Ismael Arán-Tapia

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I am a Biomedical Engineer specializing in numerical simulations and mathematical modeling, particularly in the application of Computational Fluid Dynamics (CFD), Fluid-Structure Interaction (FSI), and medical imaging reconstruction for biological systems. My research primarily focuses on the vestibular system and cardiovascular modeling, with an emphasis on personalized medicine and improving clinical outcomes through advanced simulations. With an academic background in Industrial Mathematics, Physics, and Business Administration, I bring a multidisciplinary approach to problem-solving and innovation, with a strong focus on applying academic research to real-world clinical and engineering challenges.

Education

PhD in Materials Science (July 2024)
University of Santiago de Compostela, Spain
Thesis title: *"Mathematical Modeling of the Vestibular System: A Path to Personalized Medicine*," awarded cum laude and with an international mention.

Master in Business Administration (April 2022)
ThePowerMBA, Online

Master in Industrial Mathematics (April 2021)
University of Santiago de Compostela, Spain
Specialization in Numerical Simulation.
Master's Thesis: *"Determination of the Optimal Angular Directions for the Vestibular System,"* awarded a grade of 9.6/10.

Bachelor's Degree in Physics (March 2019)
University of Santiago de Compostela, Spain
Bachelor's Thesis: *"Study of Fluid Dynamics in the Presence of a Magnetic Field Using CFD Software,"* awarded a grade of 9/10.

International Student in Physics (June 2017)
University of Coimbra, Portugal

Research and Professional Experience

Visiting Assistant Professor (February 2026 – Present)
University of Utah, USA
Research stay supported by NIH and Fulbright funding at the Department of Biomedical Engineering, working on numerical and experimental biomechanics of the vestibular system to study vestibular physiology and pathophysiology.

External Collaborator (November 2025 – Present)
University of Santiago de Compostela, Spain
Ongoing collaboration with the Nonlinear Physics Group (GFNL) on cardiology and vestibular system modeling research.

Postdoctoral Researcher (October 2024 – October 2025)
University of Santiago de Compostela, Spain
Hired by the Interreg POCTEP NewHeart project (EU), working on modeling blood flow and elasticity in digital twins generated from medical images at the CRETUS research center.

Visiting Researcher (September 2025, 9 days)
University of Bern, Switzerland
Short-term postdoctoral stay financed by a competitive CRETUS grant to the Cardiovascular Engineering Group at the ARTORG Center for Biomedical Engineering Research, focused on model evaluation and validation, as well as on exploring further collaboration.

Predoctoral Researcher (September 2021 – May 2024)
University of Santiago de Compostela, Spain
Conducted PhD research as a member of the Nonlinear Physics Group (GFNL), focusing on mathematical models of the vestibular system to enhance the understanding of vestibular physiology and applying personalized medicine in the field of otolaryngology.

Research trainee (September 2023 – December 2023)
Johns Hopkins University – School of Medicine, USA
Undertook a predoctoral research stay supported by NIH and José Otero-Carmela Martínez funding at the Department of Otolaryngology-Head and Neck Surgery, Division of Otology-Neurotology, to conduct clinical validation of the numerical results obtained during my PhD.

Research Assistant (May 2019 – December 2019)
University of Santiago de Compostela, Spain
Collaborated with the Nonlinear Physics Group (GFNL) focusing on modeling biological fluids under various physical phenomena.

Teaching Experience

Predoctoral Teaching Fellow
Taught in the Physics Degree Program during my PhD at the University of Santiago de

Compostela: Computational Physics (74h), Experimental Techniques I (28h), Complex Systems Physics (18h).

Co-Supervisor of Bachelor's and Master's Theses
Bachelor's Thesis by Sergio Trigo Rodríguez (Grade: 9.2/10), and Master's Theses by Guillermo Bastos Costas (Grade: 9.5/10), Jacobo Álvarez Sierra (Grade: 9.0/10) and Raquel Romero Lorenzo (Grade: 9.5/10).

Publications

Arán-Tapia, I., Pérez-Fernández, N., Sánchez-Yáñez, M., & Garaycochea, O. *From a conventional maneuver to a mechanical repositioning procedure for torsional-vertical down beating positioning nystagmus based on numerical simulations*. **European Archives of Oto-Rhino-Laryngology** (2026). DOI: 10.1007/s00405-026-10329-2.

Arán-Tapia, I., Bastos, G., & Muñuzuri, A. P. *Optimization of the Yacovino maneuver for superior canal BPPV using numerical simulations*. **Hearing Research**. 466:109374 (2025). DOI: 10.1016/j.heares.2025.109374.

Rossi-Izquierdo, M., Santos-Pérez, S., Arán-Tapia, I., Blanco, M., Aran, I., Vaamonde-Sánchez-Andrade, I., Franco-Gutiérrez, V., Pérez-Muñuzuri, V., Munuzuri, A. P., & Soto-Varela, A. *Personalized medicine to treat refractory benign paroxysmal positional vertigo, through computational fluid dynamics analysis from magnetic resonance image reconstructions.* **Frontiers in Neurology**. 16:1561356 (2025). DOI: 10.3389/fneur.2025.1561356.

Arán-Tapia, I., Pérez-Muñuzuri, V., Muñuzuri, A. P., Soto-Varela, A., Otero-Millan, J., Roberts, D. C., Ward, B. K. *Modeling of magnetic vestibular stimulation experienced during high-field clinical MRI*. **Communications Medicine** 5, 27 (2025). DOI: 10.1038/s43856-024-00667-9.

Arán-Tapia, I., Soto-Varela, A., Pérez-Muñuzuri, V., Santos-Pérez, S., Arán, I., Muñuzuri, A. P. *Numerical Simulations of the Epley Maneuver With Clinical Implications*. **Ear & Hearing** 45(4):1033-1044 (2024). DOI: 10.1097/AUD.0000000000001493.

Arán-Tapia, I., Soto-Varela, A., Pérez-Muñuzuri, V., Santos-Pérez, S., Arán, I., Muñuzuri, A. P. *Numerical simulations to determine the stimulation of the crista ampullaris during the Head Impulse Test.* **Computers in Biology and Medicine** 163, 107225 (2023). DOI: 10.1016/j.compbiomed.2023.107225.

Academic Presentations

Biomedical Engineering Seminar Series at University of Utah
From Physics to the Clinic: Understanding Balance Disorders (International Invited Lecture), Salt Lake City, USA, March 27, 2026. Department of Biomedical Engineering.

Biomechanics Research Course at University of Utah
Importance of Fluid–Structure Interaction in Vestibular and Cardiovascular Biomechanics

(International Invited Lecture), Salt Lake City, USA, March 6, 2026. Department of Biomedical Engineering.

5th Winter Meeting on Otoneurology
Aplicando las matemáticas para pasar de una maniobra convencional a un procedimiento de reposicionamiento en silla mecánica para el nistagmo posicional torsional-vertical hacia abajo en pacientes con VPPB (National Oral Presentation, co-author) / *Tratamiento de pacientes con VPPB refractario mediante maniobras personalizadas* (National Poster Presentation, co-author), Madrid, Spain, December 12–13, 2025. Spanish Society of Otolaryngology and Head and Neck Surgery.

ARTORG Center for Biomedical Engineering Research Seminar
Computational methods for simulating vestibular system physiology and pathophysiology (International Invited Seminar), Bern, Switzerland, September 11, 2025. University of Bern.

FisEs'25 - XXV Statistical Physics Congress
Wave reflection in the aorta / *Personalized Treatment of Benign Paroxysmal Positional Vertigo: A Successful Clinical Case* (2 National Poster Presentations, co-author), Santiago de Compostela, Spain. June 18–20, 2025. Royal Spanish Society of Physics.

NoLineal 2025 - 14th International Conference on Nonlinear Mathematics and Physics
Magnetohydrodynamic effects on the human endolymphatic fluid: a cause of dizziness in MRI (National Oral Presentation) / *Numerical study of wave reflection in the aortic artery* (National Oral Presentation, co-author), Santiago de Compostela, Spain. June 16–18, 2025. Galician Centre for Mathematical Research and Technology.

FINO 2025 Meeting
The future of personalized canalith repositioning procedures (International Invited Speaker), Porto, Portugal. May 23–24, 2025. Ibero-American Foundation of Neurotology.

2nd Multidisciplinary Course on Otoneurology and Vestibular Rehabilitation
Personalized Medicine in the Treatment of Refractory Benign Paroxysmal Positional Vertigo: A Physical Perspective (National Invited Speaker), Barcelona, Spain. March 28, 2025. Hospital del Mar.

Simcenter STAR CCM+ Seminars at the University of Santiago de Compostela
Stability in Fluid-Structure Models (Internal Group Seminar), Santiago de Compostela, Spain. February 18, 2025. Group of Nonlinear Physics.

Dizziness Grand Rounds at the University of Chicago
Personalized Medicine in Otoneurology Through Numerical Simulations (International Invited Seminar), Online, February 11, 2025. Department of Neurology, University of Chicago.

XXXII Bárány Society Meeting
Personalizing the Epley Maneuver through Computational Modeling of Vestibular Anatomy (International Oral Presentation), Uppsala, Sweden, August 25–28, 2024. Bárány Society.

XXXII Bárány Society Meeting
The Biophysics of Magnetic Vestibular Stimulation (International Poster Presentation), Uppsala, Sweden, August 25–28, 2024. Bárány Society.

Research Mentorship Program SEORL
Numerical Simulations of the Vestibular System: BPPV, vHIT, and Magnetic Vestibular Stimulation (National Invited Seminar), Online, April 11, 2024. Spanish Society of Otolaryngology and Head and Neck Surgery.

4th Winter Meeting on Otoneurology
Personalization of the Epley Maneuver through Numerical Simulations (National Oral Presentation), Madrid, Spain, February 23–24, 2024. Spanish Society of Otolaryngology and Head and Neck Surgery.

Division of Neuro-Visual and Vestibular Disorders Seminar Series
Mathematical Modeling of the Vestibular System: BPPV, vHIT, and MVS (International Invited Seminar) Baltimore, USA, November 16, 2023. Johns Hopkins Hospital.

Vestibular Pathology: From Basic Research to Clinical Application
The Role of Nonlinear Physics in the Vestibular System (National Invited Seminar), A Coruña, Spain, June 2, 2022. Royal Academy of Medicine of Galicia.

FisEs'22 - XXIII Statistical Physics Congress
Mathematical Model for the Vestibular System (National Poster Presentation), Zaragoza, Spain, May 12–14, 2022. Royal Spanish Society of Physics.

XXXI Bárány Society Meeting
Personalized Medicine for Optimal Stimulation of the Semicircular Canals (International Oral Presentation), Madrid, Spain, May 9–11, 2022. Bárány Society.

III Symposium on Research in Environmental Technologies
Controlling Magnetic Vestibular Stimulation (National Oral Presentation), Santiago de Compostela, Spain, July 4, 2019. Strategic Group for Cross-Research in Environmental Technologies (CRETUS).

Research Projects

Digital Twin of the Vestibular System for Personalized Treatment of Patients with Refractory Positional Vertigo (March 2025 – June 2025; December 2025 – May 2026) National project supported through two independent competitive evaluations by the Spanish Supercomputing Network, with a total allocation of 134,340 computing hours on CESGA-FT3 (RES-BCV-2025-1-0019 and BCV-2025-3-0002). Principal Researcher.

Improvement of Cardiac Health in the Euroregion (NewHeart) (January 2024 – December 2026)
European project funded with €2,734,697 by the Interreg POCTEP Galicia-North of Portugal (0330_NEW_HEART_1_E NEW HEART). Hired as an Associate Researcher.

Personalized Medicine for Treating Refractory Benign Paroxysmal Positional Vertigo (BPPV) through Computational Fluid Dynamics (CFD) Analysis Based on MRI Reconstructions (January 2024 – December 2026)
National project funded with €127,500 by the Spanish Institute of Health Carlos III (PI23/00248). Member of the Research Team.

Particle Margination and Interaction with Solids in Biomedical Flows (CarriersFlow) (September 2023 – August 2026)
National project funded with €77,875 by the Spanish Ministry of Science, Innovation and Universities (PID2022-141626NB-I00). Member of the Research Team.

Personalized Medicine for Treating Refractory Benign Paroxysmal Positional Vertigo (BPPV) through CFD Analysis Based on MRI (April 2022 – December 2022)
University Transfer Accelerator Program at the University of Santiago de Compostela, funded with €32,850. Member of the Research Team.

Intellectual Property

Software for the Analysis of Inner Ear Geometry and Prediction of the Membranous Labyrinth (LabyCraft)
Intellectual property registration in progress.

Clinical and Computational Protocol for Personalized BPPV Treatment
Confidential know-how protection under institutional agreement in progress.

Organization and Coordination

FisEs'25 - XXV Statistical Physics Congress
June 18–20, 2025. Santiago de Compostela, Spain. Royal Spanish Society of Physics. Local Coordinator.

Simcenter STAR CCM+ Seminars at the University of Santiago de Compostela
February 18 – April 15, 2025. Santiago de Compostela, Spain. Group of NonLinear Physics. Principal Coordinator.

Scientific Societies

Fulbrighter Network
Member since February 2026.

Spanish Society of Otolaryngology and Head and Neck Surgery (SEORL-CCC)
Member since January 2025.

Supports and Awards

MSCA Postdoctoral Fellowships Seal of Excellence
European Commission, 2025. Score: 96/100.

Extraordinary PhD Award (2023-2024)
University of Santiago de Compostela, 2025.

Best Basic or Applied Research Paper Published in an International Journal (2024)
Spanish Society of Otolaryngology and Head and Neck Surgery, 2025. Award: €1,500

Project Finalist – RIES X Forum: International Challenges of the Health Ecosystem
Galicia Health Cluster, 2025.

Grant – Ruth Lee Kennedy
Fulbright Commission for Spain–USA, 2025. Award: $5,000

Grant – International Promotion
Research Center in Environmental Technologies (CRETUS), 2025. Award: €1,500

Project Winner – University Entrepreneurial Santander X (USC)
Banco Santander, 2025. Award: €2,000

Best Oral Communication – 4th Winter Meeting on Otoneurology
Spanish Society of Otolaryngology and Head and Neck Surgery, 2024. Award: €1,500

Grant – José Otero-Carmela Martínez
José Otero-Carmela Martínez Foundation, 2022/2023. Award: €1,820

Project Winner – Akademia Program (Galicia)
Fundación Innovación Bankinter, 2019.

Languages

English: C1 (Advanced)
Portuguese: B2 (Upper Intermediate)
Russian: A2-B1 (Intermediate)
Spanish: Native
Galician: Native

Others

Reviewer of scientific articles for various journals: Scientific Reports (Q1), Journal of Bionic Engineering (Q1), Heliyon (Q1), Journal of Vestibular Research (Q1) and Frontiers in Neurology (Q2).

Private tutor in Mathematics, Physics, and Chemistry for high school and middle school students for over 5 years.

Accumulated over 250 hours of certified training across disciplines including physics, mathematics, medicine, specialized software, and educational video production.

Skills

Programming Languages: Python, MATLAB, Fortran.

Computer Simulation: Simcenter STAR-CCM+, ANSYS Fluent, COMSOL Multiphysics.

Computer-Aided Design and Imaging: 3D Slicer, SolidWorks, Meshmixer, Cinema4D, MeshLab, Blender.

Graphical and Writing Design: Inkscape, GIMP, Origin, LaTeX, Microsoft Office, Zotero, ChatGPT.

Soft Skills: Problem-solving, time management, initiative, adaptability, teamwork, communication.