

ALAN ARROYO

Postdoctoral Researcher at IST Austria

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PROFESSIONAL EXPERIENCE AND EDUCATION

Institute of Science and Technology Austria. (Austria) *October 2018 - Present*

Postdoctoral researcher.

Research group: Discrete and Computational Geometry and Topology.

Supervisor: Uli Wagner.

University of Waterloo. (Canada) *May 2018 - August 2018*

Postdoctoral researcher.

Department of Combinatorics and Optimization.

Supervisor: Bruce Richter.

University of Waterloo. (Canada) *May 2014 - April 2018*

PhD of Mathematics.

Department of Combinatorics and Optimization.

Supervisor: Bruce Richter.

University of Waterloo. (Canada) *September 2012 - April 2014*

Master of Mathematics.

Department of Combinatorics and Optimization.

Supervisor: Bruce Richter.

Universidad Nacional Autónoma de México. (Mexico) *September 2008 - April 2012*

Faculty of Sciences.

Supervisor: Hortensia Galeana.

PRIZES, AWARDS

IST Plus Postdoctoral Fellowship. Grant under MSCA program (success rate 23%). *2018-2020*

CONACYT, PhD Studies Scholarship. *2014-2018*

Best Teaching Assistant Award, Fall 2017, University of Waterloo. *2017*

Math Grad Experience Award; *2012-2014*

C & O Math Faculty Award;

William Tutte Postgraduate Scholarship, University of Waterloo.

Gabino Barreda Medal (Highest Bachelor GPA score). UNAM, Mexico. *2012*

INVITED PRESENTATIONS

1. *Drawings of graphs from a structural point of view.* Joint DIMEA and FORMELA seminar, Masaryk University, Brno, Czech Republic. March 25, 2019.
2. *Graph with at most one crossing.* GeomTop Seminar, IST Austria, Klosterneuburg, Austria. February 6, 2019.
3. *All graphs are beautiful.* Joint Grad Student Colloquium (between Pure Math and C&O Departments), University of Waterloo, Canada. June 6, 2018.

4. *Stretching drawing of graphs*. Graphs and Matroids seminar, University of Waterloo, Canada. June 27, 2018.
5. *Geometric drawings of graphs (Part I and II)*. Graphs and Matroids seminar, University of Waterloo, Canada. September 14 and 21, 2017.
6. *Characterizing pseudolinear drawings in the plane*. Geometric and Structural Graph Theory, Banff International Research Station. Banff, Canada. August 22, 2017.
7. *Rectilinear drawings with few crossings*. Thomassen's group seminar at DTU, Lynby, Denmark. April 19, 2017.
8. *Geometric drawings of graphs and their minimal forbidden subdrawings*. ACCOTA, Los Cabos, México. November 29, 2016.
9. *El problema de las dos trayectorias*. CINNMA, Queretaro, México. January 8, 2015.
10. *Jordan Curve Theorem: a proof using graphs*. Joint Grad Student Colloquium (between Pure Math and C&O Departments), University of Waterloo. March 31, 2015.
11. *The 2-linkage Problem*. Graph Theory Seminar, University of Waterloo. March 12, 2014.

CURRENT RESEARCH PROJECTS

Convex drawings of K_n .

Starting date: 2015.

Collaborators: Dan McQuillan (Norwich), Bruce Richter, Matt Sullivan (UWaterloo), Gelasio Salazar (USLP).

Description: Motivated from the Harary Hill Conjecture on the crossing number of K_n , we are searching a structural description of drawings of K_n having few crossings.

Straightening a topological drawing of a graph.

Starting date: April, 2017.

Collaborators: Bruce Richter (UWaterloo), Carsten Thomassen (DTU).

Description: We are developing a novel method for transforming a topological drawing into a geometric one and preserving crossings. We are using this method to extend classing results in Graph Drawing.

Practical algorithms for computing small crossing numbers.

Starting date: May, 2019.

Collaborators: Drago Bokal (Maribor), Jesus Leaños (AUZ).

Description: Using a recent combinatorial characterization of graphs with crossing number 1, we are studying whether this can be used to obtain algorithms to compute small crossing numbers.

Homomonotone drawings.

Starting date: May, 2019.

Collaborators: Oswin Aichholzer, Birgit Vogtenhuber (TU Graz), Rado Fulek (Univ. of Arizona).

Description: We are working on the complexity of the problem of determining when a topological drawing is homeomorphic to a x -monotone drawing.

Extending simple drawings with one edge is hard.

Starting date: June, 2019.

Collaborators: Fabian Klute (TU Wien), Seidel Raimund (Universität des Saarlandes), Irene Parada, Birgit Vogtenhuber (TU Graz), Tilo Wiedera (Universität Osnabrück).

Description: We showed that adding one edge in a simple drawing is NP-hard, even for pseudocircular drawings. We also found a polynomial-time algorithm to extend one segment in an arrangement of pseudocircles.

Bundled crossings.

Starting date: November, 2019.

Collaborators: Oswin Aichholzer (TU Graz), Martin Balko, Pavel Valtr (Charles University), Man-Kwun Chiu

(FU Berlin), Stefan Felsner (TU Berlin), Fabian Klute (TU Wien).

Description: We are studying the bundled crossing number of drawings.

PUBLICATIONS

In peer-reviewer Journals:

1. Alan Arroyo, Dan McQuillan, R Bruce Richter, and Gelasio Salazar. “Levi’s Lemma, pseudolinear drawings of K_n , and empty triangles”. In: *Journal of Graph Theory*, 2017;00:1–18. (2018).
2. Alan Arroyo, Dan McQuillan, R. Bruce Richter, and Gelasio Salazar. “Drawings of K_n with the same rotation scheme are the same up to triangle-flips (Gioan’s Theorem)”. In: *Australasian Journal of Combinatorics* 67.2 (2017), pp. 131–144
3. Alan Arroyo and R. Bruce Richter. “Characterizing Graphs with Crossing Number at Least 2”. In: *Journal of Graph Theory* 85.4 (2017), pp. 738–746
4. Carlos A Alfaro, Alan Arroyo, Marek Derňár, and Bojan Mohar. “The Crossing Number of the Cone of a Graph”. In: *SIAM Journal on Discrete Mathematics* 32.3 (2018), pp. 2080–2093
5. Alan Arroyo and Hortensia Galeana-Sánchez. “The Path Partition Conjecture is true for some generalizations of tournaments”. In: *Discrete Mathematics* 313.3 (2013), pp. 293–300
6. André C. Silva, Alan Arroyo, R. Bruce Richter, and Orlando Lee. “Graphs with at most one crossing”. In: *Discrete Mathematics* 342.11 (2019), pp. 3201–3207

In peer-reviewed Conference Proceedings:

1. Alan Arroyo, Martin Derka, and Irene Parada. “Extending simple drawings”. In: *International Symposium on Graph Drawing and Network Visualization*. 2019. To appear.

Preprint:

1. Alan Arroyo, Julien Bensmail, and R Bruce Richter. “Extending Drawings of Graphs to Arrangements of Pseudolines”. In: *arXiv preprint arXiv:1804.09317* (2018).
2. Alan Arroyo, Dan McQuillan, R Bruce Richter, and Gelasio Salazar. “Convex drawings of the complete graph, topology meets geometry”. In: *arXiv preprint arXiv:1712.06380* (2017)
3. Alan Arroyo, Fabian Klute, Irene Parada, Seidel Raimund, Birgit Vogtenhuber, and Tilo Wiedera. “Extending simple drawings with one edge is hard”. In: *arXiv preprint arXiv:1909.07347* (2019)

In preparation:

- Alan Arroyo, Matthew Sunohara, and R. Bruce Richter. “Extending drawings of complete graphs into arrangements of pseudocircles”. In preparation.
- Alan Arroyo, Carolina Medina, and Gelasio Salazar. “The Fary-Wagner theorem for the torus”. In preparation.
- Alan Arroyo, R. Bruce Richter, and Carsten Thomassen. “Straightening a topological drawing of a graph”. In preparation.
- Alan Arroyo, Dan McQuillan, R. Bruce Richter, Gelasio Salazar and Matthew Sullivan. “Drawings of Complete Graphs in the Projective Plane”. In preparation.

ORGANIZATION OF INTERNATIONAL CONFERENCES AND WORKSHOPS

1. Crossing Numbers Workshop Telč, Czech Republic. Organization Committee. May 6-10, 2019.
2. Mathematical Congress of the Americas 2017. Special Session: Current trends in Combinatorics. Organization Committee. Montreal, Canada. July 24-28, 2017.

3. II Taller de Matemáticas Discretas. Co-organizer of an undergrad research project. CINNMA, México. July 26-31, 2015.

SUPERVISING AND MENTORING

<i>2017-Now</i>	Lecturer. Advanced Graph Theory, Fall 2019 (IST Austria, PhD-level course). Introduction to Combinatorics, Spring 2018. Introduction to Combinatorics, Spring 2017.
<i>2016</i>	Co-supervise an Undergrad Research Assistant with Bruce Richter. University of Waterloo.
<i>2012-2017</i>	Teaching Assistant at University of Waterloo Introduction to Combinatorics (Spring 2013, Fall 2013, Fall 2014, Spring 2015, Winter 2017). Discrete Mathematics for Engineers (Spring 2017, Winter 2016). Calculus II (Winter 2015). Linear Algebra For Engineering (Fall 2012). Introduction to Graph Theory (Spring 2016). Network Flow Theory (Fall 2016). Graph Theory (Fall 2017).
<i>2008-2012</i>	Teaching Assistant at Universidad Nacional Autónoma de México. Calculus II, III, IV, Algebra I and II Topology II, Linear Algebra.

ACADEMIC SERVICE

I have refereed articles for the following journals and conferences.

1. Discrete Optimization.
2. Discrete Mathematics.
3. Ars Mathematica Contemporanea.
4. Graph Drawing and Network Visualization (4 times).
5. Symposium of Computational Geometry SoCG.
6. ACM-SIAM Symposium on Discrete Algorithms 2020 SODA.
7. Journal of Graph Theory.

OTHER SKILLS

Programming skills: Python, LaTeX, basic UNIX/Linux, SVN, Git.

Languages: English and Spanish.