Nicolás Alejandro Barnafi Wittwer | Ph.D.

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Education

Politecnico di Milano	**Milan – Italy**
Ph.D. in Mathematics, Mathematical Engineering	*2017–2021*
Pontificia Universidad Católica de Chile	**Santiago – Chile**
M.Sc. in Civil Engineering, Civil Engineering	*2016–2017*
Pontificia Universidad Católica de Chile	**Santiago – Chile**
Professional degree, Industrial Civil Engineering, diploma in Mathematics	*2010–2016*

Experience

Pontificia Universidad Católica de Chile — **Santiago – Chile**
Assistant Professor — *2024-current*

Center for Mathematical Modeling — **Santiago – Chile**
CMM-CNRS Chair of Excellence Post-doc researcher — *2023-current*

Pontificia Universidad Católica de Chile — **Santiago – Chile**
Post-doc researcher — *2023*
Oxygen supply of living tissues under large deformations.

Universidad de Chile — **Santiago – Chile**
Post-doc researcher — *2022-2023*
The liquid crystal behavior of ventricular muscular fibers.

Johannes Kepler University — **Linz – Austria**
Invited research collaboration — *2022*
Development of a burn injury poroelastic model for the myocardium with Argyrios Petras, Massimiliano Leoni, and Luca Gerardo-Giorda.

Università degli Studi di Pavia — **Pavia – Italy**
Post-doc researcher — *2022*
Development of scalable preconditioners for cardiac electromechanics.

Università degli Studi di Milano — **Milan – Italy**
Post-doc researcher — *2021*
Development of scalable preconditioners for cardiac mechanics.

LATAM Airlines — **Santiago – Chile**
Junior Data Analyst — *2016*
Analysis of navigation data in the web page of the company and posterior creation of classification models to predict when a client stops navigating the site.

FORIS — **Santiago – Chile**
Junior Software Developer — *2013*

Development of a Python interface to migrate the Machine Learning backend of the company, previously developed in R, to Python.

Programming experience

Overall proficiency in HPC simulations, satisfactory experience up to thousands of processors in various types of problems (poromechanics, electrophysiology, fluid dynamics, Maxwell equations, nonlinear elasticity).

Languages: Python, C/C++, Julia

Scientific computing: Scipy, FEniCS, Firedrake, deal.II, PETSc

Linux administration: Web development, server configuration, containers, Slurm

Conference attendance

WONAPDE	**Concepción – Chile**
Speaker, Efficient solvers in nonlinear poroelasticity	*2024*
WONAPDE	**Concepción – Chile**
Speaker, Cardiac ablation as a multiphase continuum	*2024*
WONAPDE	**Concepción – Chile**
Organizer, MS: Effective solvers for innovative discretizations	*2024*
SOMACHI	**Santiago – Chile**
Speaker, Discretización consistente de la poroelasticidad no-lineal	*2023*
Special Semester	**Linz – Austria**
Speaker, Thermoporoelastic modeling of cardiac ablation	*2023*
Workshop Mat. Interdisciplinar	**Concepción – Chile**
Speaker, Modelos matemáticos para la cardiología computacional	*2023*
DIM-PDE Seminar	**Santiago – Chile**
Speaker, Variational techniques for non-trivial boundary conditions	*2023*
ICIAM2023	**Tokyo - Japan**
Speaker, Scalable, parallel and robust solvers for cardiac simulations	*2023*
ICIAM2023	**Tokyo - Japan**
Organizer, MS: Efficient and scalable solvers for multiscale phenomena	*2023*
Caleta Numérica	**Valparaíso – Chile**
Speaker, Matemática computacional para tejidos blandos	*2023*
SIAMGS23	**Bergen – Norway**
Speaker, Robust and scalable solvers in nonlinear poroelasticity	*2023*
YIC23	**Porto – Portugal**
Speaker, Anderson acceleration for robust and scalable quasi-Newton methods.	*2023*
LSSC23'	**Sozopol – Bulgary**
Speaker, Accelerated Quasi-Newton schemes for multiphysics.	*2023*
M2P	**Taormina – Italy**
Speaker, A bridge between cardiac fibers and liquid crystals.	*2023*
JMZS2023	**Concepción – Chile**
Attendee, Jornadas Matemáticas de la Zona Sur.	*2023*

IPMAS2023   **Santiago − Chile**
Attendee, Inverse problems methods, applications and synergies.   *2023*

MCFM2022   **Cetraro − Italy**
Speaker, Robust and scalable solvers for cardiac electromechanics   *2022*

GACM2022   **Essen − Germany**
Speaker, A variational approach for the Bidomain equations in elect   *2022*

BioTOMath2022   **Torino − Italy**
Attendee, Mathematical Challenges in Biology and Medicine   *2022*

MATHMOD2022   **Vienna − Austria**
Speaker, Large strain porochemoelastic model for [...] myocardial oedema   *2022*

IMG2022   **Lugano − Switzerland**
Speaker, Robust and scalable solvers for cardiac electormechanics   *2022*

WCCM2022   **Online**
Speaker, Efficient solvers in cardiac mechanics   *2022*

CMBE22   **Milan − Italy**
Speaker, Scalable parallel solvers for cardiac electromechanics   *2022*

COLIBRI Focus Workshop 2022   **Graz − Austria**
Speaker, Large strain porochemoelastic model for [...] myocardial oedema   *2022*

DDM   **Milan − Italy**
Attendee, Summer School on Advanced Domain Decomposition Methods   *2021*

Young MNCM   **Pavia − Italy**
Organizer, Young Researchers Workshop on Num and Math Cardiac Modeling   *2021*
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SIMAI2021   **Parma − Italy**
Speaker, Talk 1: Cardiac poromechanics, Talk 2: Scalable solvers for mechanics   *2021*

YAMC2021   **Leuca − Italy**
Speaker, Cardiac modeling: From micro to macro scales   *2021*

MCF2021   **Milan − Italy**
Speaker, Scalable domain decomposition preconditioners for cardiac mechanics   *2021*

SIAM GS 21   **Online**
Speaker, Numerical Approximation and Efficient Solvers for [...] linear poromechanics *2021*

5th Soft Tissue Workshop   **Online**
Speaker, A novel mathematical novel for cardiac perfusion   *2021*

Structure, Regularity, and Robustness in the Approximation of PDEs   **Milan − Italy**
Attendee   *2020*

Intelligent Machines and Mathematics   **Bologna–Italy**
Attendee   *2019*

Mathematical and Computational Aspects of Machine Learning   **Pisa − Italy**
Attendee   *2019*

RISM iHeart: Modelling the Cardiac Function   **Varese − Italy**
Speaker, Numerical Analysis of a linearized poro-hyperelastic formulation   *2019*

HPC for Industry 4.0	**Milan – Italy**
Attendee	*2019*
Mathematical and Numerical Modeling of the Cardiovascular System	**Rome – Italy**
Attendee	*2018*
Computational Methods in Biology and Biomedicine	**Santiago – Chile**
Speaker, Mixed formulation of the lung registration problem	*2016*
Annual Meeting '16	**Boston – USA**
Speaker, Variational approach to lung registration	*2016*
WONAPDE '16	**Concepción – Chile**
Attendee	*2016*

Extra formation

Course: Shape and topology optimization by Grégoire Allaire (2023, CMM, Chile).

Julia: Julia Academy, self-paced training programmes (2022, online).

OpenMP/MPI: ARCHER2 self-paced training programmes (2022, online).

Containers: ARCHER2 Training for container technology and deplyoment for HPC (2021, online).

Firedrake: ARCHER2 Training, usage for scalable PDE solvers (2021, online).

Nextflow: University of Pavia, workshop on workflow technologies (2021, online).

Awards and Grants

CMM-CNRS Research fellowship: Four year researcher position	*2023*
ICIAM Travel Support program: Travel funds for ICIAM2023 conference	*2023*
ANID postdoctoral grant: Chilean grant for a 3-year postdoc.	*2023*
Best Master's thesis: Award granted to outstanding thesis in Mathematical Engineering.	*2017*
Winner of Big Data Marathon: Wildfire prediction with C. Levicán and M. Ramírez.	*2017*

Languages

Spanish: Native

English: Fluent, IELTS Certified C2

Italian: Fluent

French: Basic

Other activities

Unversità degli Studi di Pavia	**Pavia – Italy**
IT committee for administration of HPC cluster EOS	*2022*
Unversità degli Studi di Pavia	**Pavia – Italy**
Organizer of minisymposium "Fluid flows and porous media" in GIMC-SIMAI	*2022*
Unversità degli Studi di Pavia	**Pavia – Italy**
Organizer of Workshop on Mathematical and Numerical Cardiac Modeling	*2021*

Università degli Studi di Milano **Milan − Italy**
Informatic commitee Post-Doc representative *2021*

SIAM-PUC Student Chapter **Santiago − Chile**
President & Founder *2013–2015*
- Organization of first National Meeting of Mathematical Engineering (ENIM2015)
- Organization of multiple seminars and short courses on Applied Mathematics

Teaching **Chile, Italy**
Teacher assistant & Tutor *2011–2018*
- Teacher assistant @ Pontificia Universidad Católica de Chile: Calculus (I, II & III), Linear Algebra, Analysis, Programming, Optimization, Statistical Learning, Finite elasticity
- Teacher assistant @ Politecnico di Milano: Numerical methods for Engineering

Publications

- Barnafi N, Petras A, Gerardo-Giorda L. Fully nonlinear inverse poroelasticity: stress-free configuration recovery. CMAME (2024).
- Barnafi N, Regazzoni F, Riccobelli D. Reconstructing relaxed configurations in elastic bodies: mathematical formulations and numerical methods for cardiac modeling. CMAME (2024).
- Barnafi N, Pavarino LF, Scacchi S. A comparative study of scalable multilevel preconditioners for cardiac mechanics. Journal of Computational Physics. (2023).
- Barnafi N, Dassi F, Scacchi S. Parallel block preconditioners for virtual element discretizations of the time-dependent Maxwell equations. Journal of Computational Physics (2023).
- Barnafi N, De Oliveira Vilaca LM, Milinkovitch MC, Ruiz-Baier R. Coupling chemotaxis and growth poromechanics for the modelling of feather primordia patterning. Mathematics (2022).
- Barnafi N, Pavarino LF, Scacchi S. Parallel inexact Newton-Krylov and quasi-Newton solvers for nonlinear elasticity. CMAME (2022).
- Barnafi N, Gómez-Vargas B, Lourenço WJ, Reis RF, Rocha BM, Lobosco M, Ruiz-Baier R, Weber dos Santos R. Finite element methods for large-strain poroelasticity/chemotaxis models simulating the formation of myocardial oedema. Journal of Scientific Computing (2022).
- Barnafi N, Huynh NMM, Pavarino LF, Scacchi S. Parallel nonlinear solvers in computational cardiac electrophysiology. MATHMOD Conference Proceedings (2022).
- Barnafi N, Both JW. Iterative quasi-Newton solvers for poromechanics applied to heart perfusion. ECCOMAS 2021 Young Investigators Conference Proceedings (2022).
- Barnafi N, Di Gregorio S, Dede' L, Zunino P, Vergara C, Quarteroni A. A multiscale poromechanics model integrating myocardial perfusion and systemic circulation. SIAM Journal on Applied Mathematics (2022).
- Both JW, Barnafi N, Radu FA, Zunino P, Quarteroni A. Iterative splitting schemes for a soft material poromechanics model. Computer Methods in Applied Mechanics and Engineering (2022).
- Barnafi N, Gatica GN, Hurtado DE, Miranda W, Ruiz-Baier R. A posteriori error estimates for primal and mixed finite element approximations of the deformable image registration problem. SIAM Journal on Imaging Sciences (2021).
- Barnafi N, Gatica GN, Hurtado DE, Miranda W, Ruiz-Baier R. New primal and dual-mixed finite element methods for stable image registration with singular regularization. Mathematical Models and Methods in Applied Sciences (2021).
- Barnafi N, Zunino P, Dede' L, Quarteroni A. Mathematical analysis and numerical approximation of a general linearized poro-hyperelastic model. Computers and Mathematics with Applications (2020).
- Barnafi N, Gatica GN, Hurtado DE. Primal and mixed finite element methods for deformable image registration problems. SIAM Journal on Imaging Sciences (2018).

Preprints

- Osses A, Barnafi N. Frank-Oseen type solutions with orbits and vortices. HAL. 2023.
- Bansal A, Barnafi NA, Pandey DN. Nitsche method for Navier-Stokes equations with slip boundary conditions: Convergence analysis and VMS-LES stabilization. arXiv (2023).
- Barnafi N, Osses A. Modeling of cardiac fibers as oriented liquid crystals. arXiv (2023).
- Barnafi N, NMM Huynh, Pavarino LF, Scacchi S. Analysis and numerical validation of robust parallel nonlinear solvers for implicit time discretizations of the Bidomain equations. arXiv (2022).