Hsien-Chih Chang

Curriculum Vitæ

Department of Computer Science
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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

Assistant Professor, Department of Computer Science — Fall 2020–
Dartmouth College

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

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*

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*

Awards and Honors

Best student presentation award at SoCG'16 — Jun 2016
Untangling Planar Curves [12]

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] *Efficient Clustering under Stability in Near-Linear Time*, with Pankaj K. Agarwal, Kamesh Munagala, Erin Taylor, and Emo Welzl, to appear in the 40th IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS'20).

[2] *Planar Emulators for Monge Matrices*, with Tim Ophelders, to appear in the 32nd Canadian Conference on Computational Geometry (CCCG'20).

[3] *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.

[4] *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).

[5] *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.

[6] *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.

[7] *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.

[8] *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.

[9] *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.

[10] *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

[11] *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.

[12] *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.

[13] *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.

[14] *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.

[15] *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

[16] *Lower Bounds for Planar Electrical Reduction*, with Jeff Erickson, preprint, 2017. Joined with Marcos Cossarini, results from this paper have been strengthed and published in *Lower Bounds for Electrical Reduction on Surfaces* [5].

[17] *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* [11].

[18] *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* [12].

[19] *Asymptotically Optimal Thickness Bounds of Generalized Bar Visibility Graphs*, with Hsueh-I Lu and Yen-Peng Sung, unpublished manuscript, 2009.

Invited Talks

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) [8][12][16][18], 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) [8][12][16][18], Dec 2017
Theory Day in Taiwan (2017C),
Institute of Information Science, Academia Sinica, Taipei, Taiwan.

Untangling Graphs and Curves on Surfaces via Local Moves [12][16][18], 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 [12][16][18], Jan 2017
Saint Louis University, Missouri, USA.

Conference and Workshop Talks

Planar Emulators for Monge Matrices [2], Aug 2020
32nd Canadian Conference on Computational Geometry (CCCG'20),
Saskatoon, Saskatchewan, Canada. (Virtual visit due to COVID-19 pandemic.)

Tightening Curves on Surfaces Monotonically with Applications [4], Jan 2020
31st Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'20),
Salt Lake City, Utah, USA.

Lower Bounds for Electrical Reduction on Surfaces [5], Jun 2019
35th International Symposium on Computational Geometry (SoCG'19),
Portland, Oregon, USA.

Tightening Curves on Surfaces via Local Moves [8], Jan 2018
29th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'18),
New Orleans, Louisiana, USA.

Unwinding Annular Curves and Electrically Reducing Planar Networks [9], Jul 2017
Computational Geometry: Young Researchers Forum, 33rd International Symposium on Computational Geometry (SoCG'17),
Brisbane, Australia.

Untangling Planar Curves [12], 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 [13], Jun 2015
31st International Symposium on Computational Geometry (SoCG'15),
Eindhoven, Netherlands.

A Faster Algorithm to Recognize Even-Hole-Free Graphs [14], Jan 2012
23rd Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'12),
Kyoto, Japan.

Computing the Girth of a Planar Graph in Linear Time [15], Aug 2011
17th International Computing and Combinatorics Conference (COCOON'11),
Dallas, Texas, USA.

Teaching

Instruction

COSC 49.09: Introduction to Computational Topology Fall 2020

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

Postdoctoral mentor of theory graduate and undergrad students at Duke University. Fall 2017

- ***Erin Taylor***, Ph.D. student, with joint publication *Efficient Clustering under Stability in Near-Linear Time* [1].
- ***Allen Xiao***, Ph.D. student, with joint publication *Efficient Algorithms for Geometric Partial Matching* [6] and *Dynamic Geometric Set Cover and Hitting Set* [3].
- ***Daniel Orenstein***, master's student, working on tightening toroidal curves.

Services

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

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

Departmental Services

Graduate student application reviewer for Department of Computer Science	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