Hsien-Chih Chang
Curriculum Vitæ

Department of Computer Science
Dartmouth College
Room 113, Engineering and Computer Science Center
15 Thayer Drive, Hanover, NH 03755

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. ***Graph theory and algorithms***, usually from a structural perspective. ***Metric embeddings***, focusing on representation and sketching of graph metrics, often in geometric settings.

More broadly, I am interested in connections between mathematics and theoretical computer science, especially in applying topological tools to understand efficiency of computation. My current active research project revolves around the role of *planar metrics* in computation.

Employment

Assistant Professor, Department of Computer Science	Fall 2020–
Dartmouth College	(reappointed 2023)

Postdoctoral research associate, Department of Computer Science	Fall 2018–Spring 2020
Duke University	
Supervisor: *Pankaj Agarwal*	

Research assistant, Department of Computer Science	Fall 2016–Spring 2018
University of Illinois at Urbana-Champaign	Spring 2015
Supervisor: *Jeff Erickson*	Fall 2012–Spring 2013

Research assistant, Department of Computer Science	Fall 2015–Spring 2016
University of Illinois at Urbana-Champaign	
Supervisor: *Alexandra Kolla*	

Teaching assistant, Department of Computer Science	Fall 2013–Fall 2014
University of Illinois at Urbana-Champaign	
Instructor: *Jeff Erickson*	

Awards and Honors

NSF CAREER award	2025
CCF-2443017 CAREER: Efficient Distance Sketching on Graphs with Geometric Structures	

Junior Faculty Fellowship	2023

Burke award	2020

Best student presentation award at SoCG'16	Jun 2016
Untangling Planar Curves [23]	

Richard T. Cheng endowed fellowship	2012–2013

Education

University of Illinois at Urbana-Champaign (Urbana-Champaign, Illinois, USA)   2012–2018
Ph.D. in Computer Science
Advisor: *Jeff Erickson*

National Taiwan University (Taipei, Taiwan)   2005–2010
B.Sc. in Computer Science and Information Engineering
Undergrad thesis advisor: *Hsueh-I Lu*

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] *Light Tree Covers, Routing, and Path-Reporting Oracles via Spanning Tree Covers in Doubling Graphs*, with Jonathan Conroy, Hung Le, Shay Solomon, Cuong Than, accepted to STOC 2025.

[2] *Embedding Planar Graphs into Graphs of Treewidth $O(\log^3 n)$*, with Vincent Cohen-Addad, Jonathan Conroy, Hung Le, Marcin Pilipczuk, Michał Pilipczuk, accepted to SODA 2025.

[3] *Optimal Euclidean Tree Covers*, with Jonathan Conroy, Hung Le, Lazar Milenković, Shay Solomon, Cuong Than, Leibniz International Proceedings in Informatics (LIPIcs), Volume 293, pages 37:1-37:15, 2024. Invited to **special issue** of Discrete & Computational Geometry (DCG).

[4] *Computing Diameter+2 in Truly-Subquadratic Time for Unit-Disk Graphs*, with Jie Gao, Hung Le, Leibniz International Proceedings in Informatics (LIPIcs), Volume 293, pages 38:1-38:14, 2024

[5] *Shortcut Partitions in Minor-Free Graphs: Steiner Point Removal, Distance Oracles, Tree Covers, and More*, with Jonathan Conroy, Hung Le, Lazar Milenković, Shay Solomon, Cuong Than, in Proceedings of the 2024 Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'24), pages 5300–5331, 2024.

[6] *Covering Planar Metrics and Beyond by $O(1)$ Trees*, with Jonathan Conroy, Hung Le, Lazar Milenković, Shay Solomon, Cuong Than, in Proceedings of the 64th Annual IEEE Symposium on Foundations of Computer Science (FOCS'23), pages 2231–2261, 2023.

[7] *From Curves to Words and Back Again: Geometric Computation of Minimum-Area Homotopy*, with Brittany Terese Fasy, Bradley McCoy, David L. Millman, and Carola Wenk, in Proceedings of 18th International Symposium on Algorithms and Data Structures (WADS'23), pages 605–619, 2023.

[8] *Almost-Linear ε-Emulators for Planar Graphs*, with Robert Krauthgamer and Zihan Tan, in Proceedings of the 54th Annual ACM Symposium on Theory of Computing (STOC'22), pages 1311–1324, 2022.

[9] *Deterministic Algorithm for Euclidean Bipartite Perfect Matching in Near-Linear Time*, with Pankaj K. Agarwal, Sharath Raghvendra, and Allen Xiao, in Proceedings of the 54th Annual ACM Symposium on Theory of Computing (STOC'22), pages 1052–1065, 2022.

[10] *Untangling Planar Graphs and Curves by Staying Positive*, with Santiago Aranguri and Dylan Fridman, in Proceedings of the 33rd Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'22), pages 211-225, 2022.

[11] *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.

[12] *Planar Emulators for Monge Matrices*, with Tim Ophelders, in Proceedings of the 32nd Canadian Conference on Computational Geometry (CCCG'20), pages 141–147, 2020.

[13] *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.

[14] *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.

[15] *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.

[16] *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.

[17] *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.

[18] *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

[19] *Hard Diagrams of the Unknot*, with Benjamin A. Burton, Maarten Löffler, Arnaud de Mesmay, Clément Maria, Saul Schleimer, Eric Sedgwick, and Jonathan Spreer, Experimental Mathematics, 2023.

[20] *Tightening Curves on Surfaces Monotonically with Applications*, with Arnaud de Mesmay, Invited to **special issue** of the ACM Transactions on Algorithms (TALG), volume 18, issue 4, pages 36:1–32, 2022. Conference version in Proceedings of the 31st Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'20), pages 747–766, 2020.

[21] *Dynamic Geometric Set Cover and Hitting Set*, with Pankaj Agarwal, Subhash Suri, Allen Xiao, and Jie Xue, ACM Transactions on Algorithms, volume 18, issue 4, pages 40:1–37, 2022. Conference version in Proceedings of the 36th International Symposium on Computational Geometry (SoCG'20), pages 2:1–2:15, 2020. Accepted to the ACM Transactions on Algorithms (TALG).

[22] *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.

[23] *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.

[24] *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.

[25] *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.

[26] *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

[27] *Reconfiguration in Curve Arrangements to Reduce Self-Intersections and Popular Faces*, with Florestan Brunck, Maarten Löffler, Tim Ophelders, Lena Schlipf submitted, 2024.

[28] *Resolving the Steiner Point Removal Problem in Planar Graphs via Shortcut Partitions*, with Jonathan Conroy, Hung Le, Lazar Milenkovic, Shay Solomon, Cuong Than, manuscript, 2023.

[29] *On Minimizing Real and Virtual Crossings for Virtual Knots*, with Shixiong Xu, manuscript, 2023.

[30] *Near-Linear ε-Emulators for Planar Graphs*, with Robert Krauthgamer and Zihan Tan, 2023. Strengthening the results from *Almost-Linear ε-Emulators for Planar Graphs* [8].

[31] *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* [13].

[32] *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* [22].

[33] *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* [23].

[34] *Asymptotically Optimal Thickness Bounds of Generalized Bar Visibility Graphs*, with Hsueh-I Lu and Yen-Peng Sung, unpublished manuscript, 2009.

Invited Talks

Shortcut Partitions: Steiner Point Removal, Distance Oracles, Tree Covers, and More [5][6]   Nov 2023
University of Illinois at Urbana-Champaign, Urbana-Champaign, IL, USA.

Covering Planar Metrics by $O(1)$ Trees [6][28]
DIMACS Workshop on Modern Techniques in Graph Algorithms,   Jun 2023
Rutgers University, New Brunswick, NJ, USA.
Recording: https://www.youtube.com/watch?app=desktop&v=6EnxGdT2MAU

Near-Linear ε-Emulators for Planar Graphs [8],   Apr 2023
University of Massachusetts Amherst, Massachusetts, USA.

Linear-size ε-Emulators for Planar Graphs [8],   Jun 2022
"Minisymposium on Graphs Embedded on Surfaces",
Curves and Surfaces 2022
Palais des Congrès in Arcachon, France.

Morphing Planar Metrics,   Aug 2021
"Combinatorial Reconfiguration in Discrete and Computational Geometry",
online workshop.

Survey on Tightening Curves on Surfaces,   May 2021
Dagstuhl Seminar 21181: "Computational Geometry",
Schloß Dagstuhl, Wadern, Germany.
(Virtual visit due to COVID-19 pandemic.)

Are All Practical Planar Optimization Problems Easy?,   Apr 2020
University of Iowa, Iowa, USA.
(Virtual visit due to COVID-19 pandemic.)

Are All Practical Planar Optimization Problems Easy?,   Feb 2020
Brown University, Rhode Island, USA.

Toward a Better Classification of Planar Optimization Problems,   Feb 2020
Dartmouth College, New Hampshire, USA.

Discrete and Computational Topology: Planar Curves (and Beyond) [16][23][31][33],   Feb 2018
University of Colorado Boulder, Colorado, USA.

On Local Crossing Numbers of Complete Graphs and Hypercubes,   Jan 2018
AMS Special Session on Beyond Planarity: Crossing Numbers of Graphs (a Mathematics Research Communities
Session), Joint Mathematics Meetings,
San Diego, California, USA.

Discrete and Computational Topology: Untangling Planar Curves (and Beyond) [16][23][31][33],   Dec 2017
Theory Day in Taiwan (2017C),
Institute of Information Science, Academia Sinica, Taipei, Taiwan.

Untangling Graphs and Curves on Surfaces via Local Moves [23][31][33],   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 [23][31][33],   Jan 2017
Saint Louis University, Missouri, USA.

Conference and Workshop Talks

Planar Emulators for Monge Matrices [12],   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 [13],   Jun 2019
35th International Symposium on Computational Geometry (SoCG'19),
Portland, Oregon, USA.

Tightening Curves on Surfaces via Local Moves [16],   Jan 2018
29th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'18),
New Orleans, Louisiana, USA.

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

Untangling Planar Curves [23],   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 [24],   Jun 2015
31st International Symposium on Computational Geometry (SoCG'15),
Eindhoven, Netherlands.

A Faster Algorithm to Recognize Even-Hole-Free Graphs [25],   Jan 2012
23rd Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'12),
Kyoto, Japan.

Computing the Girth of a Planar Graph in Linear Time [26],   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 2025
Incorporating TA training as part of the course plan.

COSC 149.12: All about Planar Graphs   Fall 2024
New seminar-style graduate-level course developed at Dartmouth.

COSC 30: Discrete Mathematics in Computer Science   Spring 2024

COSC 30: Discrete Mathematics in Computer Science   Spring 2023

COSC 31: Algorithms   Winter 2023
Revised the syllabus geared towards modern career challenges. Half lectures and half working sessions that are very effective based on student evaluation.

COSC 2/49.11: Metric Embedding and Sketching   Fall 2022
New seminar-style graduate-level course developed at Dartmouth. Very positive student evaluation.

COSC 30: Discrete Mathematics in Computer Science   Spring 2022
Second offering of COSC 30, accompanying helpful advises from TAs and students from the previous iteration. Student evaluation suggests that the new format is very effective and helpful.

COSC 30: Discrete Mathematics in Computer Science   Winter 2022
Revised the syllabus with new materials and course objectives. Partially-flipped classroom with half lectures and half working sessions.

COSC 2/49.09: Introduction to Computational Topology   Fall 2021

COSC 39: Theory of Computation   Winter 2021
Revised the syllabus with new materials and course objectives.

COSC 2/49.09: 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

PhD advisor at Dartmouth College. 2020–

Jonathan Conroy, **Ph.D. advisee**. Metric embedding/sketching and geometric optimization [6][28][5][3][2].
Reilly Browne, **Ph.D. advisee**. Geometric intersections graphs and optimization.

Research advisor at Dartmouth College. 2020–

Eli Friedman, undergraduate student. Working on senior honor thesis "Improved Approximation Algorithm for Directed Steiner Forest in Planar Graphs".
Yunfei Zheng, undergraduate student. Working on the construction of low-dimensional graphs with nice expansion, for lower bound constructions.
Alina Chadwick, undergraduate student. Working on matching algorithms in distributed models.
Karun Ram, undergraduate student. Working on puzzle design to communicate mathematical ideas.
Benjamin Kallus, Ph.D. student. Worked on distance-related optimization problems on surface graphs.
Dylan Fridman, undergraduate student, Lovelace Scholar. Working on planar curve problems, with joint publication *Untangling Planar Graphs and Curves by Staying Positive* [10].

Research advisor at other universities. 2021–

Shixiong Xu, undergraduate student at Amherst College. Working on computation geometry and topology, studying minimal configurations in virtual knots.
Brad McCoy, Ph.D. student at Montana State University. Working on planar curve problems, with joint publication *From Curves to Words and Back Again: Geometric Computation of Minimum-Area Homotopy* [7].
Santiago Aranguri, undergraduate student at Stanford. Working on planar curve problems, with joint publication *Untangling Planar Graphs and Curves by Staying Positive* [10].

Thesis committee. 2025–

Hang Liao, Ph.D. candidate. Proposal title "Power of CUT Queries on Graph Connectivity and Beyond".

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* [11].
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* [14], *Dynamic Geometric Set Cover and Hitting Set* [21], and manuscript *Deterministic Algorithm for Euclidean Bipartite Perfect Matching in Near-Linear Time* [9].
Daniel Orenstein, master's student. Working on tightening toroidal curves.

Services

Conference Program Committee

36th International Symposium on Algorithms and Computation (ISAAC 2025)	December, 2025
41th International Symposium on Computational Geometry (SoCG 2025)	June, 2025
36rd Canadian Conference on Computational Geometry (CCCG 2024)	July 17–19, 2024
38th International Symposium on Computational Geometry (SoCG 2022)	June, 2022
33rd Canadian Conference on Computational Geometry (CCCG 2021)	August 10–12, 2021

Workshop Organizer

Dagstuhl Seminar 26122: Intractability in Discrete Geometry and Topology	March, 2026
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, 2022–2023); *European Workshop on Computational Geometry* (EuroCG 2019); *Annual IEEE Symposium on Foundations of Computer Science* (**FOCS** 2016, 2020, 2023); *International Symposium on Graph Drawing & Network Visualization* (GD 2017–2018, 2024); *International Colloquium on Automata, Languages, and Programming* (ICALP 2016–2018, 2024–2025); *International Symposium on Algorithms and Computation* (ISAAC 2017, 2021); *International Symposium on Computational Geometry* (**SOCG** 2018–2019, 2021–2022, 2024–2025); *ACM-SIAM Symposium on Discrete Algorithms* (**SODA** 2015, 2017–2018, 2020–2025); *ACM-SIAM Symposium on Simplicity in Algorithms* (SOSA 2022); *Annual ACM Symposium on Theory of Computing* (**STOC** 2022–2025); *Algorithms and Data Structures Symposium* (WADS 2019).

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

Departmental Services at Dartmouth

Graduate Ethics Trainer	2024–2026
Undergraduate Program Director in CS	Summer 2024
Faculty Search Committee in Algorithms+X	2023–2024
Award Committee in Computer Science Department at Dartmouth	2022–2023
Admission Committee for PhD hiring in Computer Science Department at Dartmouth	2020–2023

Earlier Departmental Services

Graduate student application reviewer for Department of Computer Science at UIUC	Fall 2015
Speaker of CS Ph.D. orientation seminar on "CS Grad Student Panel"	Fall 2015
Speaker of CS Graduate Student Seminar panel on "Preparing for Quals"	Fall 2014