

Gonzalo Muñoz

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Profile

I am currently an assistant professor of the Department of Industrial Engineering at Universidad de Chile. Before joining Universidad de Chile, I was an assistant professor at the Institute of Engineering Sciences at Universidad de O'Higgins. I obtained my Ph.D. degree in October 2017 from the Industrial Engineering and Operations Research Department at Columbia University.

My main interests include the theory and development of optimization algorithms for Mixed Integer Non-linear Optimization. I have worked on general optimization methodologies and computational techniques tailored to Power Grid operations and Mining scheduling problems. Other topics I am interested in are polyhedral theory and the application of non-linear programming to data-driven optimization problems.

Academic and research experience

Assistant Professor

[2024 - current]

Industrial Engineering Department, Universidad de Chile

Researcher

[2023 - current]

Institute of Complex Systems in Engineering (ISCI)

Program Director

[2021 - 2023]

Computer Engineering, School of Engineering, Universidad de O'Higgins

Assistant Professor

[2019 - 2024]

Institute of Engineering Sciences, Universidad de O'Higgins

Post-Doctoral Fellow

[2018 - 2019]

IVADO Institute, Polytechnique Montréal, Canada

Research Scientist Intern

[2016]

Three-month research internship conducted at Amazon.com in the Modeling and Optimization Team.

Research Assistant

[2010 - 2012]

Anillo ACT-88 project: "Mathematical Modeling for Industrial and Management Science Applications: An Interdisciplinary Approach," Adolfo Ibáñez University.

Research Assistant

[2009]

FONDEF-D06I1031 project: "Complex Systems, Evolutionary Computation, and Mine Scheduling Applications," Adolfo Ibáñez University.

Education

Ph.D. in Industrial Engineering and Operations Research [2013 – 2017]

IEOR Department, Columbia University

Master of Science [2012 – 2013]

IEOR Department, Columbia University

Mathematical Engineering [2005 – 2012]

School of Mathematics and Physics Sciences, University of Chile

Research projects

Fondecyt - Regular, Principal investigator [2023 - 2026]

"Strong and efficient approximations in quadratically constrained optimization," Mathematics Study Group.

Universidad de O'Higgins - Multidisciplinary Project, Co-investigator [2021 - 2023]

"Smart management of water resources for agriculture" (original name in Spanish: "Gestión Inteligente de Recursos Hídricos para la Agricultura")

Fondef - IDeA I+D, Researcher [2021 - 2023]

"Integral mine planning system subject to geometallurgical uncertainty" (original name in Spanish: "Sistema integral de planificación minera sujeto a incertidumbre geometalúrgica")

Fondecyt - Initiation, Principal investigator [2019 - 2022]

"Extended formulations and computational techniques for polynomial optimization," Mathematics Study Group.

Fondef - IDeA I+D, Researcher [2019 - 2021]

"Alicanto Scheduler: Optimization in project management for underground mining planning" (original name in Spanish: "Alicanto Scheduler: Optimización en gestión de proyectos para planificación minera subterránea")

Other research funding

IVADO Post-doctoral Fellowship [2017 - 2019]

2-year post-doctoral fellowship from the Institute for Data Valorization, Montréal, Canada.

Becas Chile Fellowship [2012 - 2016]

4-year fellowship from the Science and Technology National Commission of Chile for PhDs abroad. Selected in first place among more than 580 applicants

Honors and distinctions

Mathematical Programming 2023 Meritorious Service Award [2024]

Recognition for referees who have demonstrated exceptional diligence in their service to the journal

IOS Young Researchers Prize [2023]

INFORMS Optimization Society "Young Researchers Prize" with paper "Maximal Quadratic-Free Sets"

Mixed-Integer Non-Linear Programming Workshop [2021]

Imperial College London (Online). Plenary Talk

Mixed-Integer Programming Workshop

[2019]

MIT, Boston. Invited Talk

MIP Best Poster Award

[2017]

"Best Poster" Award of the Mixed Integer Programming Workshop with poster "Outer-Product-Free Sets for Polynomial Optimization and Oracle-based Cuts"

IOS Student Paper Prize

[2016]

INFORMS Optimization Society "Student Paper Prize" with paper "LP formulations for Mixed-Integer Polynomial Optimization Problems"

MIP Best Poster Award

[2015]

"Best Poster" Award of the Mixed Integer Programming Workshop with poster "On Optimization Problems with bounded Tree-width"

INFORMS Best Paper in Sponsored Sessions Award

[2011]

"Best Paper in Sponsored Sessions" Award of the Mining Section at the INFORMS 2011 National Meeting

Journal publications

- Bolusani S., Besançon M., Gleixner A., Berthold T., D'Ambrosio C., **Muñoz G.**, Paat J., and Thomopoulos D. "**The MIP Workshop 2023 Computational Competition on Reoptimization.**" Mathematical Programming Computation, 2024.
- Chmiela A., **Muñoz G.** and Serrano F. "**Monoidal strengthening and unique lifting in MIQCPs.**" Mathematical Programming, 2024.
- **Muñoz G.**, Salas D. and Svensson A. "**Exploiting the polyhedral geometry of stochastic linear bilevel programming.**" Mathematical Programming, 2024.
- **Muñoz G.**, Paat J. and Xavier Á. "**Compressing branch-and-bound trees.**" Mathematical Programming, 2024.
- **Muñoz G.**, Paat J. and Serrano F. "**A characterization of maximal homogeneous-quadratic-free sets.**" Mathematical Programming, 2024.
- Bienstock D., **Muñoz G.**, and Pokutta S. "**Principled Deep Neural Network Training through Linear Programming.**" Discrete Optimization, 2023.
- Dey S., Kazachkov A., Lodi A., and **Muñoz G.** "**Cutting plane generation through sparse principal component analysis.**" SIAM Journal on Optimization, 2022.
- Dey S., **Muñoz G.** and Serrano F. "**On obtaining the convex hull of quadratic inequalities via aggregations.**" SIAM Journal on Optimization, 2022.
- Chmiela A., **Muñoz G.** and Serrano F. "**On the implementation and strengthening of intersection cuts for QCQPs.**" Mathematical Programming, 2022.
- Barrera J., Moreno E. and **Muñoz G.** "**Convex Envelopes for Ray-Concave Functions.**" Optimization Letters, 2022.
- Barrera J., Moreno E., **Muñoz G.**, and Romero P. "**Exact reliability optimization for series-parallel graphs using convex envelopes.**" Networks, 2022.
- **Muñoz G.** and Serrano F. "**Maximal Quadratic-free Sets**". Mathematical Programming, 2021.

- Müller B., **Muñoz G.**, Gasse M., Gleixner A., Lodi A., and Serrano F. **“On Generalized Surrogate Duality in Mixed-Integer Non-Linear Programming.”** Mathematical Programming, 2021.
- Faenza Y., **Muñoz G.**, and Pokutta S. **“New Limits of Treewidth-based tractability in Optimization.”** Mathematical Programming, 2020.
- Rivera O., Espinoza D., Goycoolea M., Moreno E., and **Muñoz G.** **“Production scheduling for strategic open pit mine planning: A mixed-integer programming approach.”** Operations Research, 2020.
- Bienstock D., Chen C., and **Muñoz G.** **“Outer-Product-Free Sets for Polynomial Optimization and Oracle-based Cuts”.** Mathematical Programming, 2020.
- Bienstock D. and **Muñoz G.** **“LP formulations for polynomial optimization problems”.** SIAM Journal on Optimization, 2018.
- **Muñoz G.**, Espinoza D., Goycoolea M., Moreno E., Queyranne M., and Rivera O. **“A study of the Bienstock-Zuckerberg algorithm, Applications in Mining and Resource Constrained Project Scheduling”.** Computational Optimization and Applications, 2018.

Conference proceedings

- **Muñoz G.**, Paat J., and Serrano F. **“Towards a characterization of maximal quadratic-free sets.”** Integer Programming and Combinatorial Optimization. IPCO 2023. Lecture Notes in Computer Science.
- **Muñoz G.**, Salas D., and Svensson A. **“Exploiting the polyhedral geometry of stochastic linear bilevel programming.”** Integer Programming and Combinatorial Optimization. IPCO 2023. Lecture Notes in Computer Science.
- **Muñoz G.**, Paat J. and Xavier Á. **“Compressing Branch-and-Bound Trees.”** Integer Programming and Combinatorial Optimization. IPCO 2023. Lecture Notes in Computer Science.
- Chmiela A., **Muñoz G.** and Serrano F. **“Monoidal strengthening and unique lifting in MIQCPs.”** Integer Programming and Combinatorial Optimization. IPCO 2023. Lecture Notes in Computer Science.
- Chmiela A., **Muñoz G.** and Serrano F. **“On the implementation and strengthening of intersection cuts for QCQPs.”** Integer Programming and Combinatorial Optimization. IPCO 2021. Lecture Notes in Computer Science.
- **Muñoz G.** and Serrano F. **“Maximal Quadratic-free Sets”.** Integer Programming and Combinatorial Optimization. IPCO 2020. Lecture Notes in Computer Science.
- Müller B., **Muñoz G.**, Gasse M., Gleixner A., Lodi A. and Serrano F. **“On Generalized Surrogate Duality in Mixed-Integer Nonlinear Programming.”** Integer Programming and Combinatorial Optimization. IPCO 2020. Lecture Notes in Computer Science.
- Bienstock D., Chen C. and **Muñoz G.** **“Intersection Cuts for Polynomial Optimization”.** Integer Programming and Combinatorial Optimization. IPCO 2019. Lecture Notes in Computer Science.
- Mena G., Belanger D., **Muñoz G.**, and Snoek J. **“Sinkhorn Networks: Using Optimal Transport Techniques to Learn Permutations.”** NIPS Workshop in Optimal Transport and Machine Learning, 2017.
- Matke C., Bienstock D., **Muñoz G.**, Yang S., Kleinhans D., and Sager S. **“Robust optimization of power network operation: storage devices and the role of forecast errors in renewable energies.”** Complex Networks & Their Applications V. Studies in Computational Intelligence, 2017.
- Bienstock D. and **Muñoz G.** **“Approximate method for AC transmission switching based on a simple relaxation for AC-OPF problems.”** Power & Energy Society General Meeting, IEEE, 2015.

- Espinoza D., Goycoolea M., Moreno E., **Muñoz G.**, and Queyranne M. **“Open Pit Mine Scheduling under Uncertainty: a robust approach.”** Proceedings of APCOM, 2013.

Theses

- **“Integer Programming Techniques for Polynomial Optimization.”** Ph.D. Thesis. Columbia University Academic Commons, 2017.
- **“Linear Integer Programming Models and Applications to Mining.”** Engineering Degree Thesis. Academic Repository of University of Chile, 2012.

Teaching

- **Modeling and Optimization.** Industrial Engineering Department, Universidad de Chile. Fall 2024.
- **Optimization.** School of Engineering, Universidad de O’Higgins. Spring 2019, Fall 2020, Spring 2020, Spring 2021.
- **Linear Algebra.** School of Engineering, Universidad de O’Higgins. Spring 2019, Spring 2020.
- **Introduction to Discrete Mathematics.** School of Engineering, Universidad de O’Higgins. Fall 2020, Fall 2021
- **Differential Equations.** School of Engineering, Universidad de O’Higgins. Fall 2021.
- **Theory of Computation.** School of Engineering, Universidad de O’Higgins. Spring 2021, Spring 2022.
- **Theory of Algorithms.** School of Engineering, Universidad de O’Higgins. Fall 2022.
- **Discrete Mathematics.** School of Engineering, Universidad de O’Higgins. Fall 2022, Fall 2023.
- **Advanced Optimization Methods.** M.Sc. in Engineering Sciences, Universidad de O’Higgins. Spring 2022

Student Advising

Master Thesis

- Fabián Badilla, Ms. in Applied Mathematics, U. de Chile **[2023]**
- Sophia Calderón, Ms. in Engineering Sciences, U. de O’Higgins **[2023 - 2024]**
- Pablo Carrasco, Ms. in Engineering Sciences, U. de O’Higgins **[2023 - 2024]**

Undergraduate Thesis

- Álvaro Morales, Computer Engineering, U. de Chile **[2024]**
- Diego Valdés, Computer Engineering, U. de O’Higgins **[2022]**
- Orlando Cavieres, Computer Engineering, U. de O’Higgins **[2022]**

Academic Service

Editorial Service

Associate Editor Discrete Optimization Journal	[2023 – current]
Associate Editor Optimization Letters Journal	[2023 – current]
Guest Editor Frontiers in Applied Mathematics and Statistics Special Issue	[2022 – 2023]
Technical Editor Mathematical Programming Computations Journal	[2015 – 2018]

Societies

COMIPS Chair [2024 – 2025]

Committee of the Mixed-Integer Programming Society

COMIPS Member [2023 – 2024]

Committee of the Mixed-Integer Programming Society

Events

Scientific Committee Member [2023 – 2024]

25th International Symposium of Mathematical Programming, Montréal, Canada, 2024

Program Committee Member [2023 – 2024]

INFORMS Optimization Society Conference, Houston, TX, USA, 2024

Organizing Committee Member [2023]

Discrete Mathematics Summer School, Valparaíso, Chile, 2024

Program Committee Member [2023]

25th Conference on Integer Programming and Combinatorial Optimization, Wrocław, Poland, 2024

Program Committee Chair [2022 – 2023]

2023 Mixed-Integer Programming Workshop 2023, Los Angeles, CA, USA

Workshop Chair [2022]

Workshop on Data Science for Real-Time Decision-Making, Montréal, Canada

Workshop Chair [2022]

Workshop in Optimization and Algorithms, Codegua, Chile

Organizing Committee [2021]

Workshop in Optimization and Algorithms, Viña del Mar, Chile

Program Committee Member [2021]

23rd Conference on Integer Programming and Combinatorial Optimization, Eindhoven, The Netherlands

Program Committee Member [2021 – 2022]

2022 Mixed-Integer Programming Workshop 2022, New Brunswick, NJ, USA

Competitions

Jury Member [2024]

2024 Xpress Best Paper Award

Research Prize Committee Member [2024]

INFORMS Undergraduate Research Prize

Jury Member [2023]

Poster Competition of the 24th Conference on Integer Programming and Combinatorial Optimization

Jury Member [2023]

2023 Xpress Best Paper Award

Computational Competition Committee Member [2022 – 2023]

2023 Mixed-Integer Programming Workshop 2023, Los Angeles, CA, USA

Jury Member [2021]

2021 INFORMS Computing Society Student Paper Award

Computational Competition Committee Chair [2021 – 2022]

2022 Mixed-Integer Programming Workshop 2022, New Brunswick, NJ, USA