Gonzalo Muñoz

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Profile

I am currently an assistant professor at the Institute of Engineering Sciences at Universidad de O'Higgins. Before joining this university, I was an IVADO Post-doctoral Fellow at Polytechnique Montréal. 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.

Journal publications

- 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, 68(5),

1425-1444, 2020.

- Bienstock D., Chen C., and **Muñoz G.** *"Outer-Product-Free Sets for Polynomial Optimization and Oracle-based Cuts"*. Mathematical Programming, 183, 105-148, 2020.

- Bienstock D. and **Muñoz G.** *"LP formulations for polynomial optimization problems"*. SIAM Journal on Optimization 28 (2), pp. 1121-1150, 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, 69 (2), pp. 501-534, 2018.

Conference proceedings

- 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, vol 12125

- 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, vol 12125.

- Bienstock D., Chen C. and **Muñoz G**. *"Intersection Cuts for Polynomial Optimization"*. Integer Programming and Combinatorial Optimization. IPCO 2019. Lecture Notes in Computer Science, vol 11480

- 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, vol 693, pp. 809-820, 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 pp. 1-5, July 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, pp. 433-444. 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.

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.

1ˢᵗ place in "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

Academic awards

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

Education

Industrial Engineering and Operations Research Ph.D.   **[2012 – 2017]**

IEOR Department, Columbia University

Master of Science   **[2012]**

IEOR Department, Columbia University

Mathematical Engineering   **[2007 – 2012]**

School of Mathematics and Physics Sciences, University of Chile

Bachelor in Sciences of Engineering   **[2005 – 2007]**

School of Mathematics and Physics Sciences, University of Chile

Work and research experience

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.

Additional Information

Languages: Native Spanish and fluent English.

Programming Skills: Experienced in different programming languages such as Java, C/C++, MATLAB, and Python.

Extensive experience in Optimization tools such as CPLEX, Gurobi, SCIP, and XPRESS, including their interfaces with C/C++, Python, and Java.