

# Hsien-Chih Chang

## Curriculum Vitae

Department of Computer Science  
Dartmouth College  
Room 305, Anonymous Hall  
64 College St., Hanover, NH 03755

[hsien-chih.chang@dartmouth.edu](mailto:hsien-chih.chang@dartmouth.edu)  
+1 (217) 898-1041  
<https://hcsoso.github.io/>

### Research Interests

Discrete/computational topology and geometry, with focus on low-dimensional objects like points, lines, polygons, curves, surfaces, triangulations and meshes, etc. Graph theory and algorithms, usually from a structural perspective. More broadly, I am interested in connections between mathematics and theoretical computer science, especially in applying topological tools to understand efficiency of computation.

### Employment

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| Assistant Professor, Department of Computer Science<br>Dartmouth College  | Fall 2020–  |
| Postdoctoral research associate, Department of Computer Science<br>Duke University<br>Supervisor: <a href="#">Pankaj Agarwal</a>                | Fall 2018–Spring 2020   |
| Research assistant, Department of Computer Science<br>University of Illinois at Urbana-Champaign<br>Supervisor: <a href="#">Jeff Erickson</a>   | Fall 2016–Spring 2018<br>Spring 2015<br>Fall 2012–Spring 2013 |
| Research assistant, Department of Computer Science<br>University of Illinois at Urbana-Champaign<br>Supervisor: <a href="#">Alexandra Kolla</a> | Fall 2015–Spring 2016   |
| Teaching assistant, Department of Computer Science<br>University of Illinois at Urbana-Champaign<br>Instructor: <a href="#">Jeff Erickson</a>   | Fall 2013–Fall 2014   |

### Education

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| University of Illinois at Urbana-Champaign (Urbana-Champaign, Illinois, USA)<br>Ph.D. in Computer Science<br>Advisor: <a href="#">Jeff Erickson</a>          | 2012–2018 |
| National Taiwan University (Taipei, Taiwan)<br>B.Sc. in Computer Science and Information Engineering<br>Undergrad thesis advisor: <a href="#">Hsueh-I Lu</a> | 2005–2010 |

### Awards and Honors

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| Burke award  | 2020      |
| Best student presentation award at SoCG'16<br><i>Untangling Planar Curves</i> <a href="#">[13]</a> | Jun 2016  |
| Richard T. Cheng endowed fellowship  | 2012–2013 |

### Publications

Most of the papers listed below can be found on <https://hcsoso.github.io/papers/>. The coauthors are listed *alphabetically*; publication with both journal and conference versions is listed only once.

## Conference Publications

- [1] *Untangling Planar Graphs and Curves by Staying Positive*, with Santiago Aranguri and Dylan Fridman, accepted to Symposium on Discrete Algorithms (SODA'22).
- [2] *Clustering under Perturbation Stability in Near-Linear Time*, with Pankaj K. Agarwal, Kamesh Munagala, Erin Taylor, and Emo Welzl, in Proceedings of the 40th IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS'20), pages 8:1–8:16, 2020.
- [3] *Planar Emulators for Monge Matrices*, with Tim Ophelders, in Proceedings of the 32nd Canadian Conference on Computational Geometry (CCCG'20), pages 141–147, 2020.
- [4] *Dynamic Geometric Set Cover and Hitting Set*, with Pankaj Agarwal, Subhash Suri, Allen Xiao, and Jie Xue, in Proceedings of the 36th International Symposium on Computational Geometry (SoCG'20), pages 2:1–2:15, 2020.
- [5] *Tightening Curves on Surfaces Monotonically with Applications*, with Arnaud de Mesmay, in Proceedings of the 31st Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'20), pages 747–766, 2020. Invited to **special issue** of the ACM Transactions on Algorithms (TALG).
- [6] *Lower Bounds for Electrical Reduction on Surfaces*, with Jeff Erickson and Marcos Cossarini, in Proceedings of the 35th International Symposium on Computational Geometry (SoCG'19), pages 25:1–25:16, 2019.
- [7] *Efficient Algorithms for Geometric Partial Matching*, with Pankaj Agarwal and Allen Xiao, in Proceedings of the 35th International Symposium on Computational Geometry (SoCG'19), pages 6:1–6:14, 2019.
- [8] *Near-Optimal Distance Emulator for Planar Graphs*, with Paweł Gawrychowski, Shay Mozes, and Oren Weimann, in Proceedings of the 26th Annual European Symposium on Algorithms (ESA'18), pages 16:1–16:17, 2018.
- [9] *Tightening Curves on Surfaces via Local Moves*, with Jeff Erickson, David Letscher, Arnaud de Mesmay, Saul Schleimer, Eric Sedgwick, Dylan Thurston, and Stephan Tillmann, in Proceedings of the 29th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'18), pages 121–135, 2018.
- [10] *Unwinding Annular Curves and Electrically Reducing Planar Networks*, with Jeff Erickson, extended abstract appeared in Computational Geometry: Young Researchers Forum from the 33rd International Symposium on Computational Geometry (SoCG'17), 2017.
- [11] *Detecting Weakly Simple Polygons*, with Jeff Erickson and Chao Xu, in Proceedings of the 26th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'15), pages 1655–1670, 2015.

## Journal Publications

- [12] *Spectral Aspects of Symmetric Matrix Signings*, with Charles Carlson, Karthik Chandrasekaran, Naonori Kakimura, and Alexandra Kolla, Discrete Optimization, volume 37, article 100582, pages 1–22, 2020. Conference version in Proceedings of the 44th International Symposium on Mathematical Foundations of Computer Science (MFCS'19), pages 81:1–81:13, 2019.
- [13] *Untangling Planar Curves*, with Jeff Erickson, Discrete & Computational Geometry, volume 58, issue 4, pages 889–920, 2017; **special issue** of invited papers from the 32nd International Symposium on Computational Geometry (SoCG'16). Conference version in proceedings of the 32nd International Symposium on Computational Geometry (SoCG'16), pages 29:1–29:16, 2016.
- [14] *From Proximity to Utility: A Voronoi Partition of Pareto Optima*, with Sariel Har-Peled and Benjamin Raichel, Discrete & Computational Geometry, volume 56, issue 3, pages 631–656, 2016. Conference version in proceedings of the 31st International Symposium on Computational Geometry (SoCG'15), pages 689–703, 2015.
- [15] *A Faster Algorithm to Recognize Even-Hole-Free Graphs*, with Hsueh-I Lu. Journal of Combinatorial Theory, Series B, volume 113, pages 141–161, 2015. Conference version in proceedings of the 23rd Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'12), pages 1286–1297, 2012.

- [16] *Computing the Girth of a Planar Graph in Linear Time*, with Hsueh-I Lu, SIAM Journal on Computing 42(3), pages 1077–1094, 2013. Conference version in proceedings of the 17th International Computing and Combinatorics Conference (COCOON’11), Lecture Notes in Computer Science 6842, pages 225–236, 2011.

### Current Submissions and Manuscripts

- [17] *Almost-Linear  $\varepsilon$ -Emulators for Planar Graphs*, with Robert Krauthgamer and Zihan Tan, submitted, 2021.
- [18] *Deterministic Algorithm for Euclidean Bipartite Perfect Matching in Near-Linear Time*, with Pankaj K. Agarwal, Sharath Raghvendra, and Allen Xiao, submitted, 2021.
- [19] *Constructing Words from Closed Curves*, with Brittany Terese Fasy, Bradley McCoy, David L. Millman, and Carola Wenk, submitted, 2021.
- [20] *Hard Diagrams of the Unknot*, with Benjamin A. Burton, Maarten Löffler, Arnaud de Mesmay, Clément Maria, Saul Schleimer, Eric Sedgwick, and Jonathan Spreer, manuscript, 2020.
- [21] *Lower Bounds for Planar Electrical Reduction*, with Jeff Erickson, preprint, 2017. Joined with Marcos Cossarini, results from this paper have been strengthened and published in *Lower Bounds for Electrical Reduction on Surfaces* [6].
- [22] *Invertibility and Largest Eigenvalue of Symmetric Matrix Signings*, with Charles Carlson, Karthik Chandrasekaran, and Alexandra Kolla, preprint, 2016. We joined force with Naonori Kakimura and improved the results in *Spectral Aspects of Symmetric Matrix Signings* [12].
- [23] *Electrical Reduction, Homotopy Moves, and Defect*, with Jeff Erickson, preprint, 2015. Some of the results from this paper are being improved in our later paper *Untangling Planar Curves* [13].
- [24] *Asymptotically Optimal Thickness Bounds of Generalized Bar Visibility Graphs*, with Hsueh-I Lu and Yen-Peng Sung, unpublished manuscript, 2009.

### Invited Talks

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| <i>Morphing Planar Metrics</i> ,<br>“Combinatorial Reconfiguration in Discrete and Computational Geometry”,<br>online workshop.  | Aug 2021 |
| <i>Survey on Tightening Curves on Surfaces</i> ,<br>Dagstuhl Seminar 21181: “Computational Geometry”,<br>Schloß Dagstuhl, Wadern, Germany.<br>(Virtual visit due to COVID-19 pandemic.)  | May 2021 |
| <i>Are All Practical Planar Optimization Problems Easy?</i> ,<br>University of Iowa, Iowa, USA.<br>(Virtual visit due to COVID-19 pandemic.)   | Apr 2020 |
| <i>Are All Practical Planar Optimization Problems Easy?</i> ,<br>Brown University, Rhode Island, USA.  | Feb 2020 |
| <i>Toward a Better Classification of Planar Optimization Problems</i> ,<br>Dartmouth College, New Hampshire, USA.  | Feb 2020 |
| <i>Discrete and Computational Topology: Planar Curves (and Beyond)</i> [9][13][21][23],<br>University of Colorado Boulder, Colorado, USA.  | Feb 2018 |
| <i>On Local Crossing Numbers of Complete Graphs and Hypercubes</i> ,<br>AMS Special Session on Beyond Planarity: Crossing Numbers of Graphs (a Mathematics Research Communities Session), Joint Mathematics Meetings,<br>San Diego, California, USA. | Jan 2018 |

*Discrete and Computational Topology: Untangling Planar Curves (and Beyond)* [9][13][21][23], Dec 2017  
Theory Day in Taiwan (2017C),  
Institute of Information Science, Academia Sinica, Taipei, Taiwan.

*Untangling Graphs and Curves on Surfaces via Local Moves* [13][21][23], Feb 2017  
Dagstuhl Seminar 17072: “Applications of Topology to the Analysis of 1-Dimensional Objects”,  
Schloß Dagstuhl, Wadern, Germany.

*Untangling Curves on Surfaces via Local Moves* [13][21][23], Jan 2017  
Saint Louis University, Missouri, USA.

### Conference and Workshop Talks

*Planar Emulators for Monge Matrices* [3], Aug 2020  
32nd Canadian Conference on Computational Geometry (CCCG’20),  
Saskatoon, Saskatchewan, Canada. *Online conference due to COVID-19 pandemic.*

*Lower Bounds for Electrical Reduction on Surfaces* [6], Jun 2019  
35th International Symposium on Computational Geometry (SoCG’19),  
Portland, Oregon, USA.

*Tightening Curves on Surfaces via Local Moves* [9], Jan 2018  
29th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA’18),  
New Orleans, Louisiana, USA.

*Unwinding Annular Curves and Electrically Reducing Planar Networks* [10], Jul 2017  
Computational Geometry: Young Researchers Forum, 33rd International Symposium on Computational  
Geometry (SoCG’17),  
Brisbane, Australia.

*Untangling Planar Curves* [13], Jun 2016  
32nd International Symposium on Computational Geometry (SoCG’16),  
Boston, Massachusetts, USA.  
Won the **best student presentation award**.

*From Proximity to Utility: A Voronoi Partition of Pareto Optima* [14], Jun 2015  
31st International Symposium on Computational Geometry (SoCG’15),  
Eindhoven, Netherlands.

*A Faster Algorithm to Recognize Even-Hole-Free Graphs* [15], Jan 2012  
23rd Annual ACM-SIAM Symposium on Discrete Algorithms (SODA’12),  
Kyoto, Japan.

*Computing the Girth of a Planar Graph in Linear Time* [16], Aug 2011  
17th International Computing and Combinatorics Conference (COCOON’11),  
Dallas, Texas, USA.

### Teaching

#### Instruction at Dartmouth College

*COSC 30: Discrete Mathematics in Computer Science* Winter 2022

*COSC 49.09: Introduction to Computational Topology* Fall 2021

*COSC 39: Theory of Computation* Winter 2021  
Revised the syllabus with new materials and course objectives. Partially-flipped classroom with half lectures  
and half working sessions; student evaluation suggests that the new format is very effective and helpful.

*COSC 49.09: Introduction to Computational Topology* Fall 2020  
New graduate-level course developed at Dartmouth.

## Teaching Assistant

“CS374”: *Algorithms and Models of Computation*, teaching assistant. Fall 2014  
Ranked as **excellent** by student evaluation.

“CS374”: *Algorithms and Models of Computation*, **head teaching assistant**. Spring 2014  
A pioneering course that was in development with less than 50 people. Later on the course launched successfully at full scale with 400 students on average. Syllabus-wise it combines CS473 (Algorithms) and CS373 (Theory of Computation) and is aiming at junior-level students.

CS473: *Algorithms*, teaching assistant. Fall 2013  
Ranked as **excellent** by student evaluation.

## Mentoring

Research advisor at Dartmouth College. 2020–

**Dylan Fridman**, undergraduate student, Lovelace Scholar. Working on planar curve problems, with joint publication *Untangling Planar Graphs and Curves by Staying Positive* [1].

**Santiago Aranguri**, undergraduate student at Stanford. Working on planar curve problems, with joint publication *Untangling Planar Graphs and Curves by Staying Positive* [1].

**Benjamin Kallus**, Ph.D. student. Working on distance-related optimization problems on surface graphs.

Postdoctoral mentor at Duke University. 2017–2020

**Erin Taylor**, Ph.D. student. Working on geometric clustering problems, with joint publication *Efficient Clustering under Stability in Near-Linear Time* [2].

**Allen Xiao**, Ph.D. student, graduated 2020. Working on efficient geometric optimization algorithms in low-dimensional Euclidean spaces, with joint publication *Efficient Algorithms for Geometric Partial Matching* [7], *Dynamic Geometric Set Cover and Hitting Set* [4], and manuscript *Deterministic Algorithm for Euclidean Bipartite Perfect Matching in Near-Linear Time* [18].

**Daniel Orenstein**, master’s student. Working on tightening toroidal curves.

## Services

### Conference Program Committees

37th International Symposium on Computational Geometry (SoCG 2022) June, 2022

33rd Canadian Conference on Computational Geometry (CCCG 2021) August 10–12, 2021

### Workshop Program Committees

Computational Geometry: Young Researchers Forum (CG:YRF 2022) June, 2022

### Editorial Services

**Cooperated editor and collector**, report from Dagstuhl Seminar 17072—Applications of Topology to the Analysis of 1-Dimensional Objects, Dagstuhl Seminar 17072: "Applications of Topology to the Analysis of 1-Dimensional Objects", Schloß Dagstuhl, Wadern, Germany.

**External Reviewer** for *International Workshop on Approximation Algorithms for Combinatorial Optimization Problems* (APPROX 2019); *International Computing and Combinatorics Conference* (COCOON 2014); *Annual European Symposium on Algorithms* (ESA 2015, 2017, 2019–2020); *European Workshop on Computational Geometry* (EuroCG 2019); *Annual IEEE Symposium on Foundations of Computer Science* (FOCS 2016, 2020); *International Symposium on Graph Drawing & Network Visualization* (GD 2017–2018); *International Colloquium on Automata, Languages, and Programming* (ICALP 2016–2018); *International Symposium on Algorithms and Computation* (ISAAC 2017, 2021); *International Symposium on Computational Geometry* (SOCG 2018–2019,

2021); *ACM-SIAM Symposium on Discrete Algorithms* (**SODA** 2015, 2017–2018, 2020–2022); *ACM-SIAM Symposium on Simplicity in Algorithms* (SOSA 2022); *Annual ACM Symposium on Theory of Computing* (**STOC** 2022); *Algorithms and Data Structures Symposium* (WADS 2019).

**Referee** for *Algorithmica* (**ALGO**); *Annals of Combinatorics* (**AC**); *Discrete Applied Mathematics* (**DAM**); *Discrete & Computational Geometry* (**DCG**); *Discrete Mathematics and Theoretical Computer Science* (**DMTCS**); *Information Processing Letters* (**IPL**); *Journal of Discrete Algorithms* (**JDA**); *SIAM Journal on Computing* (**SICOMP**); *Transactions on Algorithms* (**TALG**).

#### **Departmental Services at Dartmouth**

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| <i>Admission Committee</i> for PhD hiring in Computer Science Department at Dartmouth | Spring 2021 |
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#### **Earlier Departmental Services**

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| <i>Graduate student application reviewer</i> for Department of Computer Science at UIUC | Fall 2015 |
| <i>Speaker</i> of CS Ph.D. orientation seminar on “CS Grad Student Panel”               | Fall 2015 |
| <i>Speaker</i> of CS Graduate Student Seminar panel on “Preparing for Quals”            | Fall 2014 |