Cristian Andrés Inzunza Domínguez

Numerical Analysis of Partial Differential Equations

Contact Information

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Academic Profile

Ph.D. in Applied Sciences with a specialization in Mathematical Engineering and Mathematical Civil Engineer, specialized in the numerical analysis of partial differential equations. My research focuses on mixed and primal variational formulations, finite element methods in Hilbert and Banach spaces, nonlinear and coupled problems, poroelasticity, flow in deformable porous media, and a priori and a posteriori error analysis. It also addresses the establishment of existence, uniqueness, and stability of solutions at the continuous level and for semidiscrete and fully discrete approximations.

Academic and Research Experience

2026–present	**Full-time Faculty Member**, Department of Mathematics, Faculty of Sciences, Universidad de La Serena, La Serena, Chile.
2026–present	**Postdoctoral Researcher**, Universidad Católica de la Santísima Concepción, Concepción, Chile. Supervisor: Sergio Caucao.
2025–2026	**Postdoctoral Researcher**, Center for Mathematical Modeling (CMM), Universidad de Chile, Santiago, Chile. Supervisors: Jessika Camaño and Sergio Caucao.
2019	**Research Assistant**, Center for Research in Mathematical Engineering (CI^{2}MA), Universidad de Concepción, Concepción, Chile.
2018	**Professional Internship**, Department of Physics, Faculty of Physical and Mathematical Sciences, Universidad de Concepción, Concepción, Chile. MATLAB programming of optimization algorithms applied to quantum tomography problems.

Current Research Project

2026–2029	**Principal Investigator**, FONDECYT Postdoctoral Project No. 3260398, ANID-Chile. *Numerical Methods for Nonlinear Poroelasticity and Related Models with Applications in Biomedicine and Engineering*. Current host institution: Universidad Católica de la Santísima Concepción. Sponsoring researcher: Sergio Caucao.

University Teaching Experience

2024–2026 | **Undergraduate Lecturer**, Universidad Católica de la Santísima Concepción, Concepción, Chile.

- **2024-I:** Introduction to Algebra, Algebra, Continuous Analysis in Two and Three Dimensions, and Calculus III.
- **2024-II:** Calculus I, Linear Algebra, Differential Equations, and Numerical Calculus.
- **2025-II:** Algebra.
- **2026-I:** Calculus.
- **2026-II:** Multivariable Calculus.

2014–2018 | **Teaching Assistant**, Faculty of Physical and Mathematical Sciences, Universidad de Concepción, Concepción, Chile.
Teaching assistantships in Numerical Calculus, Algebra I, Algebra II, Calculus I, Numerical Methods, and Introduction to University Mathematics.

Education

2020–2024 | Universidad de Concepción, Chile.
Doctor in Applied Sciences with mention in Mathematical Engineering.

2011–2018 | Universidad de Concepción, Chile.
Mathematical Civil Engineer.

Theses

2024 | **Ph.D. Thesis:** *Banach Space-Based Mixed Finite Element Methods for Coupled Diffusion Problems and Related Models*.
Advisor: Gabriel N. Gatica. Contact: ggatica@ci2ma.udec.cl.

2018 | **Undergraduate Thesis:** *An Augmented Fully-Mixed Finite Element Method for a Coupled Flow-Transport Problem*.
Advisor: Gabriel N. Gatica.

Scholarships

2020–2024 | National Doctoral Scholarship, Academic Year 2020, ANID-Chile.

Ph.D. Coursework

2020–1 | Numerical Analysis; Continuum Mechanics; Functional Analysis.

2020–2 | Topics in Finite Elements I; Finite Element Theory; Partial Differential Equations.

2021–1 | Research Seminar I; Discontinuous Galerkin Method: Theory and Applications.

2021–2 | Research Seminar II.

Publications

Author of ten articles in international journals, nine published and one accepted, in the areas of numerical analysis of partial differential equations, finite element methods, and coupled problems.

Published Journal Articles

- S. Caucao, G.N. Gatica, L.F. Gatica and C. Inzunza, *A priori and a posteriori error analysis of a mixed FEM for stationary convective Brinkman–Forchheimer flows with variable porosity*. Journal of Computa-

tional and Applied Mathematics, vol. 492, article 118115, 2027.

- G.N. Gatica, C. Inzunza and R. Ruiz-Baier, *Primal-mixed finite element methods for the coupled Biot and Poisson–Nernst–Planck equations*. Computers & Mathematics with Applications, vol. 186, pp. 53–83, 2025.
- J. Careaga, G.N. Gatica, C. Inzunza and R. Ruiz-Baier, *New Banach spaces-based mixed finite element methods for the coupled poroelasticity and heat equations*. IMA Journal of Numerical Analysis, vol. 45, pp. 1936–1984, 2025.
- G.N. Gatica, C. Inzunza and F.A. Sequeira, *New Banach spaces-based fully-mixed finite element methods for pseudostress-assisted diffusion problems*. Applied Numerical Mathematics, vol. 193, pp. 148–178, 2023.
- S. Caucao, E. Colmenares, G.N. Gatica and C. Inzunza, *A Banach spaces-based fully-mixed finite element method for the stationary chemotaxis–Navier–Stokes problem*. Computers & Mathematics with Applications, vol. 145, pp. 65–89, 2023.
- G.N. Gatica, C. Inzunza and F.A. Sequeira, *A pseudostress-based mixed-primal finite element method for stress-assisted diffusion problems in Banach spaces*. Journal of Scientific Computing, vol. 92, no. 3, article 103, 2022.
- G.N. Gatica, C. Inzunza, R. Ruiz-Baier and F. Sandoval, *A posteriori error analysis of Banach spaces-based fully-mixed finite element methods for Boussinesq-type models*. Journal of Numerical Mathematics, vol. 30, no. 4, pp. 325–356, 2022.
- G.N. Gatica and C. Inzunza, *On the well-posedness of Banach spaces-based mixed formulations for the nearly incompressible Navier–Lamé and Stokes equations*. Computers & Mathematics with Applications, vol. 102, pp. 87–94, 2021.
- G.N. Gatica and C. Inzunza, *An Augmented Fully-Mixed Finite Element Method for a Coupled Flow-Transport Problem*. Calcolo, vol. 57, no. 1, article 8, 2020.

Accepted Articles

- J. Camaño, S. Caucao and C. Inzunza, *A five-field mixed formulation for the fully dynamic Biot–Brinkman model*. ESAIM: Mathematical Modelling and Numerical Analysis, accepted, 2026. doi:10.1051/m2an/2026094. Preprint 2025-28, CI^{2}MA, Universidad de Concepción.

Preprints and Submitted Articles

- C. Inzunza, *A pseudostress-based fully mixed finite element method for the stationary Biot–Poisson–Nernst–Planck system*. Submitted, 2026. doi:10.13140/RG.2.2.11969.31844.
- J. Camaño, S. Caucao and C. Inzunza, *A pseudostress-based fully mixed formulation for the unsteady Biot–Brinkman model*. Preprint, Grupo de Investigación en Análisis Numérico y Cálculo Científico (GIANuC^2), Universidad Católica de la Santísima Concepción, 2026.
- J. Careaga and C. Inzunza, *Mixed finite element methods for a heat-assisted model of sedimentation*. arXiv:2610.28903, 2026.
- J. Camaño, S. Caucao and C. Inzunza, *A locking-free mixed-primal formulation for the Biot–Brinkman–Forchheimer model*. Preprint 2026-9, Grupo de Investigación en Análisis Numérico y Cálculo Científico (GIANuC^2), Universidad Católica de la Santísima Concepción, 2026.

Works in Preparation

- J. Camaño, S. Caucao and C. Inzunza, *A mixed formulation for the quasi-static Biot–Brinkman–*

Forchheimer model.

Conference and Seminar Presentations

2026–Oct. | **XXXIV Congreso de Matemáticas Capricornio (COMCA 2026)**, Universidad de La Serena, Chile.
A pseudostress-based fully mixed formulation for the unsteady Biot–Brinkman model.

2026–Oct. | **Seminario Caleta Numérica**, Instituto de Matemáticas, Pontificia Universidad Católica de Valparaíso, Chile.
A five-field mixed formulation for the fully dynamic Biot–Brinkman model.

2026–Apr. | **XXXVIII Jornada de Matemática de la Zona Sur**, Universidad del Bío-Bío, Concepción, Chile.
A five-field mixed formulation for the fully dynamic Biot–Brinkman model.

2025–Oct. | **Encuentro GIANuC^2: Métodos Numéricos para Sistemas Multifísicos – Teorías y Aplicaciones**.
A mixed formulation for the fully dynamic Biot–Brinkman model.

2025–Apr. | **Seminario del Departamento de Matemática y Física Aplicadas, UCSC**.
Banach spaces-based mixed methods for coupled poroelasticity and heat equations.

2024–Jan. | **Workshop on Numerical Analysis for PDE (WONAPDE 2024)**.
Fully mixed methods for the coupled poroelasticity and Poisson–Nernst–Planck equations.

2023–Dec. | **The 67th Annual Meeting of the Australian Mathematical Society (AustMS 2023)**.
A Banach spaces-based fully-mixed finite element method for the coupled poroelasticity and Poisson–Nernst–Planck equations.

2023–Oct. | **Computational Mathematics Seminar Series, Monash University**.
A Banach spaces-based mixed-primal finite element method for pseudostress-assisted diffusion problems.

Research Visits

2023 | **Research Visit**, School of Mathematics, Monash University, Australia.
Advisor: Ricardo Ruiz-Baier. Contact: ricardo.ruizbaier@monash.edu.

2019 | **Research Visit**, Department of Mathematics, Simon Fraser University, Burnaby, B.C., Canada.
Advisor: Nilima Nigam. Contact: nigam@math.sfu.ca.

Academic Event Organization

2025–Oct. | **GIANuC^2 Meeting: Numerical Methods for Multiphysics Systems – Theories and Applications**.

Peer Review

2025 | *Computers & Mathematics with Applications*.
Finite Elements in Analysis and Design.

Programming Languages and Scientific Software

Advanced proficiency: LaTeX, MATLAB, FreeFEM++, FEniCS.