Rodolfo Alexander Quintero Ospina

Postdoctoral Researcher

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Education

Lehigh University *Bethlehem, PA. USA*

Ph.D. Industrial and Systems Engineering Department (Operations Research) *Aug. 2019 - Aug. 2025*

- Thesis Title: Lagrangian and Penalty-Based Reformulations in Nonconvex Optimization: Tailoring Problems to Classical and Quantum Solvers. Download
- Advisors: Luis F. Zuluaga, Tamás Terlaky

Universidad de Los Andes *Bogotá, Colombia*

M.Sc. in Mathematics *Jan. 2014 - Dec. 2016*

- Thesis title: Aleksandrov-Fenchel inequality and intrinsic volumes
- Advisors: Jairo Andres Angel Cárdenas, Felipe Rincón

Universidad de Los Andes *Bogotá, Colombia*

B.Sc. in Mathematics *Jan. 2009 - May. 2013*

- Thesis title: Conjetura de Kneser y aplicaciones de la topología algebraica a combinatoria, 2013 (Kneser's Conjecture and applications of algebraic topology to combinatorics)
- Advisor: Jairo Andres Angel Cárdenas

Publications

1. Rodolfo Quintero, David Bernal, Tamás Terlaky, and Luis F Zuluaga. Characterization of qubo reformulations for the maximum k-colorable subgraph problem. *Quantum Information Processing*, 21(3):1–36, 2022. Download.
2. Rodolfo A Quintero and Luis F Zuluaga. Qubo formulations of combinatorial optimization problems for quantum computing devices. In *Encyclopedia of Optimization*, pages 1–13. Springer, 2022. Download

Submitted

1. Rodolfo Quintero, Juan Vera, Luis F. Zuluaga. Lagrangian Reformulation for Nonconvex Optimization: Tailoring Problems to Specialized Solvers Download.

In preparation

1. Rodolfo Quintero, Luis F. Zuluaga, Tamás Terlaky. Quantum-Aware Reformulations of Knapsack: Penalty Design and Lower Bounds on Auxiliary Variables. A preliminary version can be accessed here: Download.
2. Aida Khajavirad, Rodolfo Quintero, Mauricio Velasco. On the power of RLT and SoS hierarchies for unconstrained binary polynomial optimization.
3. Adrian Harkness, Akwum Onwunta, Rodolfo Quintero, and Tamás Terlaky. Quantum Approaches to Mixed Integer PDE-Constrained Optimization.
4. Rodolfo Quintero, Thinh Le, Vassilis Kekatos. Stochastic Gradient Descent for Variational Quantum Algorithms under Biased Gradient Estimation.

Employment History

- **Postdoctoral Researcher**. Purdue University. January 2026 - Present
- *Graduate Research Assistant*. Lehigh University. Bethlehem, PA. Fall 2019 - Winter 2025.
- **Internship - Graduate Research Assistant. Los Alamos National Laboratory**, Los Alamos, New Mexico. May 2023 - August 2023.
- *Instructor*. The Grad School, Bogota, Colombia. Fall 2015 - Spring 2019.
- *Lecturer*. Universidad de los Andes, Bogota. Fall 2015 - Spring 2016.
- *Graduate Teaching Assistant*. Universidad de los Andes, Bogota. 2014 - 2015 and 2016-2018.
- *Undergraduate Teaching Assistant*. Universidad de los Andes, Bogota. Fall, 2011 - Spring, 2012.

Honors & Awards

2024 **First place. Poster Competition,** Optimization Workshop: Theory, Algorithms, and Applications *Bogota, Colombia*

2023-2024 **2023 Rossin Professional Development Program,** P.C. Rossin College of Enginering *Lehigh University*

2019 - **Research Assistant fellowship,** P.C. Rossin College of Enginering *Lehigh University*

2008-2012 **Full Scholarship for undergraduate studies,** Mario Galan Gomez - The Colombian Petroleum Company *Bogota, Colombia.*

2008 **Academic excelence award: Best ICFES score - CALDAS,** Ministry of National Education *Bogota, Colombia.*

Further Professional Development and Academic Training

Professional Development

Future Business Analytics Professor *Iowa City, Iowa*

University of Iowa *August, 2025*

Invitation-only FutureBAProf workshop for advanced PhD students and postdoctoral researchers, focused on preparation for faculty careers in business analytics. Program topics included research and teaching in business schools, the academic job search, and professional networking. Participated in a three-minute research elevator pitch and structured faculty feedback sessions.

Preparing for the Professoriate *Bethlehem, Pennsylvania*

Lehigh University *Spring, 2024*

Overview of the job search, research program development, and service skills for graduate students entering academic careers. Transition from graduate student to faculty responsibilities, the post-doctoral experience, time management, CV/resume preparation, faculty search process, tenure and promotion, research leadership and program development, research proposal preparation, and research sponsorship.

Teaching and Presentation Skills *Bethlehem, Pennsylvania*

Lehigh University *Fall, 2023*

Development of teaching and presentation skills for scientific professionals. Worked on presentation effectiveness, teaching/presentation methodologies, classroom management, course development and content preparation, lecture/presentation development, and lecture/presentation delivery.

Quantum Computing

Qiskit Summer School *Online*

IBM *Summer, 2021*

Participated and attended actively a two week online summer school to learn and implement in Qiskit the basic concepts of Quantum Machine Learning and QAOA algorithms. Finished 100% of the exercise sessions.

Quantum Integer Programming course *Carnegie Mellon University*

Instructors: Sridhar Tayur. David Bernal *Fall, 2020*

Participated and attended actively during the online lectures to learn how to use tools from algebraic geometry and polyhedral theory to solve integer programs in Quantum Computers.

Qiskit Summer School

IBM *Summer, 2020*

Participated and attended actively a two week online summer school to learn and implement in Qiskit the basic concepts of Quantum Machine Learning and QAOA algorithms. Finished 100% of the exercise sessions.

Quantum Computing course *Lehigh University*

Instructor: Giacomo Nanicini *Spring, 2020*

Learned about basic principles of quantum computing, quantum algorithms, and quantum optimization.

Mathematics and Operations Research

MSRI-BIRS Graduate Summer School: Sums of Squares Method in Geometry, Combinatorics and Optimization *Kelowna, Canada*

Instructors: Greg Blekherman, Annie Raymond, Cynthia Vinzant *July 31 - August 12, 2022*

Actively participated in the three minicourses organized by the speakers in the Sums of Squares method applied to real algebraic varieties, graph density inequalities in combinatorics, and relaxations of convex hulls of theta bodies.

ECCO 2018-CIMPA Research school: Combinatorics meets Algebra, Geometry and Optimization *Universidad del Norte, Colombia*

Instructors: Vic Reiner, Rekha Thomas, Lauren Williams, Günter Ziegler *Summer, 2018*

Was one of the teaching assistants for the minicourse in polynomial optimization. Other relevant minicourses where I participated actively: Reflection groups and enumeration, and Polytopes: Extremal examples and combinatorial parameters.

ECCO 2016 - CIMPA Research School: Algebraic, Enumerative and Geometric Combinatorics *Universidad de Antioquia, Colombia*

Instructors: Marcelo Aguiar, Michelle L. Wachs, Francisco Santos, Sylvie Corteel *Summer, 2016*

Relevant minicourses: Enumeration of tableaux and plane partitions, Triangulations of polytopes and point configurations, Symmetric functions and Eulerian polynomials.

ECCO 2014: Cuarto Encuentro Colombiano de Combinatoria *Universidad de Los Andes, Colombia*

Instructors: Louis Billera, Richard Stanley, Sara Billey, Bruce Sagan *Summer, 2014*

Attended second week of minicourses: quasisymmetric functions, and partially ordered sets and their Möbius functions.

Teaching Experience

- *Lecturer*, Quantum Computing reading seminar. ECE department. Purdue University.
- *Lecturer*, Math preparation for general GRE and GMAT tests. *The Grad School* institute, Bogota, Colombia. Fall 2015 - Spring 2019.
- *Teaching Assistant* for the minicourse Polynomial Optimization at *ECCO 2018-CIMPA Research school: Combinatorics meets Algebra, Geometry and Optimization*. Universidad del Norte, Barranquilla. 2018.
- *Teaching Assistant*, Linear algebra. Universidad de los Andes, Bogota. 2014, 2015 and 2018.
- *Teaching Assistant*, Vector calculus. Universidad de los Andes, Bogota. 2015 and 2017.
- *Teaching Assistant*, Integral calculus and probability. Universidad de los Andes, Bogota. Fall 2016 and Spring 2017.
- *Lecturer*, Calculus III. Universidad de los Andes, Bogota. Spring, 2016.
- *Lecturer*, Differential Calculus. Universidad de los Andes, Bogota. Fall, 2015.
- *Undergrad teaching practice*, Linear algebra. Universidad de los Andes, Bogota. Fall, 2011 - Spring, 2012.

Technical Skills and Language Proficiency

Programming Languages Python, Matlab, Julia
Software AMPL, JuMP, Qiskit
Spoken Languages English, Spanish, Portuguese (Conversational)

Academic Service

Active Academic Memberships

- American Mathematical Society (AMS).
- The Institute for Operations Research and the Management Sciences (INFORMS).
- Society for Industrial and Applied Mathematics (SIAM).

Conferences Organization

2024 **Session Organizer,** ISMP 2024, Quantum Computing II *Montreal, Canada*
2023 **Session Organizer,** INFORMS 2023 *Phoenix, Arizona*

Refereeing/Reviewing Service

- Reviewer for The First ACM/IEEE International Workshop on Quantum Computing.
- Reviewer for the *European Journal of Operational Research.*
- Reviewer for *Frontiers in Computer Science.*
- Reviewer for *Discrete Optimization*.
- Reviewer for *Quantum Science and Technology.*
- Reviewer for *ACM Transactions on Quantum Computing*.
- Reviewer for *Optimization and Engineering*.
- Reviewer for *Journal of Optimization Theory and Applications*.

Student Associations

2020-2022 **Secretary,** INFORMS Student Chapter at Lehigh University *Lehigh University*

Talks, Posters and Presentations

Process Systems Engineering Seminar — *Purdue University*

Presenter — *April, 2026*

Presented the talk titled: *The Hidden Cost of Feasibility: Penalty Methods vs. Constraint-Preserving Mixers in Quantum Optimization.*

Optimization Workshop: Theory, Algorithms, and Applications — *Bogota, Colombia*

Presenter — *December, 2024*

Presented the talk titled: *Lagrangian Reformulation for Nonconvex Optimization: Tailoring Problems to Specialized Solvers*

2024 SIAM NNP Section Conference — *Rochester, NY*

Presenter — *November, 2024*

Presented the talk titled: *Lagrangian Reformulation for Nonconvex Optimization: Tailoring Problems to Specialized Solvers*

INFORMS Annual meeting 2024 — *Seattle, Washington*

Presenter — *October, 2024*

Presented the talk titled: *Lagrangian Reformulation for Nonconvex Optimization: Tailoring Problems to Specialized Solvers*

Workshop: Introducción a la optimización en computación cuántica — *Bogota, Colombia*

Presenter — *November, 2023*

Gave a lecture titled *Introduction to Quantum Optimization* for the operations research community at Universidad de La Sabana, Colombia.

INFORMS Annual meeting 2023 — *Phoenix, Arizona*

Session chair and Presenter — *October, 2023*

Organized session: *Quantum Optimization III* and presented the talk titled: *Polyhedral Structure of Penalty Constants in Quadratic Unconstrained Binary Optimization and Applications to Quantum Computing*

EURopt 2023 — *Budapest, Hungary*

Session chair and Presenter — *August, 2023*

Organized session: *Quantum Computing and Optimization V* and presented the talk titled: *Polyhedral Structure of Penalty Constants in Quadratic Unconstrained Binary Optimization and Applications to Quantum Computing*

SIAM Conference on Optimization (OP23) — *Seattle, WA*

Session chair and Presenter — *June, 2023*

Chaired session: *Theoretical Advances in Nonlinear Optimization* and presented the talk: *Lagrangian Duality In Nonconvex Optimization*

APS March Meeting 2023 — *Las Vegas, NV*

Presenter — *March, 2023*

Presented the talk: *Polyhedral Structure of Penalty Constants in Quadratic Unconstrained Binary Optimization and Applications to Quantum Computing*

INFORMS Annual meeting 2022 — *Indianapolis, Indiana*

Session chair and Presenter — *October, 2022*

Organized session: *Linear and Conic Optimization/Quantum Optimization* and presented a flash talk titled: *Polyhedral Structure of Exact Penalty Constants in Quadratic Unconstrained Binary Optimisation*

International Conference on Continuous Optimization ICCOPT — *Bethlehem, PA*

Invited Talk — *July, 2022*

Characterizing QUBO Reformulations of the Knapsack Problem and General Integer Programs

Combinatorial, Computational, and Applied Algebraic Geometry — *Seattle, WA*

Poster — *June 27-July 1, 2022*

Characterizing QUBO Reformulations of the Knapsack Problem and Applications to Quantum Computing

SIAM Conference on Discrete Mathematics — *Pittsburgh, PA*

Session chair and Presenter — *June 14-16, 2022*

Characterizing QUBO Reformulations of the Knapsack Problem and General Integer Programs

INFORMS Optimization Society Conference (IOS) — *Greenville, SC*

Session chair - Presenter — *March, 2022*

Characterizing and Benchmarking QUBO Reformulations of the Knapsack Problem

INFORMS Annual meeting — *Online*

Invited Talk — *October, 2021*

Characterization of QUBO reformulations for the maximum k-colorable subgraph problem

IFORS 2021 — *Online*

Contributed Talk — *August, 2021*

Characterization of QUBO reformulations for the maximum k-colorable subgraph problem

The Quantum Consortium QED-C Poster Session *Online*

Invited Talk *August, 2021*

Characterization of QUBO reformulations for the maximum k-colorable subgraph problem

Modeling and Optimization: Theory and Applications (MOPTA) *Bethlehem, PA*

Invited Talk *August, 2021*

Characterization of QUBO reformulations for the maximum k-colorable subgraph problem

CORS 2021 Annual Meeting *Online*

Contributed talk *June, 2021*

Characterization of QUBO reformulations for the maximum k-colorable subgraph problem and Quantum Computing

The 6th International Conference for Young Quantum Information Scientists *Online*

Poster Presentation *April, 2021*

Characterization of QUBO reformulations for the maximum k-colorable subgraph problem and Quantum Computing

INFORMS Annual meeting *Online*

Invited Talk *Nov, 2020*

Qubo Formulations Of The Stable Set Problem: Towards Their Implementation In Quantum Adiabatic Computers

International workshop: Random Models with applications in the natural sciences *Universidad de los Andes, Colombia*

Invited Talk *December 2017*

Young Sciencists Afternoon

References

- **Luis F. Zuluaga**, Associate Professor, Lehigh University. Contact: luz212@lehigh.edu
- **Tamás Terlaky**, Professor, Lehigh University. Contact: tat208@lehigh.edu
- **Juan C. Vera**, Full Professor, Tilburg University. Contact: j.C.VeraLizcano@tilburguniversity.edu
- **David E. Bernal**, Assistant Professor, Purdue University. Contact: dbernaln@purdue.edu