Curriculum Vitae

1 PERSONAL DETAILS

- Full name: Andrés Fernando Franco Gómez
- Place of birth and date: Bogotá, Colombia, September 3rd 1983.

  Permanent residence Republic of Chile, 2012 – present.
- Current address: Domeyko 1999, Santiago Centro, RM, Chile. Phone: +56 969000772
- **Current position**: Postdoctoral researcher, Fondecyt-Postdoc Santiago, Chile. 2020 - 2022.

  Faculty: Facultad de Ciencias Físicas y Matemáticas (FCFM)

  Department: Ingeniería Química, Biotecnología y Materiales.
- Email address: andresfrancog54@gmail.com   Skype ID: andres.f.franco.g

2 PROFESSIONAL BACKGROUND

Interests in Engineering, Physics and Industry:

I recently completed a **Postdoctoral Position** at the Tokyo University of Agriculture and Technology (2018 - 2020), Mechanical Systems Engineering, Tokyo, Japan. I dedicated full time to the investigation of *Liquid Jet ejection of polymeric solutions by laser- and mechanical-induced methods with applications to the development of additive manufacturing techniques (3D-printing).*

I obtained my PhD degree (2018) in Fluid Dynamics and Nonlinear Physics in the Manchester Centre for Nonlinear Dynamics, The University of Manchester, UK in the *Semi-infinite and finite bubble propagation in the presence of a channel-depth perturbation.* I completed my Master degree in the *Study of the Spatial Statistics in Wave Turbulence* (2012) at the University of Chile, FCFM, Santiago, Chile.

I have been intensively working for the last 10 years in *Fluid Mechanics*, *Nonlinear Dynamics*, *Jet Dynamics*, *non-Newtonian fluids/Rheology*, *Turbulence* and *Waves* from an experimental and numerical approach. I am also highly interested in Fluid-structure interaction, flow instabilities and flow control and computer vision (DeepLearning/MachineLearning). I focus my research interests in both fundamental research and industrial applications.

Please find at the end of this CV a list of my publications, participation in conferences, workshops and internships.

3 ACADEMIC QUALIFICATIONS

Doctoral degree:
PhD. Fluid Dynamics and Soft Matter.
Awarded February 28th 2018.
Supervisor: Professor Anne Juel.
Faculty of Science and Engineering (FSE).
School of Physics and Astronomy.
The University of Manchester.
Manchester, United Kingdom.
https://www.manchester.ac.uk/

Master degree:
MSc. Physics.
Awarded July 10th 2012.
Supervisor: Professor Claudio Falcón Beas.
Faculty of Physical Sciences and Mathematics (FCFM).
Universidad de Chile.
Santiago de Chile
http://ingenieria.uchile.cl/

Undergraduate:
Bachelor in Physics
Awarded March 11th 2008
Universidad Nacional de Colombia (UN).
Bogotá, Colombia.
www.unal.edu.co

4 LANGUAGE SKILLS

Spanish: Native, Bogotá, Colombia.

English: Semester Elective English course, Levels: I, II, III and IV (March 2007 to November 2008). Universidad Nacional de Colombia, Bogotá, Colombia.

TOEFL July 2013: score 92/120.
Experience with English language and culture living in the United Kingdom for four years (2014 – 2017).

5 ADDITIONAL WORK EXPERIENCE

Institution: Universidad de Santiago de Chile (Usach)
Position: Assistant Professor of Fluids and Thermodynamics (theoretical and experimental) for Environmental and Geophysical Engineering students.
Date: March 2013 to January 2014.

Institution: Universidad Diego Portales, Santiago, Chile
Position: Teaching support in Physics, (a) Heat and Waves, (b) Electricity and Magnetism.
Date: August 2011 to December 2011.

Institution: Universidad de Chile
Position: Teaching support in Experimental and Theoretical Physics in Newtonian Mechanics.
Date: August 2009 to August 2011.

Institution: International Center of Physics, Applied Physics and Technology Development Group, Bogotá, Colombia.
Research Assistant: Analysis of RGB and Infrared sensor for Earth Observation Satellite Technology (state-of-the-art).
Date: April 2008 to June 2009.

6 ACADEMIC REFERENCES

Prof. Franck Quero (current Postdoc supervisor).
FCFM, Ingeniería Química, Biotecnología y Materiales.
Universidad de Chile
fquero@ing.uchile.cl

Prof. Yoshiyuki Tagawa (former Postdoc supervisor).
Mechanical Systems Engineering
Tokyo University of Agriculture and Technology (TUAT).
Tokyo, Japan.
tagawayo@cc.tuat.ac.jp

Prof. Anne Juel (former PhD supervisor).
Manchester Centre for Nonlinear Dynamics and School of Physics and Astronomy.
University of Manchester
Manchester, United Kingdom.
anne.juel@manchester.ac.uk

Prof. Claudio Falcón Beas (former MSc supervisor).
FCFM, Physics Department.
Universidad de Chile.
cfalcon@cec.uchile.cl

7 List of publications

- *Bubble propagation in Hele-Shaw channels with centred constrictions, Fluid Dynamics Research,* **50***, 2018.* We study the propagation of finite bubbles in a Hele-Shaw channel, where a centred rail is introduced to provide a small axially-uniform depth constriction. For bubbles wide enough to span the channel, the systems behaviour is similar to that of semi-infinite fingers and a symmetric static solution is stable. Here, we focus on smaller bubbles, in which case the symmetric static solution is unstable and the static bubble is displaced towards one of the deeper regions of the channel on either side of the rail. Using a combination of experiments and numerical simulations of a depth-averaged model, we show that the introduction of flow can stabilise the bubble in a steady symmetric mode of propagation centred on the rail through a subtle interaction between stabilising viscous forces and destabilising surface tension forces. However, for sufficiently large capillary numbers Ca, the ratio of viscous to surface tension forces, viscous forces in turn become destabilising thus returning the bubble to an off-centred propagation regime. With decreasing bubble size, the range of Ca for which steady centred propagation is stable decreases, and eventually vanishes through the coalescence of two supercritical pitchfork bifurcations. The depth-averaged model is found to accurately predict all the steady modes of propagation observed experimentally, and provides a comprehensive picture of the underlying steady bifurcation structure. However, for sufficiently large imposed flow rates, we find that initially centred bubbles do not converge onto a steady mode of propagation. Instead they transiently explore weakly unstable steady modes, an evolution which results in their break-up and eventual settling into a steady propagating state of changed topology.

- *Bubble propagation on a rail: a concept for sorting bubbles by size, Soft Matter, Royal Chemistry Society* **13***, 2017.* We demonstrate experimentally that the introduction of a rail, a small height constriction, within the cross-section of a rectangular channel could be used as a robust passive sorting device in two-phase fluid flows. Single air bubbles carried within silicone oil are generally transported on one side of the rail. However, for flow rates marginally larger than a critical value, a narrow band of bubble sizes can propagate (stably) over the rail, while bubbles of other sizes segregate to the side of the rail. The width of this band of bubble sizes increases with flow rate and the size of the most stable bubble can be tuned by varying the rail width. We present a complementary theoretical analysis based on a depth-averaged theory, which is in qualitative agreement with the experiments. The theoretical study reveals that the mechanism relies on a non-trivial interaction between capillary and viscous forces that is fully dynamic, rather than being a simple modification of capillary static solutions.

- *Sensitivity of Saffman-Taylor fingers to channel-depth perturbations (Journal of Fluid Mechanics vol. 794, pp. 343-368, 2016)* We examine the sensitivity of Saffman–Taylor fingers to controlled variations in channel depth by investigating the effects of centred, rectangular occlusions in Hele-Shaw channels. For large occlusions, the geometry is known to support symmetric, asymmetric and oscillatory propagation states when air displaces a more viscous fluid from within the channel. A previously developed depth-averaged model is found to be in quantitative agreement with laboratory experiments once the aspect ratio (width / height) of the tube's cross-section reaches a value of 40. We find that the multiplicity of solutions at finite occlusion heights arises through interactions of the single stable and multiple unstable solutions already present in the absence of the occlusion: the classic Saffman–Taylor viscous fingering problem. The sequence of interactions that occurs with increasing occlusion height is the same for all aspect ratios investigated, but the occlusion height required for each interaction decreases with increasing aspect ratio. Thus, the system becomes more sensitive as the aspect ratio increases, in the sense that multiple solutions are provoked for smaller relative depth changes. We estimate that the required depth-changes become of the same order as the typical roughnesses of the experimental system (1 μm) for aspect ratios beyond 155, which we conjecture underlies the extreme sensitivity of experiments conducted in such Hele-Shaw channels.

- *Geometry of the Vapor Layer Under a Leidenfrost Drop (J. Burton, et al. Phys. Rev. Lett. 109, 074301 (2012)):* In the Leidenfrost effect, liquid drops deposited on a hot surface levitate on a thin vapor cushion fed by evaporation of the liquid. This vapor layer forms a concave depression in the drop interface. Using laser-light interference coupled to high-speed imaging, we measured the radius, curvature, and height of the vapor pocket, as well as nonaxisymmetric fluctuations of the interface for water drops at different temperatures. The geometry of the vapor pocket depends primarily on the drop size and not on the substrate temperature.

- *Study of complex charge distributions in an electrolyte using the Poisson-Boltzmann equation by Lattice-Boltzmann method (Microelectronics Journal, Volume 39, Issue 11, November 2008, Pages 1224-1225.):* The main goal of this work is the computational study of the Poisson-Boltzmann (PB) equation for a group of circular and elliptical charges immerse in a strong electrolyte using the Lattice-Boltzmann method. We remark that this kind of distributions has not analytical results due to the non-linearity of PB equation and the complexity of the charge distribution. The model describe the electrical potential and his interactions produced by ions adsorption on the surface of circular or elliptical charged particles and other geometries. We contrast our results with previous analytical outcomes for exact solutions to the cylindrical PB equation. Finally we analyse the evolution and stability of the method.
  Presented in **CLACSA XIII: Latinoamerican Conference in Surface Physics and Applications.** Santa Marta, Colombia, December 3rd to 7th, 2007.

8 Participation in Conferences, Workshops and Internships

Conference: 71st Annual Meeting of the APS, Division of Fluid Dynamics:
Atlanta, USA, November 18th to 21st 2018.
Oral presentation of the work: *Jet ejection of inelastic and elastic non-Newtonian fluids by laser-induced shockwave.* https://apsdfd2018.org/

3rd International Symposium on Multiscale Multiphase Process Engineering Toyama City, Toyama Prefecture, Japan, May 8th to 11th 2017.
Poster presentation of the work: *Propagation of Bubbles on a thin rail: a concept for sorting air bubbles by size.* http://www.mmpe.jp/

11th European Fluid Mechanics Conference Sevilla, Spain, September 12th to 16th 2016.
Oral presentation of the work: *Propagation of finite air bubbles in a partially occluded Hele-Shaw channel.* http://www.efmc11.org/

7th summer school Complex Motion in Fluids
Twente, Netherlands, June 19th to 24th 2016.
http://pof.tnw.utwente.nl/complexmotion2016/

Conference: 68th Annual Meeting of the APS, Division of Fluid Dynamics:
Boston, USA, November 22nd to 24th 2015.
Oral presentation: *Sensitivity to Saffman-Taylor fingers to channel-depth perturbations.*
https://apsdfd2015.mit.edu/

Internship in Experimental Physics of Fluids:
The University of Chicago, January 1st to March 23rd 2011.
James Franck Institute and Department of Physics. Nagel Group.
Thanks to the collaboration between University of Chile and University of Chicago. *Geometry of the Vapor Layer Under a Leidenfrost Drop (J. Burton, et al.) Phys. Rev. Lett. 109, 074301 (2012)*

ICMMES: The Fifth International Conference for Mesoscopic Methods in Engineering and Science
Amsterdam, The Netherlands, June 16th to 20th, 2008.
Oral presentation: *Solutions of Strong Electrolytes by Lattice-Boltzmann Method and its application to Colloidal Suspensions.*

First CEIBA Summer School: Complexity in Living Systems:
Bogotá, Colombia, July 30th to August 1st, 2007.
Undergraduate participant.