

Ralihe Raúl Villagrán Olivas

PERSONAL INFORMATION

Citizenship: Mexican.
I was born on July 16th, 1992 in a small town called Costa Rica located in the State of Sinaloa, Mexico.

CONTACT INFORMATION

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PROFESSIONAL EXPERIENCE

Eindhoven University of Technology (TU/e)

Postdoctoral Researcher, since June 2022.

- Group: Algebraic Graph Theory.
- Mentor: Aida Abiad

EDUCATION

Department of Mathematics, Center for Research and Advanced Studies of the National Polytechnic Institute (CINVESTAV-IPN)

Ph.D. in Mathematics, November, 2021.

- Dissertation: Arithmetical structures and applications of determinantal ideals of graphs.
- Advisors: Dr. Carlos A. Alfaro and Dr. Carlos E. Valencia

M.S. in Mathematics, January 2017.

- Master Thesis: Arithmetical structures on graphs and the algebraic co-rank of threshold graphs. Advisor: Dr. Carlos E. Valencia

Faculty of Physics and Mathematics, Autonomous University of Sinaloa

B.S. in Mathematics, July 2014

- Highest grade-point average of generation 2009-2014

RESEARCH INTERESTS

Combinatorics (mostly algebraic and enumerative). I am also interested in combinatorial matrix theory, commutative algebra and graph theory.

RELEVANT SKILLS

Languages: Spanish (native) and English (fluent)
Programming: Python, C, R, SageMath, Java, MATLAB, Macaulay2, \LaTeX and others

PUBLICATIONS

Journal

1. (with J. Breen, S. Butler, M. Fuentes, B. Lidicky, M. Phillips, A. N. Riasanovsky, S. Y. Song, C. Wiseman and X. Zhang) *Hadamard diagonalizable graphs of order at most 36*, in The Electronic Journal of Combinatorics, 29(2) (2022).
2. (with A. Abiad, B. Brimkov, J. Breen, T. R. Cameron and H. Gupta) *Constructions of cospectral graphs with different zero forcing numbers*, in The Electronic Journal of Linear Algebra, 38 (2022).
3. (with C. E. Valencia) *Algorithmic aspects of arithmetical structures*, in Linear Algebra and its Applications, 640 (2022).
4. (with C. A. Alfaro) *The structure of sandpile groups of outerplanar graphs*, in Applied Mathematics and Computation, 395 (2021).
5. (with C. A. Alfaro, M. D. Barrus and J. Sinkovic) *Graphs with few trivial characteristic ideals*, in Linear Algebra and its Applications, 615 (2021).

Submitted

- i. (with C. E. Valencia) *Arithmetical structures on dominated polynomials*. (February 2022) [arxiv:2202.07744](https://arxiv.org/abs/2202.07744)

Conference

- a. (with C. A. Alfaro, M. D. Barrus and J. Sinkovic) ***The characterization of graphs whose sandpile group has fixed number of generators.*** (chapter in Extended Abstracts Euro-Comb 2021), in Trends in Mathematics, 2021.

TEACHING EXPERIENCE

June 2022 Teaching assistant, An introduction to chip-firing (ECCO 2022)
Lecturer: Caroline Klivans, Brown University
Fall 2018 Teaching assistant, Discrete Mathematics, (CINVESTAV-IPN)
Lecturer: Carlos E. Valencia, CINVESTAV-IPN
2012 - 2014 Math Tutor at Faculty of Physics and Mathematics, Autonomous University of Sinaloa.

ORGANIZATION

2018 - 2020 Co-organizer of the Student Seminar (CINVESTAV-IPN)
March- July 2021 Co-organizer of the (Online) Student Seminar (CINVESTAV-IPN)

PRESENTATIONS

Key: \triangleright = invited conference, \bullet = contributed, $*$ = seminar, \square = poster.

\square *Sandpile groups of planar graphs and determinantal ideals*, 7th Colombian Combinatorics Meeting (ECCO 2022): Geometric methods in combinatorics, Bogota, Colombia, June 14-25, 2022.

\triangleright *On graphs with real algebraic co-rank at most 3*, AMS Special Session on Finding Needles in Haystacks: Approaches to Inverse Problems Using Combinatorics and Linear Algebra, 2022 Joint Mathematics Meetings, held virtually on April 6-9, 2022.

\bullet *The characterization of graphs whose sandpile group has fixed number of generators*, European Conference on Combinatorics, Graph Theory and Applications 2021, 6-10 September 2021, Barcelona (Online).

\bullet *On the sandpile groups of outerplanar graphs*, The Graduate Student Combinatorics Conference (GSCC21), hosted by the University of Minnesota (Twin Cities) on Zoom, April 25, 2021

\bullet *Hadamard-diagonalizable Graphs*, XXXV Colloquium of Graph Theory, Combinatorics and its applications, CECEQ, Queretaro, Mexico, March 2-6, 2020

$*$ *A first look to Matroid Theory*, Student Seminar of the Department of Mathematics-CINVESTAV, 2019

\square *Some algorithmic aspects of arithmetical structures on matrices*, Second School of Commutative Algebra, Center of Mathematical Research (CIMAT), Guanajuato, November 2018

\bullet *Some algorithmic aspects of arithmetical structures on graphs*, 50th National congress of the Mexican Mathematical Society, (UNAM), Mexico City, October 22-27, 2017

$*$ *On the Critical Ideals of Threshold Graphs*, Seminar of Critical Ideals and Boundary Problems, CINVESTAV-IPN, 2015

$*$ *Algebraic Geometry*, Student Seminar of The Faculty of Physics and Mathematics, Autonomous University of Sinaloa, 2013

$*$ *Moduli Spaces*, Student Seminar of The Faculty of Physics and Mathematics, Autonomous University of Sinaloa, 2012

**CONFERENCE AND
WORKSHOP
ATTENDANCES
(SINCE NOVEMBER
2014)**

1. 7th Colombian Combinatorics Meeting (ECCO 2022): Geometric methods in combinatorics, Bogota, Colombia, June 2022
2. *Mathematics of Big Data: Sketching and (Multi-) Linear Algebra (Virtual School)*, MSRI graduate summer school, June 21 to July 02, 2021.
3. *AMS MRC program; Finding Needles in Haystacks: Approaches to Inverse Problems using Combinatorics and Linear Algebra*, 2021 MRC (AMS) summer conference from June 6 to June 12, 2021.
4. *Latin American Colloquium of Algebra*, Mexico City, August 2019
5. *Graduate Research Workshop in Combinatorics (GRWC)*, University of Kansas, Lawrence, KS, June 2019
6. *Second School of Commutative Algebra*, Center of Mathematical Research (CIMAT), Guanajuato, November 2018
7. *Interinstitutional Seminar of Random Matrices (SIMA): Applications*, Center of Mathematical Research (CIMAT), Guanajuato, November 2018
8. *CIMPA Research School: "Commutative Algebra with Applications to Statistics and Coding Theory"*, June-July 2018, Autonomous University of Zacatecas, Mexico.
9. 6th Colombian Combinatorics Meeting (ECCO 2018): Combinatorics meets Algebra, Geometry and Optimization, Universidad del Norte, Barranquilla, Colombia, June 2018
10. *Interinstitutional Seminar of Random Matrices (SIMA): Free Probability*, Center of Mathematical Research (CIMAT), Guanajuato, November 2017
11. *School of Commutative Algebra*, CIMAT, Guanajuato, November 2017
12. *Conferences of Algebra 2016*, UNAM, October 2016.
13. *CIMPA-CIMAT-ICTP School on Moduli of Curves*, February-March 2016, CIMAT, Guanajuato.
14. *Sandpile Groups Workshop*, Banff International Research Station at "Casa Matematica Oaxaca", November 2015, Oaxaca, Mexico
15. *Conferences of Algebra 2015*, Autonomous National University of Mexico (UNAM), October 2015.
16. *ACCOTA (International Workshop in Combinatorial and Computational aspects of Optimization, Topology and Algebra)* November 2014, Ixtapa Zihuatanejo, Mexico

**HONORS AND
AWARDS**

1. Chebyshev grant; to attend the International Congress of Mathematicians to be held at St. Petersburg on July 6-14, 2022 (changed to a fully virtual event).
2. Grant to attend (and participate in) the Joint Mathematics Meetings, held virtually on April 6-9, 2022.
3. Grant to attend the MSRI graduate summer school "Mathematics of Big Data: Sketching and (Multi-) Linear Algebra (Virtual School)", from June 21, 2021 to July 02, 2021.
4. Grant to attend the 2021 MRC (AMS) summer conference "Finding Needles in Haystacks: Approaches to Inverse Problems using Combinatorics and Linear Algebra", from June 6 to June 12, 2021.
5. Grant to attend the MSRI graduate summer school "Sums of Squares Method in Geometry, Combinatorics and Optimization", postponed to summer 2022 due to COVID-19.
6. Grant to attend the 2019 GRWC hosted by University of Kansas in Lawrence, KS. From June 16-June 29, 2019.
7. Conacyt-Scholarship for PhD studies, Ph.D. in Mathematics.
8. Conacyt-Scholarship for Master Studies, M.S. in Mathematics.

9. Name of Generation 2009-2014 B.S. in Mathematics.
10. SEP scholarship for academic Excellence, for the 2012-2013 and the 2013-2014 academic years.
11. Mexican Academy of Sciences (AMC) scholarship, summer for Scientific Research 2012 and 2013. (both held at CIMAT under the supervision of Dr. Gloria Leticia Brambila Paz)

**GRADUATE
COURSEWORK**

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| <input type="checkbox"/> Algebra | <input type="checkbox"/> Discrete Mathematics |
| <input type="checkbox"/> Differential and Integral Equations | <input type="checkbox"/> Functional Analysis |
| <input type="checkbox"/> Advanced Programming | <input type="checkbox"/> Boundary Problems in Critical Ideals |
| <input type="checkbox"/> An introduction to Sandpile Groups | <input type="checkbox"/> Arithmetical Structures on Graphs |
| <input type="checkbox"/> Analysis and Design of Algorithms | <input type="checkbox"/> Scientific Software Development |
| <input type="checkbox"/> Mathematical Foundations of Cryptocurrencies | <input type="checkbox"/> Free Minimal Resolutions of the K-stable Ideal |
| <input type="checkbox"/> The Critical Group of a Graph | <input type="checkbox"/> Discrete Geometry |
| <input type="checkbox"/> Graph Theory (Structural and Algebraic) | <input type="checkbox"/> Selected Topics in Commutative Algebra |
| <input type="checkbox"/> Machine Learning | <input type="checkbox"/> Selected Topics in Algebraic Coding Theory |