

# Enrique Otárola

*Mathematical Engineer & Doctor  
of Philosophy (Ph.D)*

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## Professional Experience

- 2016 - **Assistant Professor**, *Departamento de Matemática, Universidad Técnica Federico Santa María, Valparaíso, Chile.*
- 2015 **Faculty Research Associate (postdoc)**, *supported by CONICYT through FONDECYT project 3160201, Universidad Técnica Federico Santa María, Valparaíso, Chile.*
- 2015 **Faculty Research Associate (postdoc)**, *supported by CONICYT through Anillo ACT-1106, Universidad Técnica Federico Santa María, Valparaíso, Chile.*
- 2014 - 2015 **Faculty Research Associate (postdoc)**, *University of Maryland, College Park and George Mason University, Fairfax.*

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## Education

- 2009 - 2014 **Doctor of Philosophy (Ph.D), Applied Mathematics and Scientific Computing**, *University of Maryland, College Park, USA.*  
Thesis: A PDE approach to numerical fractional diffusion; Advisor: Ricardo Nochetto.
- 2009 - 2012 **Master of Science (MS), Applied Mathematics and Scientific Computing**, *University of Maryland, College Park, USA.*  
Thesis: A FEM for the square root of the Laplace operator; Advisor: Ricardo Nochetto.
- 2001 - 2007 **Ingeniero Civil Matemático**, *Universidad Técnica Federico Santa María, Chile.*  
Thesis: Control activo de estructuras delgadas; Advisor: Erwin Hernández
- 2001 - 2005 **Licenciado en Ciencias de la Ingeniería Matemática**, *Universidad Técnica Federico Santa María, Chile.*

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## Awards and Distinctions

- 2018 **Fondecyt Iniciación grant**, the proposed project ranked second in the category *Mathematics*.
- 2017 **Highly Cited Paper**, *A PDE approach to fractional diffusion on general domains* has received enough citations to place it in the top 1% of the academic field of Mathematics.
- 2015 **Fondecyt Postdoctorado grant**, the proposed project ranked first in the category *Mathematics*.
- 2012 - 2013 **Mark E. Lachtman Graduate Student Award**, *recognition for outstanding academic accomplishments*, Department of Mathematics, University of Maryland, College Park.
- 2012 **John E. Osborn Fellowship**, *recognition for outstanding academic accomplishments*, Department of Mathematics, University of Maryland, College Park.
- 2012 **Kaplan Travel Grant**, *Department of Mathematics, University of Maryland, College Park.*
- 2009 - 2013 **Conicyt-Fulbright Fellowship**, *Beca de Doctorado Igualdad de Oportunidades, Chile.*
- 2007 **Distinguished son of Vallenar**, *recognition for outstanding achievement academics*, Chile.
- 2001 - 2006 **Juan Gómez Millas Fellowship**, *Ministry of education, Chile.*

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## Grants

- 2019 **USM grant**, *Modelación y aproximación numérica de sistema evolutivos basados en la concentración de CO<sub>2</sub> en alimentos envasados.*
- 2018 **Fondecyt Iniciación grant**, *Numerical analysis of problems involving fractional PDEs and nonsmooth solutions.*
- 2015 **Fondecyt Postdoctorado grant**, *Numerical fractional diffusion: A PDE approach, integral formulation, extensions, and applications.*

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## Articles

Publications available at <http://eotarola.mat.utsfm.cl/>

- 49. J. GUZMÁN, **E. Otárola**, A. J. SALGADO, Fluids on convex polyhedra, in preparation, 2020.
- 48. A. ALLENDES, F. FUICA, **E. Otárola**, D. QUERO, A posteriori error estimates for PDE-constrained optimization, in preparation, 2020.
- 47. A. ALLENDES, **E. Otárola**, A. J. SALGADO, A posteriori error estimates for the stationary Navier Stokes equations with Dirac measures, submitted, arXiv:1910.05122, 2019.
- 46. F. FUICA, F. LEPE, **E. Otárola**, D. QUERO, A posteriori error estimates in  $\mathbf{W}^{1,p} \times L^p$  spaces for the Stokes system with Dirac measures, submitted, 2019.
- 45. F. FUICA, **E. Otárola**, D. QUERO, Error estimates for optimal control problems of the Stokes system with Dirac measures, submitted, arXiv:1907.11096, 2019.
- 44. C. GLUSA, **E. Otárola**, Optimal control of a parabolic fractional PDE: analysis and discretization, submitted, arXiv:1905.10002, 2019.
- 43. R. DURÁN, **E. Otárola**, A.J. SALGADO, Stability of the Stokes projection on weighted spaces and applications, submitted, arXiv:1905.00476, 2019.
- 42. A. ALLENDES, C. NARANJO, **E. Otárola**, Stabilized finite element approximation for a generalized Boussinesq problem: a posteriori error analysis, **Computer Methods in Applied Mechanics and Engineering**, 2019 (accepted for publication).
- 41. **E. Otárola**, An adaptive finite element method for the sparse optimal control of fractional diffusion, **Numerical Methods for Partial Differential Equations**, 2019 (accepted for publication).
- 40. **E. Otárola**, A.J. SALGADO, A weighted setting for the stationary Navier Stokes equations under singular forcing, **Applied Mathematics Letters**, 99, Article 105933, 2020.
- 39. A. ALLENDES, F. FUICA, **E. Otárola**, Adaptive finite element methods for sparse PDE-constrained optimization, **IMA Journal on Numerical Analysis**, 2019. DOI: <https://doi.org/10.1093/imanum/drz025>
- 38. A. ALLENDES, F. FUICA, **E. Otárola**, D. QUERO, An adaptive FEM for the pointwise tracking optimal control problem of the Stokes equations, **SIAM Journal on Scientific Computing**, 41(5), A2967–A2998, 2019.
- 37. M. D’ELIA, C. GLUSA, **E. Otárola**, A priori error estimates for the optimal control of the integral fractional laplacian, **SIAM Journal on Control and Optimization**, 57(4), 2775–2798, 2019.
- 36. L. BANJAI, J. M. MELENK, R. H. NOCHETTO, **E. Otárola**, A. J. SALGADO AND C. SCHWAB, Tensor FEM for spectral fractional diffusion, **Foundations of Computational Mathematics**, 19(4), 901–962, 2019.
- 35. L. BANJAI, **E. Otárola**, A PDE approach to fractional diffusion: a space-fractional wave equation, **Numerische Mathematik**, 143(1), 177–222, 2019.

34. **E. Otárola**, A.J. SALGADO, R. RANKIN, Maximum–norm a posteriori error estimates for an optimal control problem, **Computational Optimization and Applications**, 73(3), 997–1017, 2019.
33. F. FUICA, **E. Otárola**, A.J. SALGADO, An a posteriori error analysis of an elliptic optimal control problem in measure space, **Computer and Mathematics with Applications**, 77(1), 2659–2675, 2019.
32. **E. Otárola**, T.N.T. QUYEN, A reaction coefficient identification problem for fractional diffusion, **Inverse Problems**, 35(4), 045019, 2019.
31. A. ALLENDES, **E. Otárola**, A.J. SALGADO, A posteriori error estimates for the Stokes problem with singular sources, **Computer Methods in Applied Mechanics and Engineering**, 345, 1007–1032, 2019.
30. **E. Otárola**, A.J. SALGADO, The Poisson and Stokes problems on weighted spaces in Lipschitz domains and under singular forcing, **Journal of Mathematical Analysis and Applications**, 471(1–2), 599–612, 2019.
29. **E. Otárola**, A.J. SALGADO, Regularity of solutions to space–time fractional wave equations: A PDE approach, **Fractional Calculus and Applied Analysis**, 21(5), 1262–1290, 2018.
28. A. Bonito, J.P. Borthagaray, R.H. Nochetto, **E. Otárola**, A.J. SALGADO, Numerical methods for fractional diffusion, **Computing and Visualization in Science**, 19(5–6), 19–46, 2018.
27. A. ALLENDES, **E. Otárola**, A.J. SALGADO, R. RANKIN, An a posteriori error analysis for an optimal control problem with Dirac measures, **ESAIM: Mathematical Modelling and Numerical Analysis**, 52(5), 1617–1650, 2018.
26. **E. Otárola**, A.J. SALGADO, Optimization of a fractional differential equation, **The IMA Volumes in Mathematics and its Applications**, 2018.
25. H. ANTIL, **E. Otárola**, A.J. SALGADO, Optimization with respect to order in a fractional diffusion model: analysis and approximation, **Journal of Scientific Computing**, 77(1), 204–224, 2018.
24. A. ALLENDES, **E. Otárola**, R. RANKIN, A posteriori error estimation for finite element approximations of a PDE–constrained optimization problem involving the generalized Oseen equations, **SIAM Journal on Scientific Computing**, 40(4), AA2200–AA2233, 2018.
23. A. ALLENDES, **E. Otárola**, R. RANKIN, A posteriori error estimators for stabilized finite element approximations of an optimal control problem, **Computer Methods in Applied Mechanics and Engineering**, 340(1), 147–177, 2018.
22. H. ANTIL, **E. Otárola**, A.J. SALGADO, Some applications of weighted norm inequalities to the analysis of optimal control problems, **IMA Journal on Numerical Analysis**, 38(2), 852–883, 2018.
21. H. ANTIL, **E. Otárola**, An a posteriori error analysis for an optimal control problem involving the fractional Laplacian, **IMA Journal on Numerical Analysis**, 38(1), 198–226, 2018.
20. **E. Otárola**, A.J. SALGADO, Sparse optimal control for fractional diffusion, **Computational Methods in Applied Mathematics**, 18(1), 95–110, 2018.
19. A. Allendes, **E. Otárola**, A.J. SALGADO, R. RANKIN, Adaptive finite element methods for optimal control problems involving Dirac measures **Numerische Mathematik**, 137(1), 159–197, 2017.
18. **E. Otárola**, A piecewise linear FEM for an optimal control problem of fractional operators: error estimates on curved domains, **ESAIM: Mathematical Modelling and Numerical Analysis**, 51(4), 1473–1500, 2017.

17. **E. Otárola**, A.J. SALGADO, Finite element approximation of the parabolic fractional obstacle problem, **SIAM Journal on Numerical Analysis**, 54(4), 2619–2639, 2016.
16. A. ALLENDES, E. HERNÁNDEZ, **E. Otárola**, A robust numerical method for a control problem of singularly perturbed equations, **Computer and Mathematics with Applications**, 72(4), 974–991, 2016.
15. L. CHEN, R.H. NOCHETTO, **E. Otárola**, A.J. SALGADO, Multilevel methods for nonuniformly elliptic equations and fractional diffusion, **Mathematics of Computations**, 85, 2583–2607, 2016.
14. H. ANTIL, **E. Otárola**, A.J. SALGADO, A fractional space-time optimal control problem: analysis and discretization, **SIAM Journal on Control and Optimization**, 54(3), 1295–1328, 2016.
13. R.H. NOCHETTO, **E. Otárola**, A.J. SALGADO, A PDE approach to space-time fractional parabolic problems, **SIAM Journal on Numerical Analysis**, 4(2), 848–873, 2016.
12. R.H. NOCHETTO, **E. Otárola**, A.J. SALGADO, Piecewise polynomial interpolation in Muckenhoupt weighted Sobolev spaces and applications, **Numerische Mathematik**, 132(1), 85–130, 2016.
11. H. ANTIL, **E. Otárola**, A FEM for an optimal control problem of fractional powers of elliptic operators, **SIAM Journal on Control and Optimization**, 53(6), 3432–3456, 2015.
10. R.H. NOCHETTO, **E. Otárola**, A.J. SALGADO, A PDE approach to numerical fractional diffusion, **Proceedings of the International Congress on Industrial and Applied Mathematics**, 2015.
9. R.H. NOCHETTO, **E. Otárola**, A.J. SALGADO, Convergence rates for the classical, thin, and fractional elliptic obstacle problems, **Philosophical Transactions of the Royal Society of London A**, 373(2050), 2015. DOI:10.1098/rsta.2014.0283
8. R.H. NOCHETTO, **E. Otárola**, A.J. SALGADO, A PDE approach to fractional diffusion: a posteriori error analysis, **Journal of Computational Physics**, 293, 339–358, 2015.
7. R.H. NOCHETTO, **E. Otárola**, A.J. SALGADO, A PDE approach to fractional diffusion in general domains: a priori error analysis, **Foundations of Computational Mathematics**, 15(3), 733–791, 2015.
6. E. HERNÁNDEZ, **E. Otárola**, A Superconvergent scheme for a locking-free FEM in a Timoshenko optimal control problem, **ZAMM**, 91(4), 288–299, 2011.
5. D. KALISE, E. HERNÁNDEZ, **E. Otárola**, A locking-free scheme for the LQR control of a Timoshenko beam. **Journal of Computational and Applied Mathematics**, 235(5), 1383–1393, 2011.
4. E. HERNÁNDEZ, D. KALISE, **E. Otárola**, Numerical Approximation of the LQR problem in a strongly damped wave equation, **Computational Optimization and Applications**, 47(1), 161–178, 2010.
3. E. HERNÁNDEZ, **E. Otárola**, A locking-free FEM in active vibration control of a Timoshenko beam, **SIAM Journal on Numerical Analysis**, 47(4), 2432–2454, 2009.
2. E. HERNÁNDEZ, **E. Otárola**, R. RODRÍGUEZ AND F. SANHUEZA, Approximation of the vibration modes of a Timoshenko curved rod of arbitrary geometry, **IMA Journal of Numerical Analysis**, 29, 180–207, 2009.
1. E. HERNÁNDEZ, **E. Otárola**, R. RODRÍGUEZ AND F. SANHUEZA, Finite element approximation of the vibration problem for a timoshenko curved rod, **Revista de la Unión Matemática Argentina**, 49(1), 15–28, 2008.

- Aug. 2019 **Seminario del Instituto de Ingenieria Matemática y Computacional UC**, *Pontificia Universidad Católica de Chile*, Error estimates for optimal control problems involving Dirac measures, Santiago, Chile.
- July 2019 **ICIAM 2019, International Congress on Industrial and Applied Mathematics**, *Minisimposia: Advances in Fractional Partial Differential Equations: Modeling, Theory and Computation*, Tensor FEM for spectral fractional diffusion, Valencia, Spain.
- July 2019 **ICIAM 2019, International Congress on Industrial and Applied Mathematics**, *Minisimposia: Control, Optimization, and Numerical Methods for Infinite Dimensional Systems*, Error estimates for optimal control problems involving Dirac measures, Valencia, Spain.
- Mar. 2017 **Oberwolfach Workshop: Space-time Methods for Time-dependent Partial Differential Equations**, *A PDE approach to space-time fractional parabolic problems*, Oberwolfach, Germany.
- Feb. 2016 **Computational/Applied Math Seminar**, *Adaptive finite element methods for optimal control problems involving Dirac measures*, University of Tennessee, USA.
- Dec. 2015 **Segunda Escuela de Control y Optimización**, *A FEM for an optimal control problem of fractional powers of elliptic operators*, Universidad Técnica Federico Santa María, Chile.
- Oct. 2015 **Seminario del Departamento de Matemática**, *A PDE approach to numerical fractional diffusion*, Universidad Técnica Federico Santa María, Chile.
- May 2015 **ITL Applied and Computational Mathematics Division seminar**, *A PDE approach to fractional diffusion*, National Institute of Standards and Technology (NIST), USA.
- Apr. 2015 **Differential Equations Seminar**, *A PDE approach to numerical fractional diffusion*, University of Maryland Baltimore County, USA.
- Mar. 2015 **NumeriWaves Seminar**, *A PDE approach to numerical fractional diffusion*, Basque center for applied mathematics, Spain.
- Mar. 2015 **Fakultät für Mathematik Seminar**, *A PDE approach to numerical fractional diffusion*, Technische Universität München, Germany.
- Mar. 2015 **Workshop on Numerical Methods for Optimal Control and Inverse Problems**, *A FEM for an optimal control problem of fractional powers of elliptic operators*, Technische Universität München, Germany.
- Jan. 2015 **Charla de Matemáticas**, *A PDE approach to numerical fractional diffusion*, Pontificia Universidad Católica de Chile, Chile.
- May 2014 **Numerical Analysis Seminar**, *A PDE approach to space-time fractional parabolic problems*, University of Maryland, College Park, USA.
- Feb. 2014 **Computational/Applied Math Seminar**, *A PDE approach to numerical fractional diffusion*, Department of Mathematics, University of Tennessee, USA.
- Jan. 2014 **Applied and Computational Math Seminar**, *A PDE approach to numerical fractional diffusion*, Department of Mathematics, George Mason University, USA.
- Aug. 2013 **Seminario del Departamento de Matemática**, *A PDE approach to numerical fractional diffusion*, Universidad Técnica Federico Santa María, Chile.
- Aug. 2013 **Charla de Matemáticas**, *A PDE approach to numerical fractional diffusion*, Pontificia Universidad Católica de Chile, Chile.
- May 2013 **Scientific Computing Group Seminar**, *A PDE approach for fractional diffusion: A priori and a posteriori error analysis*, Division of Applied Mathematics, University of Brown, USA.
- Mar. 2013 **Numerical Analysis Seminar**, *A PDE approach for fractional diffusion: A priori and a posteriori error analysis*, University of Maryland, College Park, Chile.

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## Contributed Talks

- June 2017 **Santiago Numérico III**, *Optimization with respect to order in a fractional diffusion model: analysis and approximation*, Pontificia Universidad Católica de Chile, Chile.
- Jan. 2016 **WONAPDE, Minysimposia: Adaptivity in Numerical PDE**, *Adaptive finite element methods for an optimal control problems involving Dirac measures*, Universidad de Concepción, Chile.
- Jan. 2016 **WONAPDE, Minysimposia: Numerical Methods for Nonlocal problems**, *A PDE approach to space-time fractional parabolic problems*, Universidad de Concepción, Chile.
- Aug. 2015 **XXIV Congreso de Matemática Capricornio**, *A PDE approach to space-time fractional parabolic problems*, Universidad Arturo Prat, Iquique, Chile.
- May 2015 **DelMar Numerics Day**, *Piecewise polynomial interpolation in weighted Sobolev spaces and applications to optimal control problems*, U.S. Naval Academy, Annapolis, USA.
- Mar. 2015 **Finite Element Circus**, *A PDE approach to space-time fractional parabolic problems*, George Mason University, USA.
- Oct. 2014 **Finite Element Circus**, *Convergence rates for the elliptic fractional obstacle problem*, University of Minnesota, USA.
- May 2014 **DelMar Numerics Day**, *A PDE approach to space-time fractional parabolic problems*, University of Maryland, Baltimore County, USA.
- Oct. 2013 **Finite Element Circus**, *A PDE approach to fractional diffusion: a priori error estimates*, University of Delaware, USA.
- Jan. 2013 **WONAPDE Minysimposia: Mathematical Aspects of Finite Element Methods**, *A PDE approach for fractional diffusion: a priori and a posteriori error analysis*, Universidad de Concepción, Chile.
- Aug. 2012 **7th Zürich Summer School**, *A PDE approach for fractional diffusion: a priori and a posteriori error analysis*, University of Zürich, Switzerland.
- Apr. 2012 **DelMar Numerics Day**, *A FEM for the fractional Laplace operator*, University of Delaware, USA.
- Oct. 2011 **Finite Element Circus**, *A FEM for the fractional Laplace operator*, University of Connecticut, USA.
- Aug. 2007 **XVII Congreso de Matemática Capricornio**, *A locking free FEM in the active vibration control of a Timoshenko beam*, Universidad de Atacama, Chile.
- Apr. 2007 **XXI Jornada de Matemática de la Zona Sur**, *A FEM in the active vibration control of a Timoshenko beam*, Universidad Católica de la Santísima Concepción, Chile.

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## Students

- 2018 – **Francisco Fuica**, *Ph.D in Mathematics*, Departamento de Matemáticas, Universidad Técnica Federico Santa María, Chile.
- 2018 – **Daniel Quero**, *Master of Science, Mathematics*, Departamento de Matemáticas, Universidad Técnica Federico Santa María, Chile.
- 2016 – 2018 **Francisco Fuica**, *Master of Science, Mathematics*, Departamento de Matemáticas, Universidad Técnica Federico Santa María, Chile, Title: Adaptive finite element methods in sparse PDE–constrained optimization.
- 2016 – 2017 **Daniel Quero**, *Mathematical Engineering*, Departamento de Matemáticas, Universidad Técnica Federico Santa María, Chile, Title: A posteriori error estimation for finite element approximations of a PDE–constrained optimization problem in fluid dynamics..

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## Participation in Research Projects

- 2013 -2014 **Research Assitant Fellowship**, *supported by NSF grant DMS-1109325*, Department of Mathematics, University of Maryland, College Park.

2005 - 2006 **Research Undergraduate Fellowship**, supported by *USM Project 12.05.26*, Universidad Técnica Federico Santa María, Chile.

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## Teaching Experience

2016 – 2018 **Assistant Professor**, *Calculus I, Calculus 2, Linear Algebra, Numerical Analysis II*, Departamento de Matemática, Universidad Técnica Federico Santa María, Chile.

Fall 2014 **Lecturer**, *Linear Algebra and Applications*, Department of Mathematics, University of Maryland, College Park.

Fall 2014 **Attendee**, *Teaching Seminar Training*, Department of Mathematics, University of Maryland, College Park.

Spring 2012 **Discussion Leader**, *Research Interaction Team*, Multilevel methods on quasi-uniform grids, Numerical Analysis group, University of Maryland, College Park.

Fall 2011 **Discussion Leader**, *Research Interaction Team*, Approximation classes for adaptive higher order finite element approximation: Besov spaces, Numerical Analysis group, University of Maryland, College Park.

Fall 2010 **Discussion leader**, *Research Interaction Team*, Optimal control of PDEs, Numerical Analysis group, University of Maryland, College Park.

2007 - 2008 **Lecturer**, *Calculus II and Calculus III*, Departamento de Matemática, Universidad Técnica Federico Santa María, Chile.

2007 **Lecturer**, *Linear Algebra, Calculus II and Calculus III*, Department of Science and Technology, Universidad Adolfo Ibanez, Chile.

2002-2006 **Teaching Assistant**, *Measure Theory, Numerical Linear Algebra, Numerical Analysis of Partial Differential Equations, Calculus I, Calculus II, Calculus III*, Departamento de Matemática, Universidad Técnica Federico Santa María, Chile.

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## Conference and minisymposia organization

2019 **Co-organized**, *Numerical approximation of nonlocal and fractional problems*, WONAPDE, Chile, 2019.

2018 **Co-organized**, *Análisis Numérico*, LXXXVII Encuentro anual de la sociedad de matemática de Chile, Chile, 2018.

2018 **Co-organized**, *Análisis Numérico*, Jornadas Matemáticas de la Zona Sur, Chile, 2018.

2017 **Scientific committee**, *Modeling, Analysis, and Numerics for Nonlocal Applications*, Santa Fe, USA, 2017.

2016 **Co-organized**, *Análisis Numérico de Ecuaciones en Derivadas Parciales*, SUMA, Chile, 2016.

2016 **Co-organized**, *Numerical methods for non-local problems*, WONAPDE, Chile, 2016.

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## Review and Refereeing

Referee for the following Scientific Journals:

**Foundations of Computational Mathematics, Mathematical Models and Methods in Applied Sciences, SIAM Journal on Numerical Analysis, SIAM Journal on Control and Optimization, Mathematics of Computation, Numerische Mathematik, Journal of Scientific Computing, ESAIM: Mathematical Modelling and Numerical Analysis, Computers and Mathematics with Applications, Asymptotic Analysis, Advances in Difference Equations, Calcolo.**

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## Applied Research Experience

2007 **Southeastern Pacific Research Institute, Chile**, *Computational Advanced Material Design: An algorithm in the construction of bulk metallic glass.*

2006 **Institute for Innovation in Mining and Metallurgy, Codelco, Chile,** *An stochastic optimization model in planning mining.*

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## Languages

Spanish

*Native speaker*

English

*Fluent in written and spoken*