

David HERNÁNDEZ–ARISTIZÁBAL

Computational Scientist
Mechanics & Biology
Driving licence (B)

Contact

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Programming

Python	5 years
Git / Linux	5 years
Fortran	3 years
Matlab	3 years

Simulation software

FEniCSx	2 years
Code_Aster	3 years
Abaqus (UEL)	3 years
Gmsh	5 years
ParaView	2 years

Methods

Design of experiments
Response-surface models
Nonlinear solvers
Moving-boundary problems
Parallel computing (MPI)

Languages

French	C1
English (IELTS 7.5)	C1
Spanish	Native

Profile

Computational scientist with five years' experience in the mathematical modelling of biological and mechanical systems. Specialist in finite element and multiphysics simulation, from the mathematical model to validated open-source code, and in the statistical design of simulation studies. Author of seven peer-reviewed publications (six as first author), used to working on interdisciplinary projects end to end and communicating complex results. Based in Nice; seeking industrial R&D roles in numerical simulation, computational biology or scientific software.

Professional Experience

Postdoctoral Researcher in Computational Mechanobiology
Université Côte d'Azur – Nice, France — Dec. 2024 – Present

- Developed a computational framework for cell migration and cancer invasion based on biomembrane mechanics; open source on GitHub (Python, FEniCSx).
- Identified how membrane tension and cell–nucleus coupling control the passage of cells through narrow constrictions.
- Showed how basement-membrane turnover enables protease-independent cancer invasion, using design of experiments and response-surface metamodels (R^2 0.93–0.98).
- Analysed the conditions that make a leader cell during collective invasion (ongoing).
- Worked on an interdisciplinary research project with mechanicians, biologists and mathematicians.
- Ran simulation campaigns in parallel on computing clusters (Slurm, MPI) and sped up the code by up to 3.5× through profiling, vectorisation and numba.
- Taught 18h of Calculus II and 20h of statistics.

Lecturer – Programming for Engineering (online)
Institución Universitaria de Envigado – Colombia — 2026

- Taught 24h per semester in the Master's in Engineering: scientific programming in Python and Matlab, modelling and simulation, and statistical learning.

Doctoral Researcher – Bio-Inspired Design of Mechanical Joints
Aix-Marseille University – Aix-en-Provence, France — Oct. 2021 – Nov. 2024

- Developed a bio-inspired generative-design method for contact interfaces that, unlike shape optimisation, does not need a starting shape close to the final one (Python, Code_Aster, Gmsh).
- Generated interfaces with up to 35% more uniform pressure under static loads, and up to 73% lower peak shear stress under time-dependent loads.
- Built response-surface metamodels from full-factorial designs of experiments to quantify how design parameters drive pressure uniformity.
- Developed a wear-simulation framework (Archard's law, Code_Aster) predicting about 10% less maximum wear for a 3D-printed bio-inspired joint than for a cylindrical one.
- Co-supervised a Master's internship on the wear of mechanical joints.

Graduate Researcher – Computational Modelling of Cell Migration
Universidad Nacional de Colombia – Bogotá, Colombia — Sep. 2019 – Jul. 2021

- Developed a computational model of single-cell migration coupling cell mechanics and membrane biochemistry on a deforming domain.
- Extended Abaqus with a custom finite element (Fortran 77) for moving-boundary multiphysics problems, with remeshing in Matlab.
- Validated the model with a convergence study and against experimental migration of breast-cancer cells.
- Taught 384h of Finite Element Applications.

Transferable skills

Project management
Problem-solving
Data analysis
Communication
Teaching
Interdisciplinary teamwork

Research Assistant – Reaction–Diffusion Pattern Formation
Universidad Nacional de Colombia – Bogotá, Colombia Jan. 2018 – Jul. 2019

- Developed a custom finite element solver (Abaqus, Fortran) for reaction–diffusion systems modelling biological pattern formation.
- Linked simulations to analytical stability predictions to design and validate spatially heterogeneous parameter configurations.

Education

PhD – Human Movement Sciences
Aix-Marseille University, France. November 2024
Thesis: *Bio-inspired generative design: adaptation principles of bone-joint formation to design contact interfaces.*

Master's – Mechanical Engineering
Universidad Nacional de Colombia, Colombia. April 2021

Bachelor's – Mechanical Engineering
Universidad Nacional de Colombia, Colombia. July 2019

Training

Summer School – Machine Learning + Simulation
Physics-informed neural networks, reduced-order models (PyTorch). 2026

Spring School – Mechanobiology (MECABIONIC)
Université Côte d'Azur – Nice, France March 2025
Courses on mechanotransduction and collective cell mechanics; hands-on atomic force microscopy, microfluidics and light-sheet microscopy.

Publications

- **Hernandez-Aristizabal, D.** et al. *Membrane tension and cell–nucleus mechanical coupling regulate confined cell migration.* PLOS Computational Biology 22 (2026).
- **Hernandez-Aristizabal, D.** et al. *Basement membrane turnover drives filopodial protease-independent invasion.* J. Royal Society Interface 23 (2026).
- **Hernandez-Aristizabal, D.** et al. *Bio-inspired generative design of contact interfaces subjected to time-dependent loading conditions.* Results in Engineering 25 (2025).
- **Hernandez-Aristizabal, D.** et al. *A bulk-surface mechanobiochemical modelling approach for single cell migration.* Journal of Theoretical Biology 595 (2024).
- Arroyave-Tobón, S., **Hernandez-Aristizabal, D.** et al. *Bio-inspired non-assembly joints: Design, fabrication and wear performance.* CIRP Annals 73 (2024).
- **Hernandez-Aristizabal, D.** et al. *Stress-adaptive design of 2D contact interfaces with uniform pressure: A bio-inspired approach.* Int. J. of Solids and Structures 270 (2023).
- **Hernandez-Aristizabal, D.** et al. *Turing Pattern Formation Under Heterogeneous Distributions of Parameters.* J. Nonlinear Sci. 31(2):34 (2021).

Talks: five oral presentations at conferences and seminars, including the European Conference on Mathematical and Theoretical Biology (ECMTB) 2026 (Graz, Austria), SIMAI 2025 (Trieste, Italy), the Société de Biomécanique Congress 2025 (Marseille, France) and the CIRP Design Conference 2024 (Cranfield, UK).