
TONATIUH SÁNCHEZ-VIZUET

Assistant Professor Department of Mathematics

• Numerical Analysis • Scientific Computing • Computational Physics

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Previous Appointments

Postdoctoral Associate: New York University.
 2016 – 2020 Courant Institute of Mathematical Sciences.



Education

Doctor of Philosophy: Applied Mathematics, 2016.
 University of Delaware.
 Department of Mathematical Sciences.
 Thesis: "Integral and coupled integral-volume methods
 for transient problems in wave-structure interaction."
 Advisor: Prof. Francisco-Javier Sayas.



Master of Science: Mathematics, 2011.
summa cum laude
 National Autonomous University of Mexico.
 Mathematics Institute.
 Thesis: "Numerical solution of the Euler
 equations for gas dynamics in 3D".
 Advisor: Prof. Antonio Capella-Kort.



Bachelor of Science: Physics, 2010.
 National Autonomous University of Mexico.
 School of Sciences.
 Thesis: "Solutions to the transport equation:
 analytical and numerical properties".
 Advisor: Prof. Iouri N. Skiba.



Academic Distinctions & Fellowships

- [Lathisms](#) honoree, prominent Latinx/Hispanic early career mathematician, 2018 .
- [National System of Researchers](#). Member Level I, 2018. (National Council of Science and Technology, México).
- Departmental Fellowship. University of Delaware, 2014.
- Nomination for the "Excellence in teaching award". University of Delaware, 2012.
- Howard Hughes Medical Institute Teaching Assistant. University of Delaware, 2011-2012.
- Graduate Fellowship. CONACyT 2010-2011. (National Council of Science and Technology, México).
- Research Fellowship. National Autonomous University of Mexico. Center for Atmospheric Sciences, 2008-2009.
- Research Fellowship. National Autonomous University of Mexico. Institute of Nuclear Sciences, 2005.

Awards

- 2016, SIAM Early Career Travel Award to attend the 2016 SIAM Annual meeting in Boston, MA.
- 2016, University of Delaware Winter Research Symposium. Best Poster Award. \$1,000. USD to attend the 2016 Annual International Sherwood Fusion Theory Conference. Madison, WI.
- 2015, SIAM Student Travel Award to attend the 2015 SIAM conference on Analysis of Partial Differential Equations in Scottsdale, AZ.
- 2014, University of Delaware Professional Development Award. \$1,000. USD to attend the XVI School on Numerical Simulation in Physics and Engineering at the Public University of Navarra, Spain.
- 2012, University of Delaware Professional Development Award. \$1,000. USD to attend the conference "Chebfun and Beyond" at the University of Oxford, UK.
- 2012, NSF award to attend the workshop "The Boundary Element Method: Bridging Education and Industrial Applications" at the University of Minnesota.

Research Articles

- G. C. Hsiao and T. Sánchez-Vizuet. Boundary integral formulations for transient linear thermoelasticity with combined-type boundary conditions. (*Submitted*), 2020. <https://arxiv.org/abs/2010.04909>.
- N. Sánchez, T. Sánchez-Vizuet, and M. E. Solano. A priori and a posteriori error analysis of an HDG method for semi-linear elliptic problems in curved domains. (*Submitted*), 2019. <https://arxiv.org/abs/1911.12298>.
- T. Sánchez-Vizuet, M. E. Solano, and A. J. Cerfon. Adaptive hybridizable discontinuous Galerkin discretization of the Grad-Shafranov equation by extension from polygonal subdomains. *Computer Physics Communications*, 255:107239, 2020.
- G. C. Hsiao and T. Sánchez-Vizuet. Time-domain boundary integral methods in linear thermoelasticity. *SIAM Journal on Mathematical Analysis*, 52(3):2463–2490, 2020. Dedicated to the memory of Francisco-Javier Sayas.
- T. Sánchez-Vizuet and M. E. Solano. A Hybridizable Discontinuous Galerkin solver for the Grad-Shafranov equation. *Computer Physics Communications*, 235:120 – 132, 2019.
- G. C. Hsiao, T. Sánchez-Vizuet, F.-J. Sayas, and R. J. Weinacht. A time-dependent wave-thermoelastic solid interaction. *IMA Journal of Numerical Analysis*, 39(2):924–956, 04 2018.
- T. Sánchez-Vizuet and A. J. Cerfon. Pseudo-spectral collocation with Maxwell polynomials for kinetic equations with energy diffusion. *Plasma Physics and Controlled Fusion*, 60(2):025018, 2018.
- Brown, Thomas S., Sánchez-Vizuet, Tonatiuh, and Sayas, Francisco-Javier. Evolution of a semidiscrete system modeling the scattering of acoustic waves by a piezoelectric solid. *ESAIM: Mathematical Modeling and Numerical Analysis (M2AN)*, 52(2):423–455, 2018.
- T. Sánchez-Vizuet and F.-J. Sayas. Symmetric boundary-finite element discretization of time dependent acoustic scattering by elastic obstacles with piezoelectric behavior. *Journal of Scientific Computing*, 70(3):1290–1315, 2017.
- M. Hassell, T. Qiu, T. Sánchez-Vizuet, and F.-J. Sayas. A new and improved analysis of the time domain boundary integral operators for acoustics. *Journal of Integral Equations and Applications*, 29(1):107–136, 2017.
- G. C. Hsiao, T. Sánchez-Vizuet, and F.-J. Sayas. Boundary and coupled boundary-finite element methods for transient wave-structure interaction. *IMA Journal of Numerical Analysis*, 37(1):237–265, 2016.
- V. Domínguez, T. Sánchez-Vizuet, and F.-J. Sayas. A fully discrete Calderón calculus for the two-dimensional elastic wave equation. *Computers & Mathematics with Applications*, 69(7):620–635, 2015.

Conference proceedings and other publications

- I. Gamba, C. Sormani, T. Tao, L. Greengard, T. Sánchez-Vizuet, and K. R. Payne. The mathematics of Cathleen Synge Morawetz. *Notices of the American Mathematical Society*, 65(07):764–778, Aug 2018.
- G. C. Hsiao, T. Sánchez-Vizuet, F.-J. Sayas, and R. J. Weinacht. FEM-BEM coupling for transient acoustic scattering by thermoelastic obstacles. In *Proceedings 13th. International Conference on Mathematical and Numerical Aspects of Wave Propagation (University of Minnesota)*, 2017.
- Brown, Thomas S., Sánchez-Vizuet, Tonatiuh, and Sayas, Francisco-Javier. Semidiscrete evolution of elastic waves in a piezoelectric solid. In *Proceedings 13th. International Conference on Mathematical and Numerical Aspects of Wave Propagation (University of Minnesota)*, 2017.
- G. C. Hsiao, T. Sánchez-Vizuet, and F.-J. Sayas. A system of boundary integral equations for transient wave-structure interaction. In *Proceedings 12th. International Conference on Mathematical and Numerical Aspects of Wave Propagation (Karlsruhe Institute of Technology)*, 2015.

Talks & Presentations

- Upcoming. "A boundary integral formulation for transient thermo-elasto dynamics".
SIAM conference in computational science and engineering (CSE21). March 1–5, 2021, Fort Worth, Texas.
- "Some challenges of the computational study of magnetic equilibrium in fusion reactors".
Computational and Applied Mathematics Seminar. University of Tennessee, Knoxville. October 21, 2020.
- Upcoming. "Coupling BIE and HDG: an application to a free boundary problem from plasma physics."
Minisymposium: Recent advances in mixed and hybrid discontinuous Galerkin methods.
14th World Congress in Computational Mechanics. Paris, July 19-24, 2020. (POSTPONED)
- "Coupling BIE and HDG: an application to a free boundary problem from plasma physics."
XXVI Congreso de Ecuaciones Diferenciales y Aplicaciones / XVI Congreso de Matemática Aplicada.
Special minisymposium in memory of Francisco-Javier Sayas. Gijón, Spain, June 15-19, 2020. (POSTPONED)
- Upcoming. Title TBD. Outstanding Challenges in Computational Methods for Integral Equations.
Banff International Research Station/Casa Matemática Oaxaca. Oaxaca, México. May 31 - June 5, 2020.
(POSTPONED)
- "Quantifying the Uncertainty on Magnetic Equilibrium Computations for Tokamaks".
SIAM Conference on Analysis of Partial Differential Equations. December 11, 2019. La Quinta, California.
- "Coupling Boundary Integral Equations and Partial Differential Equations: From wave-structure interaction to magnetic equilibrium in fusion reactors". Applied mathematics seminar. University of Toronto. September 27, 2019.
- "An un-fitted adaptive hybridizable discontinuous Galerkin solver for axisymmetric plasma equilibrium".
Sherwood Fusion Theory Conference. Princeton Plasma Physics Laboratory. Princeton, New Jersey. April 15-17, 2019.
- "Computational mathematics: from wave-structure interaction to fusion reactors.
Numerical analysis seminar". University of Maryland, College Park. February 12, 2019.
- "Adaptive HDG for semilinear Dirichlet boundary value problems in curved domains".
Sixth Chilean Workshop on Numerical Analysis of Partial Differential Equations. University of Concepción, Chile.
January 22, 2019.
- "Adaptive HDG for semilinear boundary value problems in curved domains: an application to plasma equilibrium".
Applied and Computational Mathematics Seminar. George Mason University. November 30, 2018.
- "Adaptive HDG for semilinear boundary value problems in curved domains: an application to plasma equilibrium".
Fluid Mechanics and Waves Seminar. New Jersey Institute of Technology. November 26, 2018.
- "An h-adaptive HDG solver for Dirichlet boundary value problems in curved domains using embedded polygonal grids:
an application to plasma equilibrium".
Advances in Numerical Approximation of Partial Differential Equations, AMS Sectional Meeting. University of Delaware.
September 29-30, 2018.
- The hybridizable discontinuous Galerkin method: an application to plasma equilibrium in fusion reactors.
Mexican Mathematicians in the World: Perspectives and Recent Contributions. Banff International Research Station/Casa Matemática Oaxaca. Oaxaca, México. June 10-15, 2018.
- "Hybridizable Discontinuous Galerkin tools for the Grad-Shafranov equation".
Sherwood Fusion Theory Conference. Auburn University. Auburn, Alabama. April 23-25, 2018.
- "A Hybridizable Discontinuous Galerkin Solver for axisymmetric Plasma equilibrium".
Applied mathematics seminar. University of Massachusetts, Lowell. April 8, 2018.
- "Hybridizable Discontinuous Galerkin tools for axisymmetric plasma equilibrium".
Latinxs in the mathematical sciences, March 8-10, 2018. Institute of Pure and Applied Mathematics, University of California, Los Angeles.
- "A Hybridizable Discontinuous Galerkin solver for axisymmetric plasma equilibrium".
Numerical Analysis and Scientific Computing Seminar. Courant Institute of Mathematical Sciences.
December 15, 2017.
- "Pseudo-spectral collocation for kinetic equations with energy diffusion".
Plasma Physics Seminar. University of Maryland. November 29, 2017.
- "A Hybridizable Discontinuous Galerkin solver for the Grad-Shafranov equation".
Mid-Atlantic numerical analysis day. Temple University, Philadelphia, PA. November 3, 2017.
- "Pseudo-spectral collocation for kinetic equations with energy diffusion".
Magneto fluid dynamics seminar. Courant Institute of Mathematical Sciences. September 26, 2017.
- "FEM-BEM coupling for transient acoustic scattering by thermoelastic obstacles".
WAVES 2017. 13th International conference on mathematical and numerical aspects of wave propagation.
University of Minnesota, May 18, 2017.
- "Pseudo-spectral collocation with Maxwell polynomials for kinetic equations with energy diffusion".
The Sherwood Fusion Theory Conference 2017. May 1st-3rd, Annapolis, Maryland.

- "BEM/FEM Coupling for transient acoustic scattering by piezoelectric obstacles". SIAM 2016 annual meeting. Boston, Massachusetts. July 11, 2016.
- "Numerical simulation of transient acoustic scattering by a piezoelectric obstacle". DelMar Numerics Day. George Mason University. May 14, 2016.
- "BEM/FEM coupling for transient acoustic scattering by piezoelectric obstacles". Fifth Chilean Workshop on Numerical Analysis of Partial Differential Equations (WONAPDE), University of Concepción, Chile. January 11-15, 2016.
- "Numerical Methods for Time Domain Two-dimensional Wave-structure Interaction". SIAM Conference on Analysis of Partial Differential Equations. December 10, 2015. Arizona.
- "Symmetric BEM/FEM scheme for wave-structure interaction in the time domain". Mid-Atlantic numerical analysis day. Temple University, Philadelphia, Pennsylvania. November 13, 2015.
- "BEM/FEM coupling for transient wave-structure interaction". Finite Element Circus. University of Massachusetts, Dartmouth. October 17, 2015.
- "A system of boundary integral equations for transient wave-structure interaction". WAVES 2015. 12th International conference on mathematical and numerical aspects of wave propagation. Karlsruhe Institute of Technology, Karlsruhe, Germany. July 21, 2015.
- "Time-domain simulation of two-dimensional elastic scattering". SIAM conference on computational sciences and engineering. Salt Lake City, Utah. March 18, 2015.
- "Simulation of linear elastic waves with the Delta Boundary Element Method". Winter research symposium. University of Delaware. February 13, 2015.
- "Transient wave-structure interaction with the Delta Boundary Element method." Poster presentation at the Mid-Atlantic Numerical Analysis Day. Temple University. Philadelphia, Pennsylvania. November 7, 2014.
- "Time-domain Wave-structure interaction with the Delta Boundary Element method". Poster presentation at the Spanish-French School on numerical simulation in physics and engineering. Public University of Navarra. Pamplona, Spain. September, 2014.
- "Boundary integral equations 101". Hallenbeck graduate student seminar. University of Delaware. April 9, 2014.
- "Semi-discrete wave-structure interaction". Poster presentation at the Mid-Atlantic numerical analysis day. Temple University. Philadelphia, Pennsylvania. November 22, 2013.
- "The layman's account on full waveform inversion". Hallenbeck graduate student seminar. University of Delaware. October 23, 2013.
- "On finite volume methods for conservation laws". Hallenbeck graduate student seminar. University of Delaware. May 8, 2013.
- "Implementation of the equal area method for first order conservation laws in Chebfun". Poster presentation at the conference "Chebfun & beyond", University of Oxford. Oxford, United Kingdom. September 18, 2012.
- "Convergence and stability considerations on the numerical solution of transport equations". Mexican Geophysical Union, annual meeting 2010. Puerto Vallarta, México. November, 2010.

Schools & Workshops

- Computational Methods for PDEs: The 7th deal.II users and developers workshop. Colorado State University. Fort Collins, CO. August 3-10, 2019.
- PDE-based Uncertainty Quantification. Argonne National Laboratory. May 20-24, 2019. Lemont, IL.
- East Coast Optimization Meeting. George Mason University. Fairfax, Virginia. April 4-5, 2019.
- Simons Collaboration on Hidden Symmetries and Fusion Energy Annual Meeting, 2019. The Flat Iron Institute, New York. March 28-29, 2019.
- Workshop "Recent Advances and Challenges in Discontinuous Galerkin Methods and Related Approaches". Institute for Mathematics and its Applications, University of Minnesota. June 29-July 1, 2017.
- Workshop. "Computational and Numerical Analysis of Transient Problems in Acoustics, Elasticity, and Electromagnetism". Banff International Research Station. Banff, Canada. January 17-22, 2016.
- IMA Hot topics workshop. "Hydraulic fracturing: From modeling and simulation to reconstruction and characterization". Institute for Mathematics and its Applications. University of Minnesota. May, 2015.
- Jaques-Louis Lions Spanish-French School on numerical simulation in physics and engineering. Public University of Navarra. September, 2014.

- CBMS-NSF Conference "Fast direct solvers for elliptic PDE's". Dartmouth College. June, 2014.
- MSRI Summer School. "Introduction to the mathematics of seismic imaging". Mathematical Sciences Research Institute. University of California, Berkeley. July, 2013.
- NSF Workshop on the Boundary Element Method. " Bridging Education and Industrial Applications". University of Minnesota. May, 2012.
- Workshop on Multiscale Computing in Cloud Physics. University of Delaware. August, 2011.
- Summer school on Partial Differential Equations. National Autonomous University of Mexico, June 2011.
- Summer School on holomorphic foliations and dynamical systems. National Autonomous University of Mexico, June 2010.
- Summer school on averaging methods for periodic differential equations. National Autonomous University of Mexico, June 2009.
- Summer school on scientific computing and numerical relativity. CINVESTAV, 2005.

Teaching Experience

Courses taught

- Spring 2016. MATH 242 (Calculus and Analytic Geometry B). Teaching assistant. University of Delaware.
- Fall 2015. MATH 241 (Calculus and Analytic Geometry A). Teaching assistant. University of Delaware.
- Fall 2015. MATH 221 (Business Calculus). Teaching assistant. University of Delaware.
- Fall 2014. MATH 512 (Contemporary applications of mathematics). Teaching assistant. University of Delaware.
- Fall 2013. MATH 512 (Contemporary applications of mathematics). Teaching assistant. University of Delaware.
- Spring 2013. MATH 241 (Calculus and Analytic Geometry A). Teaching assistant. University of Delaware.
- Fall 2012. MATH 460 (Introduction to systems biology). *Howard Hughes Teaching Assistant*. University of Delaware.
- Spring 2012. MATH 260 (Integrative seminar). *Howard Hughes Teaching Assistant*. University of Delaware.
- Fall 2011. MATH 241 (Calculus and Analytic Geometry A). Teaching assistant. University of Delaware.
- Fall 2011. Topics on theoretical & mathematical physics. Teaching assistant. National Autonomous University of Mexico, School of Sciences.
- Fall 2011. Mathematics for Applied Sciences II. Teaching assistant. National Autonomous University of Mexico, School of Sciences.
- Spring 2011. Topics on theoretical & mathematical physics. Teaching assistant. National Autonomous University of Mexico, School of Sciences.
- Spring 2010. Vector Mechanics. Teaching assistant. National Autonomous University of Mexico, School of Sciences.
- Fall 2009. Heat transfer, waves & fluids. Teaching assistant. National Autonomous University of Mexico, School of Sciences.

Other teaching-related activities

- **Supervision of graduate research**

Masters

 - Ms. Jiaying Liang. M.S. Applied Mathematics, Courant Institute 2017-2018.
Topic: Iterative methods for Finite Element discretizations of semilinear elliptic equations.
(Now in the Ph.D. program in Applied Mathematics and Scientific Computing. University of Maryland, College Park.)

Doctoral

 - Mr. Néstor Sánchez. Ph. D. Applied Mathematics, Universidad de Concepción, Chile. (Current).
Topic: Hybridizable discontinuous Galerkin methods for non-linear equations in domains with curved boundaries.
Co-advised with Manuel Solano.
 - Ms. Jiaying Liang. Ph. D. Applied Mathematics, University of Maryland, College Park. (Current).
Topic: Computational methods for uncertainty quantification in plasma equilibrium.
Co-advised with Howard Elman.
- **Supervision of undergraduate research**
 - Mr. Henry Prior. B.S. Economics and Mathematics, Courant Institute (2017-2018).
Topic: Newton-Krylov methods for ill-posed problems / Machine learning methods for differential equations.

- Mr. Matthew Moyer. B.S. Quantitative Biology, University of Delaware, 2012-2013.
(Now in the Ph. D. program in Applied Mathematics at the New Jersey Institute of Technology)
Topic: Spectral methods for hyperbolic conservation laws.
- **Evaluator of Doctoral dissertations**
 - Mr. Paulo Andrés Zúñiga. Ph. D. in Applied Sciences focused on Mathematical Engineering. Title: "*High-order mixed methods in continuum mechanics*". Universidad de Concepción, Chile (2019).
- **Member of thesis examination committees**
 - Mr. Fernando Peña. Mathematical Engineering. Title: "*A discontinuous Galerkin method for the heat equation in non polygonal domains*". Universidad de Concepción, Chile (2020).
- **Graduate review sessions:** Instructor for five week long review sessions for incoming doctoral students at the Department of Mathematical Sciences, University of Delaware. Ordinary differential equations (Summer 2014) and Analysis (Summer 2015).
- **Graduate qualifier preparation sessions:** Instructor for a five week-long review session for first and second year graduate students preparing to take the doctoral qualifying examinations. Analysis (Winter 2015).
- **Orientation for incoming Teaching Assistants:** As part of a University-wide orientation for incoming teaching assistants. Representative for the Department of Mathematical Sciences for the 2015 and 2016 sessions.

Professional Service

Organization of Minisymposia

- "Mathematical Challenges in Computational Plasma Physics". SIAM—Analysis of Partial Differential Equations. December 11—14, 2019. La Quinta, CA. In collaboration with Antoine Cerfon.
- "Discontinuous Galerkin approximations in plasma physics: building bridges between theory and applications". Sixth Chilean Workshop on Numerical Analysis of Partial Differential Equations, University of Concepción, Chile. January 21-25, 2019. In collaboration with Antoine Cerfon.

Refereeing

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| ● AMS-Mathematical Reviews | ● Journal of Computational Physics |
| ● Applicable Analysis | ● Journal of Computational and Applied Mathematics |
| ● Communications in Computational Physics | ● Journal of Integral Equations and Applications |
| ● Computational and Applied Mathematics | ● Mathematics and Mechanics of Solids |
| ● Computer Physics Communications | ● Numerical Methods for Partial Differential Equations |
| ● Electronic Transactions on Numerical Analysis | ● SIAM Journal of Applied Mathematics |
| ● Indian Journal of Physics | ● SIAM Journal of Numerical Analysis |
| ● International Journal for Numerical Methods in Fluids | ● The Graduate Journal of Mathematics |

Other

- Member of the Selection Committee for the [Fifth Meeting of Mexican Mathematicians in the World](#). Banff International Research Station / Casa Matemática Oaxaca, December 2021.
- Reviewer/Evaluator for the National Council of Science and Technology (CONACyT), Mexico.
- President of the University of Delaware SIAM student chapter. 2012/2013.