CONTACT INFORMATION

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Research Interests

Applied mathematics: partial differential equations and calculus of variations, with a focus on elliptic systems and models arising in physics (liquid crystals, superconductors, micromagnetism, elasticity). Conformally invariant systems. Scalar conservations laws. Differential inclusions.

Positions

2016-	<i>Maître de conférence</i> (associate professor) at Université Toulouse 3 , Toulouse, France.
2015-2016	Postdoctoral researcher at the Max Planck Institute for Mathematics in the Sciences.
2012-2015	Teaching Assistant at Ecole Normale Supérieure and Université Lyon 1, Lyon, France.
2009-2010	Mathematics teacher at french secondary school Lycée Chateaubriand, Rome, Italy.

EDUCATION

2022	Habilitation, Université Toulouse 3.
2015	Ph.D., Université de Lyon , France. Advisor: Petru Mironescu.
2012	Agrégation externe de Mathématiques (national competitive exam for high school and university teaching, ranked ${\bf 1st}$).
2011	M.Sc. in Mathematics, Ecole Normale Supérieure, Lyon, France.

GRANTS AND AWARDS

2022-2026	Coordinator of the ANR-JCJC project SING.
2021	CNRS 'delegation' at CMM, Santiago de Chile
2020-2021	CNRS 'International Emerging Actions' project
2018-2022	Member of the ANR-JCJC project BLADE-JC.
2018-2022	PEDR (award for excellence in research).
2018	CNRS PEPS project.

ORGANIZED EVENTS

2023	'Recent advances in geometric analysis', CIRM (Marseille, France), Nov. 6-10
	ANR SING workshop (Toulouse, France), Jun. 12-14
	Trimester Program 'Mathematics for complex materials' (Bonn, Germany), Jan. 3-Apr. 14
2020	Workshop on singularities in variational models (Toulouse, France), Jan. 8-10
2019	Thematic semester 'Calculus of Variations and Probability' (Toulouse, France), FebJun.

STUDENTS & POSTDOCS

2024-	Bin Deng, Postdoc, Université Toulouse 3
2024	Jean-Pierre Mansour, Master thesis, Université Toulous e $\boldsymbol{3}$
2023-	Thibault Lacombe, PhD student, Université Toulouse 3 $$

ARTICLES

Submitted

[38] "Interaction energies in nematic liquid crystal suspensions", with L. Bronsard, D. Stantejsky and R. Venkatraman.

[37] "On the existence of degenerate solutions of the two-dimensional H-system", with A. Guerra and K. Zemas.

[36] "On C^1 regularity for degenerate elliptic equations in the plane", with T. Lacombe.

[35] "On regularity and rigidity of 2×2 differential inclusions into non-elliptic curves", with A. Lorent and G. Peng.

[34] "Optimal Quantitative Stability of the Möbius group of the sphere in all dimensions", with A. Guerra and K. Zemas.

Published or accepted

[33] "Sharp quantitative stability of the Möbius group among sphere-valued maps in arbitrary dimension", with A. Guerra and K. Zemas.

Trans. Amer. Math. Soc., 2025.

- [32] "Generation of vortices in the Ginzburg-Landau heat flow", with M. Kowalczyk. Ann. Inst. H. Poincaré Anal. Non Linéaire, 2023.
- [31] "On Lebesgue points of entropy solutions to the eikonal equation", with E. Marconi. Proc. Roy. Soc. Edinburgh Sect. A, 2023.
- [30] "Stability of the vortex in micromagnetics and related models", with E. Marconi. Ann. Sc. Norm. Super. Pisa Cl. Sci., 2023.
- [29] "Quantitative rigidity of differential inclusions in two dimensions", with A. Lorent and G. Peng. Int. Math. Res. Not. IMRN, 2023.

[28] "Far-field expansions for harmonic maps and the electrostatics analogy in nematic suspensions",

with S. Alama, L. Bronsard and R. Venkatraman.

J. Nonlinear Sci., 2023.

[27] "On optimal regularity estimates for finite-entropy solutions of scalar conservation laws", with A. Lorent and G. Peng.

C. R. Math. Acad. Sci. Paris, 2023.

- [26] "On a generalized Aviles-Giga functional: compactness, zero-energy states, regularity estimates and energy bounds", with A. Lorent and G. Peng.
- Comm. Partial Differential Equations., 2022.
- [25] "Entire vortex solutions of negative degree for the anisotropic Ginzburg-Landau system", with M. Kowalczyk and P. Smyrnelis.

Arch. Ration. Mech. Anal., 2022.

[24] "Singular perturbation of manifold-valued maps with anisotropic energy", with A. Contreras. *Anal. PDE*, to appear.

[23] "Generalized characteristics for finite entropy solutions of Burgers' equation", with A. Contreras Hip and E. Marconi.

Nonlinear Anal., 2022.

- [22] "On the stability of radial solutions to an anisotropic Ginzburg-Landau equation", with A. Zúñiga. SIAM J. Math. Anal., 2022.
- [21] "Saturn ring defect around a spherical particle immersed in nematic liquid crystal", with S. Alama,
- L. Bronsard and D. Golovaty.

Calc. Var. Partial Differential Equations, 2021.

- [20] "On the L^2 stability of shock waves for finite entropy solutions of Burgers", with A. Contreras Hip. J. Differential Equations, 2021.
- [19] "Rigidity of a non-elliptic differential inclusion related to the Aviles-Giga conjecture", with A. Lorent and G. Peng.

Arch. Ration. Mech. Anal., 2020.

[18] "Global uniform estimate for the modulus of 2D Ginzburg-Landau vortexless solutions with asymptotically infinite boundary energy", with R. Ignat and M. Kurzke.

SIAM J. Math. Anal., 2020.

- [17] "Optimal Besov differentiability for entropy solutions of the eikonal equation", with F. Ghiraldin. Comm. Pure Appl. Math., 2020.
- [16] "Lifting of \mathbb{RP}^{d-1} -valued maps in BV and applications to uniaxial Q-tensors. With an appendix on an intrinsic BV-energy for manifold-valued maps", with R. Ignat.
- Calc. Var. Partial Differential Equations, 2019.
- [15] "On the convergence of minimizers of singular perturbation functionals", with A. Contreras and R. Rodiac.

Indiana Univ. Math. J., 2018.

- [14] "Regularity of solutions to scalar conservation laws with a force", with B. Gess. Ann. Inst. H. Poincaré Anal. Non Linéaire, 2018.
- [13] "On the regularity of weak solutions to Burgers' equation with finite entropy production", with F. Otto.
 - Calc. Var. Partial Differential Equations, 2018.
- [12] "Spherical particle in nematic liquid crystal under an external field: the Saturn ring regime", with
- S. Alama and L. Bronsard. J. Nonlinear Sci., 2018.
- [11] "Biaxial escape in nematics at low temperature", with A. Contreras. J. Funct. Anal., 2017.
- [10] "Minimizers of the Landau-de Gennes energy around a spherical colloid particle", with S. Alama and L. Bronsard.

Arch. Ration. Mech. Anal., 2016.

- [9] "Analytical description of the Saturn-ring defect in nematic colloids", with S. Alama and L. Bronsard. Phys. Rev. E, 2016.
- [8] "Boundary regularity of weakly anchored harmonic maps", with A. Contreras and R. Rodiac. C. R. Math. Acad. Sci. Paris, 2015.
- [7] "Vortex structure in p-wave superconductors", with S. Alama and L. Bronsard. J. Math. Phys, 2015.
- [6] "Persistence of superconductivity in thin shells behond H_{c_1} ", with A. Contreras. *Commun. Contemp. Math.*, 2015.
- [5] "Characterization of function spaces via low regularity mollifiers", with P. Mironescu. Discrete Contin. Dyn. Syst. A, 2015.
- [4] "Uniaxial symmetry in nematic liquid crystals". Ann. Inst. H. Poincaré Anal. Non Linéaire, 2015.
- [3] "Bifurcation analysis in a frustrated nematic cell". J. Nonlinear Sci., 2014.
- [2] "Existence of critical points with semi-stiff boundary conditions for singular perturbation problems in simply connected planar domains", with P. Mironescu.

J. Math. Pures Appl., 2014.

 "Some properties of the nematic radial hedgehog in the Landau-de Gennes theory". J. Math. Anal. Appl., 2013.

RECENT INVITED TALKS

Conferences

2025	'Winter School on Variational and PDE Methods in Geometric Analysis' Jan. 20-24, Rome, Italy.
	'PDE in Barcelona' May 26-30, Barcelona, Spain.
2024	'Warsaw meeting in Analysis and PDEs' Sept. 23-27, Warsaw, Poland.
	Workshop 'Calculus of Variations' Aug. 12-16, Oberwolfach, Germany.
	'Mathematical Analysis of Soft Matter' Jul. 1-5, Banff, Canada.
	'Variational Models in Materials Science' Feb. 21-23, Naples, Italy.
	'Differential Inclusions and Continuum Mechanics' Feb. 12-14, Zürich, Switzerland.
2023	'Optimal Transport and the Calculus of Variations' Dec. 11-15, Edinburgh, Scotland.
	'Young researchers in PDEs' Oct. 2-6, Madrid, Spain.
	'Emerging Trends in Variational Models of Materials' Jun. 26-30, Montreal, Canada.
2022	Workshop 'Calculus of Variations' Aug. 14-20, Oberwolfach, Germany.
	'CY days in Nonlinear Analysis' Mar. 28-31, Cergy, France.
2021	'LXXXIX Encuentro Anual SOMACHI' Dec. 15-17, Rancagua, Chile.

Seminars

2025	Naples (Mar.31, Apr.2, Apr.4)
2024	Marseille (Jan. 16), Paris-Saclay (Feb. 1), Tours (Feb. 29), Padova (Mar. 11), Rome (Mar. 18)
2023	Leipzig (Apr. 18)
2022	Paris 13 (Mar. 22)
2021	Santiago de Chile (Mar. 18)