Carlos Pérez Arancibia

Curriculum Vitae

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Last updated December 4, 2023

Research Interests

Scientific computing; high-order PDE solvers; fast algorithms; numerical analysis; boundary and volume integral equations; wave phenomena; computational electromagnetics; optical metamaterials.

Employment History

Assistant Professor (UD-1, tenured) — *9/21 - Present*
Mathematics of Computational Science
Department of Applied Mathematics
University of Twente, Enschede, The Netherlands

Assistant Professor — *7/17 - 8/21*
Institute for Mathematical and Computational Engineering
Pontificia Universidad Católica de Chile, Santiago, Chile

Instructor in Applied Mathematics — *9/16 - 6/18*
Department of Mathematics
Massachusetts Institute of Technology, Cambridge, MA, USA

Education

California Institute of Technology, Pasadena, CA, USA — *8/16*
· Ph.D. in Applied & Computational Mathematics
· Thesis supervisor: Oscar P. Bruno

Pontificia Universidad Católica de Chile, Santiago, Chile
· Diploma in Mathematical Engineering (with the highest distinction) — *5/10*
· Master in Engineering Sciences (with the highest distinction) — *5/10*
· Minor in Philosophy — *5/10*
· Bachelor in Engineering Sciences — *12/08*

Journal Papers[1]

27.† A.-S. Bonnet-Ben Dhia, L. Faria and C. Pérez-Arancibia. A complex-scaled boundary integral equation for time-harmonic water waves. Submitted, 2023.

26.† T. G. Anderson, M. Bonnet, L. Faria and C. Pérez-Arancibia. Fast, high-order accurate numerical evaluation of volume potentials via polynomial density interpolation. Submitted, 2023.

25.‡ V. Hojas, C. Pérez-Arancibia and M. A. Sánchez. Reflectionless discrete perfectly matched layers for higher-order finite difference schemes. Submitted, 2023.

24.† T. G. Anderson, M. Bonnet, L. Faria and C. Pérez-Arancibia. On particular solutions of linear partial differential equations with polynomial right-hand-sides. Submitted, 2023.

23.† L. Faria, C. Pérez-Arancibia and C. Turc. Combined field-only boundary integral equations for PEC electromagnetic scattering problem in spherical geometries. To appear in *SIAM J. Appl. Math.*

22.‡ T. Strauszer-Caussade, L. Faria, A. Fernandez-Lado and C. Pérez-Arancibia. Windowed Green function method for wave scattering by periodic arrays of 2D obstacles. *Stud. Appl. Math.*, 150(1):277-315, 2023.

[1]Papers marked with the symbol † follow the mathematical tradition of alphabetical authorship ordering, whereas those marked with ‡ denote collaborative work with students.

21.‡ R. Arrieta and C. Pérez-Arancibia. Windowed Green function MoM for second-kind surface integral equation formulations of layered media electromagnetic scattering problems. *IEEE Trans. Antennas Propag.*, 70(12):11978-11989, 2022.

20.‡ V. Gómez and C. Pérez-Arancibia. On the regularization of Cauchy-type integral operators via the density interpolation method and applications. *Comput. Math. Appl.*, 87:108-119, 2021.

19. L. Faria, C. Pérez-Arancibia and M. Bonnet. General-purpose kernel regularization of boundary integral equations via density interpolation. *Comput. Methods Appl. Mech. Engrg.*, 378(113703):1-29, 2021.

18. C. Pérez-Arancibia, C. Turc, L. Faria and C. Sideris. Planewave density interpolation methods for the EFIE on simple and composite surfaces. *IEEE Trans. Antennas Propag.*, 69(1):317-331, 2021.

17.† D. Nicholls, C. Pérez-Arancibia, and C. Turc. Sweeping preconditioners for the iterative solution of quasiperiodic Helmholtz transmission problems in layered media. *J. Sci. Comput.*, 82:44, 2020.

16.‡ I. Labarca, L. Faria and C. Pérez-Arancibia. Convolution quadrature methods for time-domain scattering from unbounded penetrable interfaces. *Proc. R. Soc. A*, 2019.0029, 2019.

15. C. Pérez-Arancibia, C. Turc and L. Faria. Planewave density interpolation methods for 3D Helmholtz boundary integral equations. *SIAM J. Sci. Comput.*, 41(4):A2065-A2087, 2019.

14.† C. Pérez-Arancibia, S. Shipman, C. Turc and S. Venakides. Domain decomposition for quasi-periodic scattering by layered media via robust boundary-integral equations at all frequencies. *Commun. Comput. Phys.*, 26:265-310, 2019.

13. C. Pérez-Arancibia, L. Faria and C. Turc. Harmonic density interpolation methods for high-order evaluation of Laplace layer potentials in 2D and 3D. *J. Comput. Phys.*, 376:411-434, 2019.

12. R. Pestourie, C. Pérez-Arancibia, Z. Lin, W. Shin, F. Capasso and S. G. Johnson. Inverse design of large-area metasurfaces. *Opt. Express*, 26(26):33732-33747, 2018.

11. C. Pérez-Arancibia, R. Pestourie and S. G. Johnson. Sideways adiabaticity: Beyond ray optics for slowly varying metasurfaces. *Opt. Express*, 26(23):30202-30230, 2018.

10. C. Pérez-Arancibia, E. Godoy and M. Durán. Modeling and simulation of an acoustic well stimulation method. *Wave Motion*, 77:214-228, 2018.

9. C. Pérez-Arancibia. A planewave singularity subtraction technique for the classical Dirichlet and Neumann combined field integral equations. *Appl. Numer. Math.*, 123:221-240, 2018.

8.† C. Jerez-Hanckes, C. Pérez-Arancibia and C. Turc. Multitrace/singletrace formulations and Domain Decomposition Methods for the solution of Helmholtz transmission problems for bounded composite scatterers. *J. Comput. Phys.*, 350:343-360, 2017.

7.† O. P. Bruno, E. Garza-Gonzalez and C. Pérez-Arancibia. Windowed Green Function method for nonuniform open-waveguide problems. *IEEE Trans. Antennas Propag.*, 65(9):4684-4692, 2017.

6.† O. P. Bruno and C. Pérez-Arancibia. Windowed Green Function method for the Helmholtz equation in presence of multiply layered media. *Proc. R. Soc. A*, 473(2202), 2017.

5.† O. P. Bruno, M. Lyon, C. Pérez-Arancibia and C. Turc. Windowed Green Function method for layered-media scattering. *SIAM J. Appl. Math.*, 76(5):1871-1898, 2016.

4. C. Pérez-Arancibia and O. Bruno. High-order integral equation methods for problems of scattering by bumps and cavities on half-planes. *J. Opt. Soc. Am. A*, 31(8):1738-1746, 2014.

3. C. Pérez-Arancibia, P. Zhang, O. P. Bruno and Y. Y. Lau. Electromagnetic power absorption due to bumps and trenches on flat surfaces. *J. Appl. Phys.*, 116(12):124904, 2014.

2. C. Pérez-Arancibia, P. Ramaciotti, R. Hein and M. Durán. Fast multipole boundary element method for the Laplace equation in a locally perturbed half-plane with a Robin boundary condition. *Comput. Methods Appl. Mech. Engrg.*, 233(1):152-163, 2012.

1. C. Pérez-Arancibia and M. Durán. On the Green's function for the Helmholtz operator in an impedance circular cylindrical waveguide. *J. Comput. Appl. Math.*, 235(1):244-262, 2010.

Conference (Peer-Reviewed) Papers

· R. Arrieta, L. Faria, C. Pérez-Arancibia, and C. Turc. A high-order density-interpolation-based Nyström method for three-dimensional electromagnetic boundary integral equations. *WAVES 2022: The 15th International Conference on Mathematical and Numerical Aspects of Wave Propagation*, July 24–29 2022, Palaiseau, France.

· J. Hu, E. Garza, C. Pérez-Arancibia and C. Sideris. High-Order accurate integral equation based mode solver for layered nanophotonic waveguides. *International Microwave Symposium*, June 6–11 2021, Atlanta, GA, USA.

· C. Pérez-Arancibia and O. P. Bruno. A high-order integral equation solver for problems of electromagnetic scattering by three-dimensional open surfaces. *WAVES 2015: The 12th International Conference on Mathematical and Numerical Aspects of Wave Propagation*, July 20–24 2015, Karlsruhe, Germany.

Theses

· Windowed integral equation methods for problems of scattering by defects and obstacles in layered media. Ph.D. thesis, California Institute of Technology, Pasadena, CA, USA, 2016.

· Modeling and simulation of time-harmonic wave propagation in cylindrical impedance waveguides: Application to an oil well stimulation technology. Master's thesis, Escuela de Ingeniería, Pontificia Universidad Católica de Chile, Santiago, Chile, 2010.

Selected Talks and Presentations

· The 10^{th} International Congress on Industrial and Applied Mathematics (ICIAM 2023), Tokyo, Japan, August 20–25, 2023 (invited talk).

· Workshop on Computational Methods for Multiple Scattering. Isaac Newton Institute, Cambridge, UK, April 17–21, 2023 (invited talk). Link to video.

· SIAM Conference on Computational Science and Engineering, Amsterdam, The Netherlands, March 1, 2023.

· The 12^{th} International Conference on Mathematical and Numerical Aspects of Wave Propagation (WAVES 2023), Palaiseau, France, July 25-29, 2023.

· IEEE GRSS-APS Joint Student Chapter, University of Southern California, Los Angeles, CA, USA, April 7, 2022 (invited talk online).

· Conference on Mathematics of Wave Phenomena, Karlsruhe, Germany, February 14–18, 2022 (invited talk online).

· Applied Mathematics Colloquium, University of Colorado at Boulder, January 21, 2022 (invited talk online).

· International Conference on Spectral and High Order Methods (ICOSAHOM 2020+1), Vienna, Austria, July 12–16, 2021.

· POEMS Seminar, ENSTA Paris, Palaiseau, France, April 15, 2021 (invited talk online).

· Numerical Analysis of Electromagnetic Problems, Oberwolfach Mathematical Research Institute, Germany, March 23, 2021 (invited talk online).

· Applied Mathematics Colloquium, New Jersey Institute of Technology, Newark, NJ, USA, January 31, 2020 (invited talk).

· Numerical Methods for Partial Differential Equations Seminar, MIT, Cambridge, MA, USA, January 29, 2020 (invited talk).

· Applied Mathematics and Scientific Computing Seminar, Temple University, Philadelphia, PA, USA, January 27, 2020 (invited talk).

· French Latin-American Conference on New Trends in Applied Mathematics, Center for Mathematical Modeling, Universidad de Chile, Santiago, Chile, November 5-8, 2019 (invited talk).

· PUC-Bath Workshop on PDE's and Applications, Santiago, Chile, September 12, 2019 (invited talk).

· Coloquio del Departamento de Ingeniería Matemática, Universidad de Concepción, Chile, May 23, 2019 (invited talk).

· SIAM Conference on Computational Science and Engineering, Spokane, Washington, WA, USA, March 1, 2019 (invited talk).

· The 6th Chilean Workshop on Numerical Analysis of Partial Differential Equations (WONAPDE 2019), Concepción, Chile, January 22, 2019.

· The 2nd Chilean Symposium on Boundary Element Methods, Universidad Federico Santa María, Valparaíso, Chile, December 14, 2018 (invited talk).

· Mathematical Sciences Colloquium, University of Massachusetts at Lowell, MA, USA, October 13, 2017 (invited talk).

· Institute for Mathematical and Computational Engineering Seminar, PUC, Santiago, Chile, August 24, 2017 (invited talk).

· Caleta Numérica, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile, August 18, 2017 (invited talk).

· The 9th Meeting on Numerical Analysis of Partial Differential Equations (Santiago Numérico III), Santiago, Chile, June-28-30, 2017.

· Numerical Methods for Partial Differential Equations Seminar, MIT, Cambridge, MA, USA, April 19, 2017 (invited talk).

· The 10th International Conference on Scientific Computing and Applications, Fields Institute, Toronto, Canada, June 6-10, 2016 (invited talk).

· The 13th Annual Conference on Frontiers in Applied and Computational Mathematics (FACM 2016), Newark, NJ, USA, June 3-4, 2016 (invited talk).

· Applied and Computational Mathematics Seminar, University of California, Irvine, CA, USA, February 22, 2016 (invited talk).

· Applied and Computational Mathematics Seminar, University of California, Merced, CA, USA, February 2, 2016 (invited talk).

· The 12th International Conference on Mathematical and Numerical Aspects of Wave Propagation (WAVES 2015), Karlsruhe, Germany, July 20-24, 2015.

· AMMCS-CAIMS Congress, Waterloo, Ontario, Canada, June 7-12, 2015 (invited talk).

· SIAM Conference on Computational Science and Engineering, Salt Lake City, Utah, USA, March 14-18, 2015 (invited talk).

· International Conference on Spectral and High Order Methods (ICOSAHOM 2014), Salt Lake City, UT, USA, June 23-27, 2014.

· NSF Workshop on the BEM, University of Minnesota, Minneapolis, MN, USA, April 23-26, 2012 (poster).

· Valparaíso's Mathematics and its Applications Days, Pontificia Universidad Católica de Valparaiso, Valparaíso, Chile, December 12-14, 2012 (invited talk).

Teaching Experience

University of Twente *9/21 - Present*

Lecturer

· Analysis I, 1st term, 2022 and 2023.
· Analysis II, 2nd term, 2022 and 2023.

Pontificia Universidad Católica de Chile *6/18 - 8/21*

Lecturer

· Calculus III (MAT1630), 1st semester of 2020 (∼240 students) and 2021 (∼190 students).
· Engineering Applications of PDEs and Functional Analysis (IMT3130/3773), 1st semester of 2019, 2020, and 2021.
· Scientific Computing II (MAT2615), 2nd semester 2020.
· Scientific Computing I (MAT2605), 2nd semester 2019.

· Advanced Topics in Numerical Analysis (IMT3810), 2nd semester 2019.
· Capstone Course on Mathematical and Computational Engineering (IMT3500), 2nd semester 2018.

Massachusetts Institute of Technology *9/16 - 6/18*
Lecturer

· Fast Methods for Partial Differential and Integral Equations (18.336J/6.335J), Fall 2016 and 2017 (link to the course's website).
· Linear Partial Differential Equations: Analysis and Numerics (18.303), Spring 2018.

California Institute of Technology *9/12 - 6/16*
Teaching Assistant

· Methods of Applied Mathematics A (ACM101A), Fall 2014 and 2015.
· Methods of Applied Mathematics B (ACM101B), Winter 2015 and 2016.
· Introductory Methods of Applied Mathematics A (ACM100A), Fall 2012, 2013 and 2014.
· Introductory Methods of Applied Mathematics B (ACM100B), Winter Term 2013.
· Introductory Methods of Applied Mathematics C (ACM100C), Spring 2013, 2014 and 2015.
· Introductory Methods of Computational Mathematics B (ACM106B), Winter 2014.

Pontificia Universidad Católica de Chile *8/10 - 12/10*
Lecturer

· Mathematical Methods Applied to Engineering (IMM2650), 2nd Semester 2010.

Pontificia Universidad Católica de Chile *3/06 - 12/09*
Teaching Assistant

· Numerical Analysis of Partial Differential Equations, 2nd semester 2009.
· Introduction to Numerical Analysis of Partial Differential Equations, 1st semester 2009.
· Calculus II, 2nd semester 2008.
· Calculus III, 2nd semester 2008.
· Partial Differential Equations, 1st semester 2007 and 2008.
· Calculus I (Maple laboratory), 1st semester 2008.
· Differential Equations, 1st semester 2006 and 2nd semester 2007.
· Linear Algebra, 1st and 2nd semesters 2006.

Awards

· Top China UC Santander Fellowship, December 2018.
· ICES Postdoctoral Fellowship, University of Texas at Austin, February 2016 (declined).
· IMA Postdoctoral Fellowship, University of Minnesota, January 2016 (declined).
· PIMS Postdoctoral Fellowship (Canada), December 2015 (declined).
· AMMCS-CAIMS Student Travel Award, June 2015.
· SIAM Student Travel Award, March 2015.
· Student Travel Award, NSF Workshop on the BEM, University of Minnesota, April 2012.
· Caltech Institute Fellowship, September 2011.
· Conicyt Scholarship for Master's Studies in Chile, January 2009.
· Padre Alberto Hurtado Award, Pontificia Universidad Católica de Chile, March 2003.

Funding

· Proyecto Fondecyt de Iniciación en Investigación 11181032: *Fast and efficient method of moments for electromagnetic wave propagation and scattering in the presence of unbounded material interfaces.* Principal investigator. Three-year research grant. Budget: 61,298,000 CLP ($\sim$ 87,500 USD).

· MISTI-MIT Global Seed Funds Grant: *High-Contrast Challenges in Numerical Wave Scattering.* October 2016.

Service

Journal paper review

· Journal of Computational Physics (2015, 2018, 2019, 2022)
· SIAM Journal on Applied Mathematics (2018, 2020, 2022)
· SIAM Journal on Scientific Computing (2017)
· SIAM Journal on Numerical Analysis (2018)
· Computers and Mathematics with Applications (2019)
· Advances in Computational Mathematics (2023)
· IMA Journal of Applied Mathematics (2022)
· IMA Journal of Numerical Analysis (2020)
· SN Partial Differential Equations and Applications (2020)
· IEEE Transactions on Antennas and Propagation (2021)
· Engineering Optimization (2017)
· International Journal for Numerical Methods in Engineering (2015)
· Journal of Algorithms and Optimization (2014)
· Progress in Electromagnetic Research PIERS (2011, 2012, 2014)
· International Journal on Geomathematics (2022)

Seminar and minisymposium organization

· Recent Advances on Integral Equation and Spectral Methods for Inhomogeneous Problems (with Thomas G. Anderson, Rice University). Minisymposium at SIAM CSE 2023, March 2023.
· Time-Evolution and Frequency-Domain Methods for Partial Differential Equations (with David Shirokoff, NJIT). Minisymposium at WONAPDE 2019, January 2019.
· Seminar of the Institute for Mathematical and Computational Engineering. Weakly research seminar for graduate and undergraduate applied mathematics students at PUC Chile. 2020 academic year.
· Numerical Methods for Partial Differential Equations Seminar (with Manuel A. Sánchez, PUC). PUC Chile, 2nd Semester 2018.

Memberships

· Applied Mathematics Programme Committee, University of Twente (since September 2023).
· Society of Industrial and Applied Mathematics (SIAM).
· Institute of Electrical and Electronics Engineers (IEEE).

Participation in Ph.D. Committees

· Erli Wind-Andersen, Ph.D. in Mathematical Sciences, New Jersey Institute of Technology.
· Ruben Ailwyn. Ph.D. in Electrical Engineering, PUC Chile.

Research Supervision

Graduate Students

· Vicente Hojas: PUC Chile, master's thesis.
· Rodrigo Arrieta: PUC Chile, master's thesis (currently pursuing a Ph.D. at MIT).
· Thomas Strauszer: PUC Chile, master's thesis (currently pursuing a Ph.D. at University College London).
· Ignacio Labarca: PUC Chile, master's thesis (currently pursuing a Ph.D. at ETH Zürich).

Undergraduate Students

· Gernt Hanskamp: University of Twente, The Netherlands. Bachelor's thesis.
· Jelle Boon: University of Twente, The Netherlands. Bachelor's thesis.
· Guilhem Penet: ENSTA Paris, France. Research internship.
· Vicente Gomez: PUC Chile (currently pursuing a Ph.D. at NYU Courant Institute).