Ignacio Brevis Vergara

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Experience

Nov 2022-	**Research Fellow**, School of Mathematical Sciences, University of Nottingham, Nottingham, United Kingdom
Apr 2019-Oct 2022	**Postdoctoral Fellow**, Institute of Mathematics, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile
Jul 2018-Dec 2019	**Part-time Lecturer**, Department of mathematics, Universidad Técnica Fererico Santa María, Valparaíso, Chile
Apr 2017-Jun 2018	**Technical staff**, *Laboratory for Scientific Image Analysis* (SCIAN-Lab), BNI, Program of Anatomy and Development, ICBM, Faculty of Medicine, Universidad de Chile, Santiago, Chile
Nov 2016-Mar 2017	**Project Engineer**, *Center for Mathematical Modeling* (CMM), FCFM, Universidad de Chile, Santiago, Chile
Mar 2014-Dec 2014	**Part-time Lecturer**, Department of Mathematics and Computer Science, Faculty of Sciences, Universidad de Santiago de Chile, Santiago, Chile

Education

Ph.D. **Universidad de Chile**, Department of Mathematical Engineering — 2018
Ph.D. in Engineering Sciences, Mention in Mathematical Modeling
Dissertation: *Source Time Reversal Methods for Acoustic and Elastic Waves*
Advisor: Prof. Jaime H. Ortega
Co-advisor: Prof. David Pardo (Universidad del País Vasco (UPV/EHU))

Eng **Universidad de Santiago de Chile**, Department of Mathematics and Computer Science — 2011
Mathematical Engineer
Thesis: *Fractional Fourier Transform in Magnetic Resonance Imaging* (spanish)
Advisor: Prof. Carlos Lizama

B.S. **Universidad de Santiago de Chile**, Department of Mathematics and Computer Science — 2010
B.S. in Mathematics

Research Interests

- Numerical Analysis
- Scientific Computing
- Deep Learning
- Partial Differential Equations
- Machine learning
- Inverse Problems

Computational Skills

- Python
- PyTorch
- LaTeX
- FEniCS
- Matlab

Publications

In preparation or Submitted

- C. Montoya, **I. Brevis**, and D. Bolivar, **Inverse source problems for coupled parabolic systems from measurements of one internal component**.

Published

- **I. Brevis**, I. Muga, D. Pardo, O. Rodriguez, and K. G. van der Zee, **Learning quantities of interest from parametric PDEs: An efficient neural-weighted Minimal Residual approach**, *Computers and Mathematics with Applications*, Vol. 164, 2024, pp. 139–149.
- **I. Brevis**, I. Muga, and K. G. van der Zee, **Neural control of discrete weak formulations: Galerkin, least-squares & minimal-residual methods with quasi-optimal weights**, *Computer Methods in Applied Mechanics and Engineering*, Vol. 402, 2022, pp. 115716.
- **I. Brevis**, I. Muga, and K. G. van der Zee, **A machine-learning minimal-residual (ML-MRes) framework for goal-oriented finite element discretizations**, *Computers and Mathematics with Applications*, Vol. 95, 2021, pp. 186–199.
- **I. Brevis**, A. Rodríguez-Rozas, J. H. Ortega, and D. Pardo, **Source time reversal (STR) method for linear elasticity**, *Computers and Mathematics with Applications*, Vol. 77, Issue 5, 2019, pp. 1358–1375.
- **R. I. Brevis**, J. H. Ortega, and D. Pardo, **A source time reversal method for seismicity induced by mining**, *Inverse Problems and Imaging*, Vol. 11, Issue 1, 2017, pp. 25–45.

Research Visits

May 2022-Jun 2022	**Research Stay**, *part of the project MATHROCKS*, Basque Center for Applied Mathematics (BCAM), Bilbao, Spain
Jul 2021-Jan 2022	**Research Stay**, *part of the project MATHROCKS*, Department of Applied Mathematics, Statistics, and Operational Research, Universidad del País Vasco (UPV/EHU), Leioa, Spain
Dec 2020-Mar 2021	**Research Stay**, *part of the project MATHROCKS*, Department of Applied Mathematics, Statistics, and Operational Research, Universidad del País Vasco (UPV/EHU), Leioa, Spain
Apr 2015-Feb 2016	**Internship**, *Mathematical Modeling, Simulations, and Industrial Applications* (M2SI) group, Department of Applied Mathematics, Statistics, and Operational Research, Universidad del País Vasco (UPV/EHU), Leioa, Spain

Awards and Fellowships

2020	**Postdoctoral grant**	*Concurso Fondecyt de Postdoctorado* at Pontificial Universidad Católica de Valparaíso (project id: 3200827).
2019	**Postdoctoral grant**	*Concurso Interno* at Pontificial Universidad Católica de Valparaíso (project id: 37.0 / 2019).
2012	**PhD scholarship**	*Beca de Doctorado Nacional* at Conicyt (project id: 21120646).

Research Projects Participation

2018-2023 **EPSRC EP/W010011/1** *Additive and intelligent manufacturing of multi-functional membranes (AIM3)*
(PI: Begum Tokay).
Research fellow (Nov 2022-Jun 2025).

2018-2023 **H2020-MSCA-RISE-2017-777778** *Multiscale Inversion of Porous Rock Physics using High-Performance Simulators: Bridging the Gap between Mathematics and Geophysics (MATHROCKS)*
(PI: David Pardo).
Researcher (Dec 2020-Mar 2021) and (Jul 2021-Jan 2022).

2020-2022 **FONDECYT de Postdoctorado 3200827**, *Data-driven methods for solving differential equations using deep learning and goal-oriented finite element spaces.*
Principal Investigator (Apr 2020-Nov 2022).

2016-2019 **FONDECYT Iniciación 11161033**, *Breaking the Brightness Constancy Constraint in Optical Flow Methods for in vivo Biomedical Imaging.*
(PI: Mauricio Cerda)
Technical Staff (Apr 2017-Jul 2018).

2015-2017 **H2020-MSCA-RISE-2014 644202** *Geophysical Exploration using Advanced Galerkin Methods (GEAGAM).*
(PI: David Pardo)
Researcher (Apr 2015-Dec 2015)

2011-2015 **FONDECYT Regular 1111012** *Variational Approach for Image Processing Problems.*
(PI: Jaime H. Ortega)
PhD. Thesis Student (Mar 2015-Dec 2015)

2010-2014 **FONDECYT Regular 1100485** *Analysis of Continuous, Discrete and Stochastic Evolution Equations in Banach Spaces.*
(PI: Carlos Lizama)
Thesis Student (Mar 2012-Sep 2012)

2009-2013 **FONDECYT Regular 1090470** *Qualitative Properties of some Nonlinear Partial Differential Equations: Analysis and Simulation.*
(PI: Ignacio Guerra)
Technical Staff (Sep 2009-Jan 2010)

Conferences and Workshops

Sep 2023 **2nd IACM Mechanistic Machine Learning and Digital Engineering for Computational Science Engineering and Technology Conference 2023**,
The University of Texas at El Paso, Texas, USA

Mini-symposium: Deep Learning Residual Minimization Methods
Title: *Learning quantities of interest from parametric PDEs*

Feb 2023 **SIAM Conference on Computational Science & Engineering (CSE23)**,
RAI Congress Centre, Amsterdam, Netherlands

Poster Session
Title: *A machine learning minimal residual method for solving quantities of interest of parametric PDEs*

Jun 2022 **VI ECCOMAS CONGRESS 2022**,
NOVA Spektrum, Oslo, Norway

Mini-symposium: Deep Learning in Scientific Computing

Talk: *A machine learning minimal residual method for solving quantities of interest of parametric PDEs*

Jul 2021 **VI ECCOMAS YOUNG INVESTIGATORS CONFERENCE**,
Universitat Politècnica de València, Valencia, Spain (Virtual Conference)

Mini-symposium: Stabilized and unconditionally stable FE methods for challenging problems in engineering and science
Talk: *A machine-learning minimal-residual (ML-MREs) framework for goal-oriented finite element discretizations*

Jun 2021 **SIAM Conference on Mathematical & Computational Issues in the Geosciences (GS21)**,
Politecnico di Milano, Milan, Italy (Virtual Conference)

Mini-symposium: Enhanced Forward Modelling using Machine Learning Techniques
Talk: *A machine-learning minimal-residual (ML-MREs) framework for goal-oriented finite element discretizations*

Aug 2019 **IX Congreso Internacional de Matemática Aplicada y Computacional**,
Universidad Nacional Agraria La Molina, Lima, Perú

Talk: *Time reversal methods for source reconstruction on acoustic and elastic waves*

Apr 2019 **XXXII Jornada de Matemática de la Zona Sur**,
Universidad de Magallanes, Punta Arenas, Chile

Talk: *Time reversal methods for source reconstruction on acoustic and elastic waves*

Jan 2019 **Valparaíso's Mathematics and its Applications Days 2019**,
Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile

Talk: *Time reversal methods for source reconstruction on acoustic and elastic waves*

Jan 2018 **3er MINIWORKSHOP Control y Problemas Inversos de EDP**,
Universidad Técnica Federico Santa María, Valparaíso, Chile

Talk: *Source time reversal methods for seismicity induced by mining*

Nov 2016 **X CONGRESS GAFEVOL 2016**,
Universidad de Santiago de Chile, Santiago, Chile

Talk: *A source time-reversal method for seismicity induced by mining*

Nov 2010 **V Taller de Análisis Funcional y Ecuaciones de Evolución**,
Universidad de Santiago de Chile, Santiago, Chile

Talk: *Transformada de Fourier fraccionaria en imágenes de resonancia magnética*

Teaching

Lectures

Fall 2022 **Elective: Deep learning for solving PDEs**, Mathematics, Pontificia Universidad Católica de Valparaíso.

2018-2019 **Algebra I**, Engineering, Universidad Técnica Federico Santa maría.

2014 **Vector calculus**, Mathematical Engineering, Universidad de Santiago de Chile.

Teaching Assistant

2018 **Algebra & Calculus**, Engineering, Universidad Técnica Federico Santa maría.

Fall 2008 **Calculus**, Mathematical Engineering, Universidad de Santiago de Chile.

Spring 2006 **Introduction to complex analysis**, Mathematical Engineering, Universidad de Santiago de Chile.

Specialization courses

- **Neural Networks**, *Deep Neural Networks with PyTorch*, Instructor Joseph Santarcangelo, IBM, Online. Apr 2023.
- **Machine Learning**, *Convolutional Neural Networks*, Instructor Andrew Ng, DeepLearning.AI, Online. May 2020
- **Machine Learning**, *Structuring Machine Learning Projects*, Instructor Andrew Ng, DeepLearning.AI, Online. May 2020
- **Machine Learning**, *Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization*, Instructor Andrew Ng, DeepLearning.AI, Online. May 2020
- **Machine Learning**, *Neural Networks and Deep Learning*, Instructor Andrew Ng, DeepLearning.AI, Online. Apr 2020
- **Finite element**, *Fast and smooth simulation of space-time problems*, Prof. Maciej Paszynski, Institute of Mathematics (IMA), Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile. Jul 2017
- **Finite element**, *Coding the FEM II*, Prof. David Pardo, Cajón del Maipo, Chile. Jan 2017
- **Finite element**, *Coding the FEM*, Prof. David Pardo, Casablanca, Chile. Sep 2014
- **Summer course**, *Curso Iniciação Científica: Análise na reta*, Prof. Fagner Araruna, Universidade Federal de Pernambuco, Recife, Brasil. Jan 2008-Feb 2008

Thesis Advising

Master Level

2023 **Max Bradley**,
Mathematics 4th Year Dissertation, University of Nottingham.

Title: *Utilising neural networks to approximate functions and solve differential equations with network enhancement methods*
(Co-supervision with Kris van der Zee).

2023 **Thomas Carruthers**,
Mathematics 4th Year Dissertation, University of Nottingham.

Title: *Using Deep Learning Algorithms and Uzawa Iterations to Solve Weak First-Order PDEs*
(Co-supervision with Kris van der Zee).

Undergraduate Level

2022 **Carlos Gonzalez Moraga**,
Mathematics, Pontificia Universidad Católica de Valparaíso.

Title: *Deep Learning for solving Partial Differential Equations* (in spanish)
(Co-supervision with Paulina Sepúlveda).

Reviewer

- **Journal of Computational Science**
- **Computer Methods in Applied Mechanics and Engineering**
- **Engineering with Computers**
- **National Science Centre Poland** www.ncn.gov.pl

Outreach

- **Research Group Member**, *IMA Numerics* (Web page), Valparaíso, Chile. 2019-2022
- **Research Group Member**, *Grupo de Análisis Funcional y Ecuaciones de Evolución* (GAFEVOL) (Web page), Santiago, Chile. 2009-2012

Languages

Spanish	Fluent (Native)
English	Advanced (SELT UKVI level B1 passed with merit)

(Current version: April 26, 2024)