Carlos Pérez Arancibia

Curriculum Vitae

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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*

Funding

· NWO Open Competition Domain Science (M1) awarded by the Dutch Research Council, the Netherlands
Title: *Density interpolation methods for the fast and high-order evaluation of volume potentials in complex geometries*
Role: Principal investigator
Period: 2024 – 2028 (4 years)
Budget: €372,565 (∼ $405,209)

· Strategic Research Initiative awarded by the 4TU Applied Mathematics Institute, the Netherlands
Title: *Advancing mathematical methods for wave phenomena*
Role: Co-principal investigator
Period: 2024 – 2026 (2 years)
Budget: €20,000 (∼ $21,751)

· Fondecyt de Iniciación en Investigación awarded by Agencia Nacional de Investigación y Desarrollo, Chile
Title: *Fast and efficient method of moments for electromagnetic wave propagation and scattering in the presence of unbounded material interfaces*
Role: Principal investigator

Period: 2018 – 2021 (3 years)
Budget: CLP 61,298,000 (∼ $87,500)

· MISTI Global Seed Funds awarded by the Massachusetts Institute Technology and the Pontificia Universidad Católica de Chile
Title: *High-Contrast challenges in numerical wave scattering*
Role: Co-principal investigator
Period: 2016 – 2017 (2 years)

Journal Papers[1]

27.‡ V. Hojas, C. Pérez-Arancibia and M. A. Sánchez, *Reflectionless discrete perfectly matched layers for higher-order finite difference schemes*. Accepted to SIAM Journal on Scientific Computing, 2024.

26.† A.-S. Bonnet-Ben Dhia, L. Faria and C. Pérez-Arancibia, *A complex-scaled boundary integral equation for time-harmonic water waves*. To appear in SIAM Journal on Applied Mathematics, 2024.

25.† T. G. Anderson, M. Bonnet, L. M. Faria and C. Pérez-Arancibia, *Fast, high-order accurate numerical evaluation of volume potentials via polynomial density interpolation*, J. Comput. Phys., 511 (2024), p. 11309.

24.† T. G. Anderson, M. Bonnet, L. M. Faria, and C. Pérez-Arancibia. *Construction of polynomial particular solutions of linear constant-coefficient partial differential equations*, Comput. Math. Appl., 162 (2024), pp. 94-103.

23.† L. Faria, C. Pérez-Arancibia and C. Turc. *Combined field-only boundary integral equations for PEC electromagnetic scattering problem in spherical geometries*, SIAM J. Appl. Math., 84.1 (2024), pp. 1-38.

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. (2023), pp. 277-315.

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 (2022), pp. 11978-11989.

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 (2021), pp. 108-119.

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

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 (2021), pp. 317-331.

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), pp. 1-45.

16.‡ I. Labarca, L. Faria and C. Pérez-Arancibia, *Convolution quadrature methods for time-domain scattering from unbounded penetrable interfaces*, Proc. R. Soc. A, 475.2027 (2019), pp. 1-18.

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. (2019), pp. A2065-A2087.

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 (2019), pp. 265-310.

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 (2019), pp. 411-434.

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. (2018), pp. 33732-33747.

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

11. C. Pérez-Arancibia, R. Pestourie and S. G. Johnson, *Sideways adiabaticity: Beyond ray optics for slowly varying metasurfaces*, Opt. Express, 26.23. (2018), pp. 30202-30230.

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

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

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 (2017), pp. 343-360.

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 (2017), pp. 4684-4692.

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), pp. 1-20.

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 (2016), pp. 1871-1898.

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 (2014), pp. 1738-1746.

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 (2014), p. 124904.

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. (2012), pp. 152-163.

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 (2010), pp. 244-262.

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

· International Conference on Applied Mathematics (ICAM 2024), City University of Hong Kong, Hong Kong, May 28 – June 1, 2024 (invited speaker).

· Institute of Computational Mathematics and Scientific Computing Seminar, Chinese Academy of Sciences, May 7, 2024 (invited talk online).

· Seminars in Numerical Analysis, Delft University of Technology, Delft, March 16, 2024 (invited talk).

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

· The 2^{nd} 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.

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 Mentorship

- Vicente Hojas: PUC Chile, master's thesis (Ph.D. student at Caltech).
- Rodrigo Arrieta: PUC Chile, master's thesis (Ph.D. student at MIT).
- Thomas Strauszer: PUC Chile, master's thesis (Ph.D. student at University College London).
- Ignacio Labarca: PUC Chile, master's thesis (Ph.D. from ETH Zürich).

Undergraduate Students Mentorship

- 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 (Ph.D. student at NYU Courant Institute).