

# Rodolfo Alexander Quintero Ospina

PH.D. CANDIDATE · RESEARCH ASSISTANT

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## Education

### Lehigh University

PH.D. INDUSTRIAL AND SYSTEMS ENGINEERING DEPARTMENT (OPERATIONS RESEARCH)

Bethlehem, PA. USA

Aug. 2019 - Fall 2024 (Expected)

- Thesis Title: Lagrangian Reformulation for Nonconvex Optimization and Applications to Quantum Computing
- Advisors: Luis F. Zuluaga, Tamás Terlaky

### Universidad de Los Andes

M.SC. IN MATHEMATICS

Bogotá, Colombia

Jan. 2014 - Dec. 2016

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

### Universidad de Los Andes

B.SC. IN MATHEMATICS

Bogotá, Colombia

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](#)

### IN PREPARATION

1. Rodolfo A Quintero and Luis F Zuluaga. Characterizing and benchmarking qubo reformulations of the knapsack problem. Technical report, Lehigh University, 2022. [Download](#).
2. Rodolfo Quintero, Juan Vera, Luis F. Zuluaga. Lagrangian Reformulation for Nonconvex Optimization: Tailoring Problems to Specialized Solvers.
3. Rodolfo Quintero, Juan Vera, Luis F. Zuluaga. Polyhedral Structure of Penalty Constants in Quadratic Unconstrained Binary Optimization and Applications to Quantum Computing.
4. Aida Khajavirad, Rodolfo Quintero, Mauricio Velasco. On the power of RLT and SoS hierarchies for unconstrained binary polynomial optimization

## Employment History

- *Graduate Research Assistant*. Lehigh University. Bethlehem, PA. 2019-Present.
- **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

2023-2024 **2023 Rossin Professional Development Program**, P.C. Rossin College of Engineering

Lehigh University

2019 - **Research Assistant fellowship**, P.C. Rossin College of Engineering

Lehigh University

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

Bogota, Colombia.

2008 **Academic excellence award: Best ICFES score - CALDAS**, Ministry of National Education

Bogota, Colombia.

## Further Academic Training

### QUANTUM COMPUTING

## Qiskit Summer School

IBM

Online

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

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

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

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

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*, 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

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

# Academic Service

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## 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  
2023 **Session Organizer**, INFORMS 2023

Montreal, Canada  
Phoenix, Arizona

## REFEREING/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 *Quantum Science and Technology*.

## STUDENT ASSOCIATIONS

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

Lehigh University

# Talks, Posters and Presentations

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## 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

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

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)**

SESSION CHAIR - PRESENTER

Characterizing and Benchmarking QUBO Reformulations of the Knapsack Problem

Greenville, SC

March, 2022

## **INFORMS Annual meeting**

INVITED TALK

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

Online

October, 2021

## **IFORS 2021**

CONTRIBUTED TALK

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

Online

August, 2021

## **The Quantum Consortium QED-C Poster Session**

INVITED TALK

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

Online

August, 2021

## **Modeling and Optimization: Theory and Applications (MOPTA)**

INVITED TALK

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

Bethlehem, PA

August, 2021

## **CORS 2021 Annual Meeting**

CONTRIBUTED TALK

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

Online

June, 2021

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

POSTER PRESENTATION

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

Online

April, 2021

## **INFORMS Annual meeting**

INVITED TALK

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

Online

Nov, 2020

## **International workshop: Random Models with applications in the natural sciences**

Universidad de los Andes, Colombia

INVITED TALK

Young Sciencists Afternoon

December 2017