

# ALEJANDRO PARADA-MAYORGA

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University of Pennsylvania  
Department of Electrical and Systems Engineering

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## RESEARCH INTERESTS

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Signal processing, abstract harmonic analysis, algebraic signal processing, algebraic neural networks, applications of representation theory of algebras, category theory, graph signal processing, graph neural networks, and compressed sensing.

## EDUCATION

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**Ph.D. in Electrical Engineering** July 2019  
University of Delaware Newark, DE, USA  
• Thesis: Blue Noise and Optimal Sampling on Graphs (advisor: Gonzalo Arce)

**Master in Electrical Engineering** May 2012  
Industrial University of Santander Bucaramanga, Colombia  
• Dissertation: Dynamic Tracking of Facial Expressions using DIP (advisor: Arturo Plata)

**B.Sc. in Electrical Engineering (5 years diploma)** June 2009  
Industrial University of Santander Bucaramanga, Colombia  
• Dissertation: Analysis of thermal distribution in iron by Eddy currents using FEM (advisor: Ernesto Aguilera)  
• *Additional courses: Abstract Algebra, Real Analysis, Special functions and Complex Analysis, Set Theory, Mathematical Physics I (tensor analysis), Mathematical Physics II (PDE and special functions), Differential equations and dynamical systems.*

## HONORS AND AWARDS

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- Professional Development Award. University of Delaware April 2019
- National Science Foundation NSF #1815992. \$ 300,000. “Blue-Noise Graph Sampling”, University of Delaware. I contributed substantially in the preparation of this proposal, under the supervision of Gonzalo R. Arce. June 1 2018 - May 31 2021
- Signal Processing and Communications Graduate Faculty Award. ECE department, University of Delaware May 2018
- UDRF Strategic Initiative Award. “Efficient Design of Uniqueness Sets for Bandlimited Signals on Networks University of Delaware. I assisted Gonzalo R. Arce in the preparation of this proposal. Feb 2018
- Dissertation Fellowship Award. University of Delaware June 2018
- Colciencias Scholarship 617  
Scholarship for Ph.D studies sponsored by the government of Colombia 2014
- Scholarship for Master Studies  
Department of Electrical Engineering, Industrial University of Santander, Colombia. 2009
- Outstanding Student. Industrial University of Santander, Colombia 2003

## APPOINTMENTS

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- **Postdoctoral Researcher.** Department of Electrical and Computer Engineering August 2019- Present. **University of Pennsylvania.**
- **Visitor Scholar.** Department of Electrical and Computer Engineering February 2013- June 2013. **University of Delaware.**

## TEACHING EXPERIENCE


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### Lecturer/Instructor

- Department of Electrical and Computer Engineering, University of Pennsylvania.
  - Graph Neural Networks (ESE5140) ([\[CourseWebsite\]](#)) Fall 2022.
- Department of Electrical Engineering, Industrial University of Santander.
  - Digital Image Processing 2012
  - Signal Processing 2011-2012

### Teaching Assistant

- *Teaching Material Development.* Department of Electrical and Computer Engineering, University of Pennsylvania.
  - Graph Neural Networks (ESE5140) Fall 2020.

I prepared online educational resources for the course ESE5140 ([\[CourseWebsite\]](#)), taking the main lead in the section devoted to *algebraic signal processing* and *algebraic neural networks* .
- Department of Electrical and Computer Engineering, University of Delaware.
  - Computational Imaging Seminar (ELEG 667) Fall 2016
  - Foundations of Statistical Learning (ELEG 815) Fall 2016
  - Electronic Circuit Analysis II (ELEG312080) Fall 2017
  - Digital Imaging and Photography (ELEG404010) Spring 2018
- Department of Electrical Engineering, Industrial University of Santander.
  - Signals and Systems 2007-2008
  - Digital Signal Processing. 2008-2009

## RESEARCH EXPERIENCE BEFORE THE PH.D.

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- **Industrial University of Santander** (Colombia), Department of Electrical Engineering
  - **Computational Electromagnetism** (June 2009). Mathematical modeling and simulation of heating in ferromagnetic materials induced by eddy currents: I provided the numerical and mathematical analysis of this problem in rectangular and cubic geometries using the Finite Elements Method (FEM) and developed code for simulation purposes. [\[pdf\]](#)
  - **Image Processing and Nonlinear Dimensionality Reduction** (December 2012). Dynamic tracking of facial expressions: I analyzed the problem of automatic tracking of facial expressions using image processing techniques, manifold analysis of data and nonlinear dimensionality reduction. [\[pdf\]](#)
- **University of Delaware** (USA), Department of Electrical Engineering

- **Computational Imaging and Compressed Sensing** (Spring 2013): I provided the mathematical analysis necessary to state spectral resolution limits in CASSI systems and provided numerical and experimental results proving the hypothesis stated. [pdf]

## PUBLICATIONS

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### Preprints

1. **A. Parada-Mayorga**, Z. Wang, and A. Ribeiro, “Graphon Pooling for Reducing Dimensionality of Signals and Convolutional Operators on Graphs”, (submitted to IEEE-TSP, under review). [2022] [pdf]
2. Butler, L., **Parada-Mayorga, A.**, and Ribeiro, A. Learning with Multigraph Convolutional Filters. (accepted, ICASSP 2023) [conference paper] (equal contribution). [2022] [pdf]
3. Kumar, H., **Parada-Mayorga, A.**, and Ribeiro, A. Algebraic Convolutional Filters on Lie Group Algebras. (accepted, ICASSP 2023) [conference paper]. [2022] [pdf]
4. L. Butler, **A. Parada-Mayorga**, and A. Ribeiro, “Convolutional Learning on Multigraphs”, (accepted to IEEE-TSP, under review, equal contribution). [2022] [pdf]
5. **A. Parada-Mayorga**, Z. Wang, F. Gamma and A. Ribeiro, “Stability of Aggregation Graph Neural Networks”, (submitted to IEEE-TSPIN, under review). [2022][pdf]
6. **A. Parada-Mayorga**, L. Butler and A. Ribeiro, “Convolutional Filtering and Neural Networks with Non Commutative Algebras”, (submitted to IEEE-TSP, under review). [2022] [pdf]
7. **A. Parada-Mayorga**, H. Riess, A. Ribeiro and R. Ghrist, “Quiver Signal Processing (QSP)”, (<https://arxiv.org/abs/2010.11525>). [2021] [pdf]

### Journal papers

1. **A. Parada-Mayorga** and A. Ribeiro, “Algebraic Neural Networks: Stability to Deformations,” in IEEE Transactions on Signal Processing, vol. 69, pp. 3351-3366, doi: 10.1109/TSP.2021.3084537. [2021] [pdf]
2. D.L. Lau, G. R. Arce, **A. Parada-Mayorga**, D. Dapena, K. Pena-Pena, “Blue-Noise Sampling of Graph and Multigraph Signals”, Special Issue of the IEEE Signal Processing Magazine On Graph Signal Processing: Foundations and Emerging Directions. [2020][pdf]
3. **A. Parada-Mayorga**, D. Lau, Jhony H. Giraldo and G.R. Arce, “Blue-Noise Sampling on Graphs”. IEEE Transactions on Signal and Information Processing over Networks. [2019][pdf]
4. E. Salazar, **A. Parada-Mayorga** and G.R. Arce, “Spectral Zooming and Resolution Limits of Spatial Spectral Compressive Spectral Imagers”. IEEE Transactions on Computational Imaging. [2019][pdf]
5. **A. Parada-Mayorga** and G. R. Arce, “Colored Coded Aperture Design in Compressive Spectral Imaging via Minimum Coherence,” in IEEE Transactions on Computational Imaging, vol. 3, no. 2, pp. 202-216. doi: 10.1109/TCI.2017.2692649. [2017][pdf]
6. **A. Parada-Mayorga** and G.R. Arce, “Spectral Super-Resolution in Colored Coded Aperture Spectral Imaging,” in IEEE Transactions on Computational Imaging, vol. 2, no. 4, pp. 440-455. doi: 10.1109/TCI.2016.2612943. [2016][pdf]
7. Rueda, H. F, **Parada, A.**, & Arguello, H. “Spectral resolution enhancement of hyperspectral imagery by a multiple-aperture compressive optical imaging system”. Ingeniería e Investigación. <https://dx.doi.org/10.15446/ing.investig.v34n3.41675>. [2014] [pdf]

## Conference Papers

1. **A. Parada-Mayorga** and A. Ribeiro, “Stability of Algebraic Neural Networks to Small Perturbations”, ICASSP. [2021] [\[pdf\]](#)
2. **A. Parada-Mayorga**, L. Ruiz and A. Ribeiro, “ Graphon Pooling in Graph Neural Networks”, EUSIPCO. [2020][\[pdf\]](#)
3. **A. Parada-Mayorga**, D. Lau, J. Giraldo, G. Arce, “Blue-Noise Sampling of Signals on Graphs”, International Conference on Sampling Theory and Applications (SampTA), Bordeaux. [2019] [\[pdf\]](#)
4. **A. Parada-Mayorga**, D. Lau, J. Giraldo, G. Arce, “Sampling of Graph Signals with Blue Noise dithering”, IEEE data Science Workshop, Minneapolis, Minnesota. [2019][\[pdf\]](#)
5. D. Guillot, **A. Parada-Mayorga**, S. Cioaba, G. Arce, “Optimal Sampling Sets in Cographs”, IEEE data Science Workshop, Minneapolis, Minnesota. [2019][\[pdf\]](#)
6. E. Salazar, **A. Parada-Mayorga** and G.R. Arce, “Spectral zooming in SSCSI Compressive Spectral Imagers”. OSA Imaging and Applied Optics Congress. [2018][\[pdf\]](#)
7. E. Salazar, **A. Parada-Mayorga** and G.R. Arce, “Spatial Super-resolution reconstruction via SSCSI Compressive Spectral Imagers”. OSA Imaging and Applied Optics Congress. [2018] [\[pdf\]](#)
8. **A. Parada-Mayorga**, A. Cuadros and G.R. Arce, “Coded Aperture Design for Compressive X-ray Tomosynthesis via Coherence Analysis”. IEEE International Symposium on Biomedical Imaging. Melbourne, Australia. [2017] [\[pdf\]](#)
9. **A. Parada Mayorga**, G.R. Arce, “Spectral Super-Resolution in Colored Coded Aperture Spectral Imaging,” in Imaging and Applied Optics 2015, OSA Technical Digest (online) (Optical Society of America), paper CTh2E.2. [2015] [\[pdf\]](#)
10. H. Rueda, **A. Parada**, H. Arguello, Y. Wu, D. Prather, and G.R. Arce, “Demonstration of a Higher-Order Discretization Model for Compressive Spectral Imaging,” in Imaging and Applied Optics, OSA Technical Digest (online) (Optical Society of America), paper CM4C.4. [2013][\[pdf\]](#)
11. H. Arguello, **A. Parada**, G.R. Arce; “Optimization of pseudorandom coded apertures for compressive spectral imaging”. Proc. SPIE 8717, Compressive Sensing II, 87170D. [2013] [\[pdf\]](#)
12. **A. Parada-Mayorga** and A. Plata. “Fast Object Detection using Colour Segmentation”. ISSN: 2145-812X. *Tercer Congreso Internacional de Ingeniería Mecatrónica. Bucaramanga*. [2011] [\[pdf\]](#)
13. **A. Parada-Mayorga** and A. Plata. “A New Facial Point Detector using Active Appearance Models”. ISSN: 2145-812X. *Tercer Congreso Internacional de Ingeniería Mecatrónica. Bucaramanga*. [2011] [\[pdf\]](#)

## Master Thesis

- Dynamic Tracking of Facial Expressions using Digital Image Processing. Industrial University of Santander, 2012. [\[pdf\]](#)

## Bsc. Thesis

- Analysis of the Thermal Distribution in Iron by Eddy currents, using the Finite Element Method. Industrial University of Santander, 2009. [\[pdf\]](#)

## PROFESSIONAL SERVICE

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### Reviewer for the following Journals

- IEEE transactions on Image Processing

January 2018-Present

- IEEE transactions on Computational Imaging January 2018-Present
- IEEE Signal Processing Letters January 2019-present
- IEEE transactions on Signal Processing January 2019-present
- IEEE transactions of Signal and Information Processing over Networks January 2020-present

**Reviewer for the following conferences**

- 13th International conference on sampling theory and applications Bordeaux, France. 2019
- 26th European Signal Processing Conference EUSIPCO 2018 Rome, Italy. 2018

**LANGUAGES**

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- English: Full professional proficiency.
- Spanish: Native or bilingual proficiency.