to fold reprogrammable mechanical metamaterials](#), J. Silverberg, A. Evans, L. McLeod, R. Hayward, T. Hull, C. Santangelo, and I. Cohen, *Science*, Vol. 345, No. 6197 (2014), 647–650.

## Publications in Progress

- *Origametry: Mathematical Methods in Paper Folding* (research monograph), in preparation, 350+ pages written.
- A rigid-folding gadget for culling configuration space branches, with T. Tachi, in preparation.
- Face-flipping flat-foldable origami tessellations, with H. Akitaya and A. Lubiw, in preparation
- Non-crossing conditions for isometric foldings of Riemannian manifolds, in preparation.
- Minimal running time algorithms for CNC folding machines, with S. Calisch and E. Demaine, in preparation.
- Coloring duality for polypolyhedra, with s-m. belcastro, in preparation.
- Minimal forcing sets of single vertex flat folds, with S. McLaren, in preparation.

## Other Publications

- [\*Project Origami: activities for exploring mathematics\*](#) 2nd edition, CRC Press / AK Peters, Wellesley, MA (2012).  
Translated into Japanese under the title ドクター・ハルの折り紙数学教室 by Nippon Hyoronsha, Tokyo (2015) and in Chinese under 數學摺紙計畫 by Shima Publishing, New Taipei City, Taiwan (2018).
- H.P. Lovecraft: a horror in higher dimensions, *Math Horizons*, February (2006), 10–12.
- Origami Quiz, *The Mathematical Intelligencer*, Vol. 26, No. 4 (Fall 2004), 38–39, 61–63.
- Final Exam, *Math Horizons*, November (2003), inside back cover.
- Editor, [\*Origami<sup>3</sup>: Proceedings of the Third International Meeting of Origami Science, Mathematics, and Education\*](#), AK Peters, Natick, MA (2002).  
Selections translated into Japanese under the title 折り紙の数理と科学 (*Mathematics and Science of Origami*), T. Kawasaki ed., Morikita Publishing Co., Tokyo (2005).
- In search of a practical map fold, *Math Horizons*, February (2002), 22–24.
- Interviewing for a job in academia, with M. Jones and D. Thomas, *Notices of the AMS*, Vol. 45, No. 10 (1998), 1353–1357.

## Selected Recent Presentations

- “Folding Compact Manifolds and Modern Origami,” Mathematics Colloquium, University of Essex, Colchester, UK (invited speaker, Sept. 3, 2018)
- “Rigid Foldability of the Augmented Square Twist,” 7th International Meeting of Origami Science, Mathematics, and Education, Oxford University, Oxford, UK (Sept., 2018)
- “Self-foldability of Monohedral Quadrilateral Origami Tessellations,” 7th International Meeting of Origami Science, Mathematics, and Education, Oxford University, Oxford, UK (Sept., 2018)
- “Folding Paper, Polymers, and Robots: Origami & Math,” Common Hour Talk, Franklin & Marshall College, Lancaster, PA (invited speaker, Feb. 15, 2018) <https://tinyurl.com/yad652vo>
- “Combinatorial Geometry in Origami: the Kawasaki-Maekawa Connection,” Joint Meetings of the AMS/MAA, San Diego, CA (Jan., 2018)
- “The Central Role of Combinatorics in Origami,” Origami-based Geometric Modeling and Analysis Symposium, Meiji University, Tokyo, Japan, (keynote speaker, Aug. 2017)
- “Double-Line Rigid Origami,” 11th Asian Forum on Graphic Science, The University of Tokyo, Komaba Campus, Japan (Aug. 2017)
- “Self-foldability and Rigid Origami,” MEAM Seminar, University of Pennsylvania (invited speaker, June 2017)
- “Origami: How to Do Math and Science Without Scissors or Glue,” National Academy of Sciences Distinctive Voices Lecture Series, Irving, CA (Dec. 2016) <http://www.nasonline.org/programs/distinctive-voices/>

- “Origami-Mathematics and Applications”  
Yokohama National University, Yokohama, Japan (invited speaker, Nov. 2015)  
International Christian University, Mitaka, Japan (invited speaker, Dec. 2015)
- “Folding a New Tomorrow: Origami Meets Math and Science,” Distinguished Lecture Series, MAA Carriage House, Washington D.C. (invited speaker, Nov. 2015) <https://www.youtube.com/watch?v=c3SJ7W6OWfM>
- “Folding Compact Manifolds Without Boundary: An Origami Perspective,” Mathematics Colloquium, Worcester Polytechnic University, Worcester, MA (invited speaker, Sept. 2015)
- “Modern Origami Theory,” 14th Japanese-American Frontiers of Science (JAFoS) Symposium, National Academy of Sciences/Japan Society for the Promotion of Science, Tokyo, Japan (invited speaker, Dec. 2014)
- “Mathematical Methods in Origami, Self-Folding, and Meta-Materials,” ASME Conference on Smart Materials, Adaptive Structures, and Intelligent Systems, Newport, RI (invited speaker, Sept. 2014)
- “Counting Miura-ori Phantom Folds,” 6th International Meeting of Origami Science, Mathematics, and Education, University of Tokyo, Tokyo, Japan (August, 2014)
- “Forcing Sets in Self-folding Origami,” SIAM Conference on Discrete Mathematics, Minn., MN (June 2014)
- “Origami, Volume, and Dissections of the Cube,” MAA Session on Tactile Learning Activities in the Undergraduate Mathematics Classroom, Joint Mathematics Meetings, San Diego, CA (Jan. 2013)
- “Origami Tessellations, their Symmetry, and Applications,” St. Louis University Department of Mathematics and Computer Science Colloquium, St. Louis, MO (invited speaker, April 2011)

(and an additional 21 talks given since 2010)

## Grants

- Japan Society for the Promotion of Science (JSPS) Grant  
Funded 2-week research visit at the Univ. of Tokyo, Japan to work with Dr. Tomohiro Tachi, Aug. 6–19, 2017.
- Co-PI, NSF Emerging Frontiers in Research and Innovation ODISEI grant: “Meta-Materials from Self-Folding Polymer Sheets” (EFRI-1240441), PI: Christian Santangelo (UMass), Co-PIs: Itai Cohen (Cornell), Ryan Hayward (UMass), Thomas Hull, awarded August 2012  
\$2 million, 5-year grant to develop theory and mechanics of a self-folding polymer technology. Supported undergraduate research and outreach through the MAMT program at Western New England University.
- PI, Regional Undergraduate Mathematics Conference (RUMC) grant, MAA/NSF, awarded June 2011  
\$5000 grant to help host the Hudson River Undergraduate Mathematics Conference at WNE in April 2012.

## Awards

- Western New England University’s 2018 Arts and Sciences Faculty Research Award, May 2018
- A. T. Yang Memorial Award in Theoretical Kinematics, with T. Tachi for our paper “Self-foldability of rigid origami” presented at the American Society of Mechanical Engineers’ 40th Mechanisms and Robotics Conference, Charlotte, NC, August 23, 2016
- Kavli Fellow of the National Academy of Sciences, 2014  
Invited by the NAS to speak and participate at interdisciplinary symposia emphasizing communication of a wide range of contemporary science topics across the traditional disciplines.
- Murray Fellowship Award, Merrimack College, 2004–2005  
\$10,000 grant to pursue research work and book-writing projects in origami-mathematics.
- Project NExT Fellow, 1998–1999 (silver dot)  
Competitive MAA Fellowship for new Ph.D.s. Helped organize panel discussions for Project NExT fellows at the 1999 AMS/MAA Joint Meetings.



## Committees and Service

### Department

- Committees:  
MAMT Committee (WNE, 2012–present, chair), Web Page Committee (WNE, 2012–present, chair), Technology Committee (WNE, 2012–present), Job Search Committee (WNE, 2010, 2011, 2014, 2016), HRUMC Committee (WNE, 2010–2012, PI on grant), MAA Conference Committee (WNE, 2009), Search Committee (Merrimack, 1997–2002, chair 1998)
- Math Club advisor (WNE, 2008–present; Merrimack, 2000–2008)

### College

- Elected offices: Faculty Senate (WNE, 2010–2012), Faculty Senate Executive Committee (Merrimack, 2007–2008)
- Committees:  
A&S Curriculum Committee (WNE, 2016–present), Faculty Senate Personnel Committee (WNE, 2013–2015), Faculty Senate Sub-Committee on the Undergraduate Curriculum (WNE, 2010–2012, co-chair), Salary Equity Committee (WNE, 2009–2010), Curriculum and Educational Policy Committee (Merrimack, 1999–2002, chair 2000–2002), Academic Strategic Planning Committee (Merrimack, 1998–2002)
- Berkshire Hall Learning Interest Community invited faculty guest speaker (WNE, 2018)
- Weekly radio show for WNEK, the WNE student-run radio station. (WNE, 2009–2013, 2016–2017)
- Co-director of the Interdisciplinary Studies Group (Merrimack, 2003–2004)
- Gay-Straight Alliance faculty advisor (Merrimack, 1999–2002)

### Profession

- Program Committee member for 7OSME (the 7th International Meeting of Origami in Science, Mathematics, and Education), Oxford University (Sept. 5–7, 2018)
- External Examiner for a math Ph.D. defense on origami mathematics, University of Essex, UK, (Sept 4, 2018)
- Kavli Japanese-American Frontiers of Science, Program Group Member (2014–2016, co-chair 2016)
- Organized AMS Special Session on Origami Methods and Applications with E. Demaine and R. Lang, Joint Mathematics Meetings (Seattle 2016)
- Hudson River Undergraduate Mathematics Conference, Steering Committee Chair (2012)  
Managed planning and local organization of the 2012 HRUMC, held at Western New England University
- Arnold Ross Lecture Committee, AMS (2008–2011, chair 2010–2011)
- Organized MAA Invited Paper Session on The Mathematics of Origami with T. Veenstra  
Joint Mathematics Meetings (San Francisco 2010)
- Project NExT Consultant (2009–2010, 2016–2017)
- Board of Directors: Origami USA (a national non-profit cultural and educational arts organization) (1995–2008)
- MAA minicourse “Using Origami in Undergraduate Mathematics Classes”  
Joint Mathematics Meetings (New Orleans 2007, Atlanta 2005, Phoenix 2004)
- Panel Discussion: Getting your first book published, Joint Mathematics Meetings (Jan. 2007)
- 3rd International Meeting of Origami Science, Math, and Education, Program Chair, Asilomar Conference Center, Monterey, CA (March 2001)
- Organized AMS Special Session on Mathematical Methods in Paper Folding with R. Lang, Joint Mathematics Meetings, Baltimore, MD (Jan. 1998)
- Referee for The American Mathematical Monthly (2007, 2009, 2010, 2012, 2015), Mathematics Magazine (2002, 2004–2006, 2009, 2010, 2012–2017), The College Mathematics Journal (2004, 2005, 2006, 2008, 2011, 2018), SoCG (2008–2010), MathSciNet (2009), Science (2015), Nature (2015), ASME (2012–2016), and other journals

### Other

- Featured in the documentary *Between the Folds* (2009, Green Fuse Films, distributed by Independent Lens)
- Origami model *Five Intersecting Tetrahedra* was awarded by the British Origami Society in 2000 in their list of “Top 10 Origami Models of All Time.”
- Member: AAUP, AMS, AWM, MAA