# Alessio Figalli

Curriculum Vitae

Department of Mathematics ETH Zürich  $\boxtimes$  alessio.figalli@math.ethz.ch www.math.ethz.ch/~afigalli/

Professor of Mathematics & FIM Director Phd, SNS Pisa and ENS Lyon, 2007

#### Personal information

Place and date of birth Rome (Italy), April 2, 1984

Language skills Italian (native), English and French (fluent),

Spanish (intermediate), German (basic)

Citizenship Italian citizen, Swiss permanent resident

Civil status married

### Position held

Sep 2019 – present FIM Director, ETH Zürich (Zurich, Switzerland)

Sep 2016 – present Chaired Professor, ETH Zürich (Zurich, Switzerland)

Sep 2013 - Aug 2016 Full Professor and R. L. Moore Chair,

The University of Texas at Austin (Austin, TX, USA)

Sep 2011 - Aug 2013 Full Professor, The University of Texas at Austin (Austin, TX, USA)

Sep 2010 – Aug 2011

Associate Professor, The University of Texas at Austin (Austin, TX, USA)

Sep 2009 – Aug 2010

Associate Professor and Harrington Faculty Fellow, The University of Texas at Austin (Austin, TX, USA)

Oct 2008 – Aug 2009 Professor (Professeur Hadamard), École Polytechnique (Palaiseau, France)

Oct 2007 – Sep 2008 Researcher (Chargé de recherche CNRS), University of Nice (Nice, France)

#### Formation

Feb 17, 2009 Habilitation à Diriger de Recherche (French habilitation)

Mémoire HDR (in english): Optimal transport, Euler equations, Mather and DiPerna-Lions theories

Nov 2006 – Sep 2007 PhD student at the Scuola Normale Superiore of Pisa (Italy) and at the École Normale Supérieure of Lyon (France).

Advisors: Luigi Ambrosio and Cédric Villani.

PhD degree obtained Oct. 24, 2007 (italian grade: 70/70 cum laude; french grade: mention trés honorable).

Phd thesis (in english): Optimal transportation and action-minimizing measures

Oct 2002 – Oct 2006

Student of mathematics at the Scuola Normale Superiore of Pisa (Italy)

Master degree obtained the Jun 23, 2006 (grade: 110/110 cum laude).

Master thesis (in english): Trasporto ottimale su varietà non compatte

Bachelor degree obtained Nov 29, 2004 (grade: 110/110 cum laude).

Degree thesis (in italian): Il problema di Bernstein e una conqettura di De Giorgi

# Honors, Prizes and Awards

#### Prizes

- 2024 Golden Owl (ETH award for exceptional teaching)
- 2024 UIMP Medal
- 2023 Frontiers of Science Awards
- 2020 Falling Walls Award in Engineering and Technology
- 2020 Girolamo Cardano International Prize
- 2019 Prize I numeri UNO of "The Italian Chamber of Commerce for Switzerland"
- 2019 Gili Agostinelli Prize of the "Accademia delle Scienzedi Torino"
- 2018 Fields Medal
- 2017 Feltrinelli Prize of "Accademia Nazionale dei Lincei"
- 2016 O'Donnell Award in Science of "The Academy for Medicine, Engineering, & Science of Texas (TAMEST)"
- 2015 Stampacchia Gold Medal of the Italian Mathematical Union
- 2012 European Mathematical Society (EMS) Prize
- 2011 2012 Peccot-Vimont Prize and Cours Peccot of the "Collège de France"
  - 2010 Gioacchino Iapichino Prize of the "Accademia Nazionale dei Lincei"
  - 2010 Anile Prize of the "Associazione Angelo Marcello Anile" and the "Consorzio Catania Ricerche"
  - 2008 Carlo Miranda Prize of the "Accademia di Scienze Fisiche e Matematiche" of Naples
  - 2008 Giuseppe Borgia Prize of the "Accademia Nazionale dei Lincei"
- 2006 2007 Benedetto Sciarra Prize of the "Scuola Normale Superiore" of Pisa

#### Honors

- 2022 present Asteroid 438523 Figalli (2007 SC12)
- 2018 present Knight of the Order of Merit of the Italian Republic
  - 2009 2010 Harrington Faculty Fellowship

#### Doctorates Honoris Causa

- 2022 University of Sussex
- 2019 Universitat Politècnica de Catalunya
- 2018 Université Côte d'Azur

#### Membership to Academies

- 2023 present Corresponding Member of the Accademia dei Lincei
- 2022 present Corresponding Member of the Accademia delle Scienze di Torino
- 2022 present Foreign Member of the Accademia Nazionale delle Scienze detta dei XL
- 2021 present Foreign Member of the Istituto Lombardo Accademia di Scienze e Lettere
- 2021 present Honorary Member of Real Sociedad Matemática Española (RSME)
- 2019 present Member of Academia Europaea
- 2019 present Foreign Member of the Academy of Sciences of Bologna
- 2018 present Foreign Member of the Royal Spanish Academy of Sciences
- 2017 present Fellow and Honorary Member of the European Academy of Sciences

#### Grants

- 2024 2028 SNF Sinergia Grant, "From single disease reductionist research to informed Machine Learning: a new research paradigm for multimorbidity"
- 2017 2023 ERC Grant, "Regularity and Stability in Partial Differential Equations (RS)"
- 2014-2017  $\,$  NSF Grant DMS-1361122, "FRG: Collaborative Research: Vectorial and geometric problems in the calculus of variations"
- 2013 2018 NSF Grant DMS-1262411, "Regularity and stability results in variational problems"

2010-2013 NSF Grant DMS-0969962, "Analytical and geometrical problems in calculus of variations and partial differential equations"

#### Selected Invited Talks

- May 2024 Euler Lecture 2024, University of Potsdam, Potsdam, Germany
- Apr 2024 Weierstrass Lecture 2024, Paderborn University, Paderborn, Germany
- Oct 2023 Plenary Talk at Panorama of Mathematics II, at the University of Bonn, Bonn, Germany
- Aug 2022 9th International Congress of Chinese Mathematicians, ICCM2022, Distinguished Speaker, Nanjing, China online
- Jul 2022 2nd Joint Congress of Mathematics AMS-EMS-SMF 2022, Plenary Speaker, Grenoble, France online
- Dec 2021 Conference on Neural Information Processing Systems, Plenary Speaker, New Orleans, USA online
- Sep 2021 15th International Conference on Free Boundary Problems, Plenary Speaker, Berlin, Germany online
- Jun 2021 James Perry Browne Sussex Mathematics Colloquium at the University of Sussex, Brighton, UK - online
- May 2021 Göran Gustafsson Lectures at the KTH, Plenary Speaker, Stockholm, Sweden online
- Sep 2019 Dynamics, Equations and Applications (DEA 2019) Plenary Speaker, Krakow, Poland
- Jul 2019 Equadiff 2019 Plenary Speaker, Leiden, Netherlands
- Feb 2019 PIMS-UBC Math Distinguished Colloquium at the University of British Columbia, Vancouver, Canada
- Feb 2019 Joseph D'Atri Memorial Lectures at Rutgers University, New Brunswick, NJ, USA
- Oct 2018 John von Neumann Lecture at Münster University, Münster, Germany
- Aug 2018 International Congress of Mathematicians (ICM), Plenary Speaker, Rio de Janeiro, Brazil
- Jun 2018 Bourbaki seminar at IHP Paris, France
- May 2018 Rouse Ball Lecture at the University of Cambridge, Cambridge, UK
- Feb 2018 Harold J. Gay Lecture, Worcester, MA, USA
- Jun 2017 23rd Rolf Nevanlinna Colloquium at ETH Zürich, Zurich, Switzerland
- Nov 2016 Leonardo Da Vinci Lectures Milan, Italy
- Sep 2015 XX Congress of the Italian Mathematical Union, Plenary Speaker, Siena, Italy
- Mar 2015 Thomas Wolff Memorial Lectures in Mathematics at Caltech, Pasadena, CA, USA
- Fall 2014 Nachdiplom-Vorlesungen at ETH Zürich, Zurich, Switzerland
- Aug 2014 International Congress of Mathematicians (ICM), Invited Speaker, Soul, Korea
- Jul 2014 XV International Conference on Hyperbolic Problems, Plenary Speaker, Rio de Janeiro, Brazil
- May 2014 1st Nirenberg Lectures in Geometric Analysis at CRM, Montreal, Canada
- Apr 2014 AMS Spring Central Regional Meeting at Texas Tech University, Plenary Speaker, Lubbock, TX, USA
- Dec 2013 SIAM Conference on Analysis of Partial Differential Equations, Plenary Speaker, Lake Buena Vista, Florida, USA
- Jun 2013 INdAM Day, Invited Speaker, Palermo, Italy
- Jul 2012 European Congress of Mathematics (ECM), Invited Speaker, Kraków, Poland
- Apr 2010 2009-2010 Salomon Bockner Lectures in Mathematics, Houston, Texas, USA
- Jun 2009 Bourbaki seminar at IHP, Paris, France

# Mentoring

#### Postdocs

- 2024 present Bill Cooperman, ETH Zürich
- 2022 present André Guerra, ETH Zürich
  - 2021 2024 Hyunju Kwon, ETH Zürich
- 2020 2021, 2022 2024 Christoph Kehle, ETH Zürich
  - 2020 2023 João Pedro Gonçalves Ramos, ETH Zürich
  - 2018 2021 Hardy Chan, ETH Zürich
  - 2019 2020 Yi Zhang, ETH Zürich
  - 2016 2018 Joaquim Serra, ETH Zürich
  - 2016 2018 Connor Mooney, UT Austin ETH Zürich
  - 2015 2016 Brian Krummel, UT Austin (coadvised with Francesco Maggi)
  - 2014 2015 Begoña Barrios, UT Austin
  - 2014 2016 Xavier Ros-Oton, UT Austin
    - 2013 Shibing Chen, MSRI.
    - 2012 Filippo Cagnetti, UT Austin (coadvised with Luis Caffarelli)
  - 2010 2011 Clayton Bjorland, UT Austin (coadvised with Luis Caffarelli)

#### PhD Students

- 2025 present Mitchell Taylor, ETH Zürich
- 2025 present Bader Ammari, ETH Zürich
- 2024 present Gemei Liu, ETH Zürich
- 2024 present Susanna Bertolini, ETH Zürich (coadvised with Joaquim Serra)
- 2022 present Giacomo Colombo, ETH Zürich
  - 2020 2024 Lauro Silini, ETH Zürich
  - 2019 2024 Federico Franceschini, ETH Zürich (coadvised with Joaquim Serra)
  - 2018 2022 Federico Glaudo, ETH Zürich
  - 2015 2020 Xavier Fernández-Real, UT Austin ETH Zürich
  - 2014 2018 Yash Jhaveri, UT Austin ETH Zürich
  - 2013 2017 Javier Morales, UT Austin
  - 2013 2017 Robin Neumayer, UT Austin (coadvised with Francesco Maggi)
  - 2012 2015 Maria Colombo, UT Austin SNS Pisa (coadvised with Luigi Ambrosio)
  - 2011 2016 Rohit Jain, UT Austin (coadvised with Luis Caffarelli)
  - 2011 2012 Levon Nurbekyan, UT Austin IST Lisbon (coadvised with Diogo Gomes)
  - 2010 2013 Diego Marcon Farias, UT Austin IST Lisbon (coadvised with Diogo Gomes)
  - 2009 2013 Emanuel Indrei, UT Austin
  - $2009-2012 \ \textit{Eric Baer}, \, \text{UT Austin}$

#### Master/Bachelor Students

As a Professor at the Department of Mathematics at ETH, I supervise several Bachelor's and Master's theses

# Scientific and administrative responsibilities

#### Current editorial work

- 2025 present Editor of MFML
- 2025 present Editor of Comm. AMS
- 2024 present Editor of Journal of Convex Analysis
- 2021 present Editor of Transactions of the LMS

- 2021 present Editor of Publ. Math. Inst. Hautes Études Sci.
- 2016 present Editor of Arch. Ration. Mech. Anal.
- 2014 present Editor of Duke Math. J.

#### Past editorial work

- 2016 2018 Editor of Commun. Contemp. Math.
- 2015 2022 Editor of Probab. Theory Related Fields
- 2015 2017 Editor of Appl. Math. Res. Express. AMRX
- 2013 2022 Advisory Board Member for Lecture Notes in Math.
- 2013 2022 Editor of J. Ecole Polytechnique
- 2013 2019 Editor of *Anal. PDE*
- 2013 2017 Associate Editor of ESAIM: Control Optim. Calc. Var.
- 2012 2016 Managing Editor of Discrete Contin. Dyn. Syst. Series A
- 2011 2018 Editor of Discrete Contin. Dyn. Syst. Series A
- 2011 2016 Editor of AIMS Series on Applied Mathematics
- 2010 2016 Corresponding Editor of Acta Appl. Math.

#### Conference organization

- May 2027 Aug 2027 Co-organizer of the thematic program on "Nonlinear partial differential equations (analytic and geometric method)" at the Isaac Newton Institute (Cambridge, UK)
- Sep 2022 Dec 2022 Co-organizer of the thematic program on "Geometric Aspects of Nonlinear Partial Differential Equations" at the Institute Mittag-Leffler (Djursholm, Sweden)
  - Jun 2021 Co-organizer of the conference on "Calculus of Variations and PDEs: recent developments and future directions" at ETH (Zurich, Switzerland)
  - Aug 2020 Co-organizer of the workshop on "Calculus of Variations" at the MFO (Oberwolfach, Germany)
- Apr 2019 Jun 2019 Co-organizer of the thematic program on "Optimal transport" at the Erwin Schrödinger Institute (Vienna, Austria)
- Oct 2018 Nov 2018 Co-organizer of the conference on "PDEs and Geometric Measure Theory" at ETH (Zurich, Switzerland)
  - Aug 2018 Co-organizer of the workshop on "Calculus of Variations" at the MFO (Oberwolfach, Germany)
  - Jul 2016 Co-organizer of the workshop on "Calculus of Variations" at the MFO (Oberwolfach, Germany)
  - Jul 2016 Co-organizer of the session on "Quantitative geometric and functional inequalities and new trends in nonlinear PDEs" at the 11th AIMS Conference (Orlando, FL, USA)
  - Oct 2015 Co-organizer of the workshop "Analysis in Lyon" (Lyon, France)
- Sep 2015 Dec 2015 Co-organizer of the program "Fall Semester 2015 in Analysis" (Lyon, France)
  - May 2015 Co-organizer of the program "Calculus of Variations and Nonlinear Partial Differential Equations" (Austin, TX, USA)
  - Nov 2014 Co-organizer of the Fields Medal Symposium "The many facets of entropy: Kinetic Theory, Optimal Transport, Geometry" in honor of Cédric Villani at the Fields Institute (Toronto, Canada)
  - Oct 2014 Co-organizer of the Thematic day on "Optimal transport and sub-Riemannian manifolds" at IHP (Paris, France)
- Apr 2014 May 2014 Co-organizer of the "UT Austin Workshop: Kinetics, non-standard diffusion and multiscale phenomena: emerging challenges in the sciences" (Austin, TX, USA)
- Aug 2013 Dec 2013 Co-organizer of the MSRI program on "Optimal Transport: Geometry and Dynamics" (Berkeley, CA, USA)
  - Aug 2013 Co-organizer of the "Introductory Workshop on Optimal Transport: Geometry and Dynamics" (Berkeley, CA, USA)

- May 2012 Co-organizer of the Workshop "Optimal transportation and differential geometry" at BIRS (Banff, Canada)
- Jun 2011 Co-organizer of the CoLab Mathematics Summer School and Workshop "Aubry Mather Theory and Optimal Transport (Summer School) Nonlinear PDEs (Workshop)" (Lisbon, Portugal)
- Jan 2011 Co-organizer of the conference "Kynetic theory, optimal transport, probability, geometry: old and new" in the honor of Cédric Villani, Fields medalist 2010 (ENS Paris, France)
- Jul 2010 Organizer of the minisymposium "Geometric Measure Theory and Calculus of Variations" at IHES Asian-French Summer school on "Singularities in PDE" (IHES, France)
- Apr 2010 Co-organizer of Workshop "Optimal transportation and applications" at BIRS (Banff, Canada)
- Apr 2010 Organizer of the Workshop "Nonlinear Analysis and PDEs" at the University of Texas at Austin (Austin, TX, USA), sponsored by the Harrington Foundation
- May 2009 Organizer of the minisymposium "Transport optimal et applications" at the SMAI Conference (La Colle sur Loup, France)

#### Research

## Published/Accepted papers

- 1) The Monge problem on non-compact manifolds, Rend. Sem. Mat. Univ. Padova 117 (2007), 147-166.
- 2) Existence, uniqueness and regularity of optimal transport maps, SIAM J. Math. Anal. 39 (2007), no. 1, 126-137.
- 3) High action orbits for Tonelli Lagrangians and superlinear Hamiltonians on compact configuration spaces" (with A. Abbondandolo), *J. Differential Equations* 234 (2007), no. 2, 626-653.
- 4) Strong displacement convexity on Riemannian manifolds (with C. Villani), *Math. Z.* 257 (2007), no. 2, 251-259.
- 5) On the regularity of the pressure field of Brenier's weak solutions to incompressible Euler equations" (with L. Ambrosio), Calc. Var. Partial Differential Equations 31 (2007), no. 4, 497-509.
- 6) Existence and uniqueness of martingale solutions for SDE with rough or degenerate coefficients, J. Funct. Anal. 254 (2008), no. 1, 109-153.
- 7) A simple proof of the Morse-Sard theorem in Sobolev spaces, *Proc. Amer. Math. Soc.* 136 (2008), no. 10, 3675-3681.
- 8) Synchronized traffic plans and stability of optima (with M. Bernot), ESAIM Comtrol Optim. Calc. Var. 14 (2008), 864-878.
- 9) Invariant measures of Hamiltonian systems with prescribed asymptotic Maslov index (with A. Abbondandolo), *J. Fixed Point Theory Appl.* 3 (2008), no. 1, 95-120.
- 10) Absolute continuity of Wasserstein geodesics in the Heisenberg group (with N. Juillet), J. Funct. Anal. 255 (2008), no. 1, 133-141.
- 11) An approximation lemma about the cut locus, with applications in optimal transport theory (with C. Villani), *Methods Appl. Anal.* 15 (2008), no. 2, 149-154.
- 12) Convergence to the viscous porous medium equation and propagation of chaos (with R. Philipowski), ALEA Lat. Am. J. Probab. Math. Stat. 4 (2008), 185-203.
- 13) Generalized solutions for the Euler equations in one and two dimensions (with M. Bernot and F. Santambrogio), *J. Math. Pures Appl.* 91 (2009), no. 2, 137-155.
- 14) Geodesics in the space of measure-preserving maps and plans (with L. Ambrosio), *Arch. Ration. Mech. Anal.* 194 (2009), no. 2, 421-462.

- 15) A geometric lower bound on Grad's number, ESAIM Control Optim. Calc. Var. 15 (2009), no. 3, 569-575.
- 16) On the Hausdorff Dimension of the Mather quotient (with A. Fathi and L. Rifford), Comm. Pure Appl. Math. 62 (2009), no. 4, 445-500.
- On flows associated to Sobolev vector fields in Wiener spaces: an approach à la DiPerna-Lions (with L. Ambrosio), J. Funct. Anal. 256 (2009), no. 1, 179-214.
- 18) A note on Cheeger sets (with F. Maggi and A. Pratelli), *Proc. Amer. Math. Soc.* 137 (2009), no. 6, 2057-2062.
- 19)  $C^1$  regularity in 2 dimension for potentials of the optimal transport problem (with G. Loeper), Calc. Var. Partial Differential Equations 35 (2009), no. 4, 537-550.
- 20) A note on the regularity of the free boundaries in the optimal partial transport problem, *Rend. Circ. Mat. Palermo* 58 (2009), no. 2, 283-286.
- 21) Continuity of optimal transport maps and convexity of injectivity domains on small deformations of S<sup>2</sup> (with L. Rifford), *Comm. Pure Appl. Math.* 62 (2009), no. 12, 1670-1706.
- 22) A refined Brunn-Minkowski inequality for convex sets (with F. Maggi and A. Pratelli), Ann. Inst. H. Poincaré Anal. Non Linéaire 26 (2009), no. 6, 2511-2519.
- 23) Some new well-posedness results for continuity and transport equations, and applications to the chromatography system (with L. Ambrosio, G. Crippa, and L. V. Spinolo), SIAM J. Math. Anal. 41 (2009), no. 5, 1890-1920.
- 24) Optimal transportation on non-compact manifolds (with A. Fathi), *Israel J. Math.* 175 (2010), no. 1, 1-59.
- 25) The optimal partial transport problem Arch. Ration. Mech. Anal. 195 (2010), no. 2, 533-560.
- 26) Mass Transportation on Sub-Riemannian Manifolds (with L. Rifford), Geom. Funct. Anal. 20 (2010), no. 1, 124-159.
- 27) On flows of  $H^{3/2}$ -vector fields on the circle, Math. Ann. 347 (2010), no. 1, 43-57.
- 28) Regularity properties of optimal maps between nonconvex domains in the plane, Comm. Partial Differential Equations 35 (2010), no. 3, 465-479.
- 29) A new transportation distance between non-negative measures, with applications to gradients flows with Dirichlet boundary conditions (with N. Gigli), *J. Math. Pures Appl.* 94 (2010), no. 2, 107-130.
- 30) On the Ma-Trudinger-Wang curvature on surfaces (with L. Rifford and C. Villani), Calc. Var. Partial Differential Equations 39 (2010), no. 3-4, 307-332.
- 31) Almost everywhere well-posedness of continuity equations with measure initial data (with L. Ambrosio), C. R. Acad. Sci. Paris 348 (2010), no. 5-6, 249-252.
- 32) Partial regularity of Brenier solutions of the Monge-Ampère equation (with Y.-H. Kim), *Discrete Contin. Dyn. Syst.* 28 (2010), no. 2, 559-565.
- 33) A mass transportation approach to quantitative isoperimetric inequalities (with F. Maggi and A. Pratelli), *Invent. Math.* 182 (2010), no. 1, 167-211.
- 34) Local semiconvexity of Kantorovich potentials on non-compact manifolds (with N. Gigli), ESAIM Control Optim. Calc. Var. 17 (2011), no. 3, 648-653.
- 35) A variational method for a class of parabolic PDEs (with W. Gangbo and T. Yolcu), Ann. Scuola Norm. Sup. Pisa Cl. Sci. (5) 10 (2011), no. 1, 207-252.
- 36) Global-in-time weak measure solutions and finite-time aggregation for nonlocal interaction equations (with J. A. Carrillo, M. Di Francesco, T. Laurent, and D. Slepčev), *Duke Math. J.* 156 (2011), no. 2, 229-271.
- 37) Fine properties of minimizers of mechanical Lagrangians with Sobolev potentials (with V. Mandorino), *Discrete Contin. Dyn. Syst.* 31 (2011), no. 4, 1325-1346.
- 38) On the shape of liquid drops and crystals in the small mass regime (with F. Maggi), Arch. Ration. Mech. Anal. 201 (2011), no. 1, 143-207.

- 39) Surface measures and convergence of the Ornstein-Uhlenbeck semigroup in Wiener spaces (with L. Ambrosio), *Ann. Fac. Sci. Toulouse Math.* (6) 20 (2011), no. 2, 407-438.
- 40) When is multidimensional screening a convex program? (with Y.-H. Kim and R. J. McCann), *J. Econom. Theory* 146 (2011), no. 2, 454-478.
- 41) Tangent cut loci on surfaces (with L. Rifford and C. Villani), *Differential Geom.* Appl. 29 (2011), no. 2, 154-159.
- 42) Semiclassical limit of quantum dynamics with rough potentials and well posedness of transport equations with measure initial data (with L. Ambrosio, G. Friesecke, J. Giannoulis, and T. Paul), *Comm. Pure Appl. Math.* 64 (2011), no. 9, 1199-1242.
- 43) Necessary and sufficient conditions for continuity of optimal transport maps on Riemannian manifolds (with L. Rifford and C. Villani), *Tohoku Math. J.* (2) 63 (2011), no. 4, 855-876.
- 44) Nearly round spheres look convex (with L. Rifford and C. Villani), Amer. J. Math. 134 (2012), no. 1, 109-139.
- 45) Non-Local Tug-of-War and the Infinity Fractional Laplacian (with C. Bjorland and L. Caffarelli), Comm. Pure Appl. Math. 65 (2012), no. 3, 337-380.
- 46) Isoperimetric-type inequalities on constant curvature manifolds (with Y. Ge), Adv. Calc. Var. 5 (2012), no. 3, 251-284.
- 47) Confinement in nonlocal interaction equations (with J. A. Carrillo, M. Di Francesco, T. Laurent, and D. Slepčev), *Nonlinear Anal.* 75 (2012), no. 2, 550-558.
- 48) Semiclassical limit for mixed states with singular and rough potentials (with M. Ligabò and T. Paul), *Indiana Univ. Math. J.* 61 (2012), no. 1, 193-222.
- 49) Total Variation Flow and Sign Fast Diffusion in one dimension (with M. Bonforte), J. Differential Equations 252 (2012), no. 8, 4455-4480.
- 50) Existence of Eulerian solutions to the semigeostrophic equations in physical space: the 2-dimensional periodic case (with L. Ambrosio, M. Colombo, and G. De Philippis), Comm. Partial Differential Equations 37 (2012), no. 12, 2209-2227.
- 51) Non-Local Gradient Dependent Operators (with C. Bjorland and L. Caffarelli), *Adv. Math.* 230 (2012), no. 4-6, 1859-1894.
- 52) Regularity of optimal transport maps on multiple products of spheres (with Y.-H. Kim and R. J. McCann), J. Eur. Math. Soc. (JEMS) 15 (2013), no. 4, 1131-1166.
- 53) A stability result for the relative isoperimetric inequality inside convex cones (with E. Indrei), J. Geom. Anal. 23 (2013), no. 2, 938-969.
- 54) Regularity of solutions to the parabolic fractional obstacle problem (with L. Caffarelli), J. Reine Angew. Math. 680 (2013), 191-233.
- 55)  $W^{2,1}$  regularity for solutions of the Monge-Ampère equation (with G. De Philippis), *Invent. Math.* 192 (2013), no. 1, 55-69.
- 56) Sharp stability theorems for the anisotropic Sobolev and log-Sobolev inequalities on functions of bounded variation (with F. Maggi and A. Pratelli), Adv. Math. 242 (2013), 80-101.
- 57) Stability for a GNS inequality and the Log-HLS inequality, with application to the critical mass Keller-Segel equation (with E. Carlen), *Duke Math. J.* 162 (2013), no. 3, 579-625.
- 58) On the isoperimetric problem for radial log-convex densities (with F. Maggi), Calc. Var. Partial Differential Equations 48 (2013), no. 3-4, 447-489.
- 59) Asymptotics of the s-perimeter as  $s \searrow 0$  (with S. Dipierro, G. Palatucci, and E. Valdinoci), Discrete Contin. Dyn. Syst. 33 (2013), no. 7, 2777-2790.
- 60) A note on interior  $W^{2,1+\varepsilon}$  estimates for the Monge-Ampère equation (with G. De Philippis and O. Savin), *Math. Ann.* 357 (2013), no. 1, 11-22.
- 61) Second order stability for the Monge-Ampère equation and strong Sobolev convergence of optimal transport maps (with G. De Philippis), *Anal. PDE* 6 (2013), no. 4, 993-1000.

- 62) On sets of finite perimeter in Wiener spaces: reduced boundary and convergence to half-spaces (with L. Ambrosio and E. Runa), Atti Accad. Naz. Lincei Cl. Sci. Fis. Mat. Natur. Rend. Lincei (9) Mat. Appl. 24 (2013), no. 1, 111-122.
- 63) Hölder continuity and injectivity of optimal maps (with Y.-H. Kim and R. J. McCann), Arch. Ration. Mech. Anal. 209 (2013), no. 3, 747-795.
- 64) Sobolev regularity for Monge-Ampère type equations (with G. De Philippis), SIAM J. Math. Anal. 45 (2013), no. 3, 1812-1824.
- 65) On supporting hyperplanes to convex bodies (with Y.-H. Kim and R. J. McCann), *Methods Appl. Anal.* 20 (2013), no. 3, 261-271.
- 66) A geometric approach to correlation inequalities in the plane (with F. Maggi and A. Pratelli), Ann. Inst. Henri Poincaré Probab. Stat. 50 (2014), no. 1, 1-14.
- 67) Bootstrap regularity for integro-differential operators, and its application to nonlocal minimal surfaces (with B. Barrios and E. Valdinoci), *Ann. Sc. Norm. Super. Pisa Cl. Sci.* (5) 13 (2014), no. 3, 609-639.
- 68) A global existence result for the semigeostrophic equations in three dimensional convex domains (with L. Ambrosio, M. Colombo, and G. De Philippis), *Discrete Contin. Dyn. Syst.* 34 (2014), no. 4, 1251-1268.
- 69) WKB analysis of Bohmian dynamics (with C. Klein, P. Markowich, and C. Sparber), Comm. Pure Appl. Math. 67 (2014), no. 4, 581-620.
- 70) Regularity results for very degenerate elliptic equations (with M. Colombo), *J. Math. Pures Appl.* (9) 101 (2014), no. 1, 94-117.
- 71) How to recognize convexity of a set from its marginals (with D. Jerison), *J. Funct. Anal.* 266 (2014), no. 3, 1685-1701.
- 72) An excess-decay result for a class of degenerate elliptic equations (with M. Colombo) Discrete Contin. Dyn. Syst. Ser. S 7 (2014), no. 4, 631-652.
- 73) Higher integrability for minimizers of the Mumford-Shah functional (with G. De Philippis), Arch. Ration. Mech. Anal. 213 (2014), no. 2, 491-502.
- 74) A general class of free boundary problems for fully nonlinear elliptic equations (with H. Shahgholian), *Arch. Ration. Mech. Anal.* 213 (2014), no. 1, 269-286.
- 75) Strongly nonlocal dislocation dynamics in crystals (with S. Dipierro and E. Valdinoci), Comm. Partial Differential Equations 39 (2014), no. 12, 2351-2387.
- 76) Closing Aubry sets I (with L. Rifford), Comm. Pure Appl. Math. 68 (2015), no. 2, 210-285.
- 77) Closing Aubry sets II (with L. Rifford), Comm. Pure Appl. Math. 68 (2015), no. 3, 345-412.
- 78) Optimal regularity of the convex envelope (with G. De Philippis), *Trans. Amer. Math. Soc.* 367 (2015), no. 6, 4407-4422.
- 79) A general class of free boundary problems for fully nonlinear parabolic equations (with H. Shahgholian), Ann. Mat. Pura Appl. (4) 194 (2015), no. 4, 1123-1134.
- 80) Quantitative stability for sumsets in  $\mathbb{R}^n$  (with D. Jerison), J. Eur. Math. Soc. (JEMS) 17 (2015), no. 5, 1079-1106.
- 81) Generic hyperbolicity of Aubry sets on surfaces (with G. Contreras and L. Rifford), *Invent. Math.* 200 (2015), no. 1, 201-261.
- 82) Isoperimetry and stability properties of balls with respect to nonlocal energies (with N. Fusco, F. Maggi, V. Millot, and M. Morini), *Comm. Math. Phys.* 336 (2015), no. 1, 441-507.
- 83) Partial regularity for optimal transport maps (with G. De Philippis), *Publ. Math. Inst. Hautes Études Sci.* 121 (2015), 81-112.
- 84) On the convexity of injectivity domains on nonfocal manifolds (with T. Gallouët and L. Rifford), SIAM J. Math. Anal. 47 (2015), no. 2, 969-1000.
- 85) Boundary  $\varepsilon$ -regularity in optimal transportation (with S. Chen), Adv. Math. 273 (2015), 540-567.

- 86) A note on the dimension of the singular set in free interface problems (with G. De Philippis), *Differential Integral Equations* 28 (2015), 523-536.
- 87) Transport maps for  $\beta$ -matrix models and universality (with F. Bekerman and A. Guionnet), Comm. Math. Phys. 338 (2015), no. 2, 589-619.
- 88) Existence and uniqueness of maximal regular flows for non-smooth vector fields (with L. Ambrosio and M. Colombo), *Arch. Ration. Mech. Anal.* 218 (2015), no. 2, 1043-1081.
- 89) BMO-type norms related to the perimeter of sets (with L. Ambrosio, J. Bourgain, and H. Brezis), Comm. Pure Appl. Math. 69 (2016), no. 6, 1062-1086.
- 90) On the density function on moduli spaces of toric 4-manifolds (with Á. Pelayo), Adv. Geom. 16 (2016), no. 3, 291-300.
- 91) Nonlinear bounds in Hölder spaces for the Monge-Ampère equation (with Y. Jhaveri and C. Mooney), J. Funct. Anal. 270 (2016), no. 10, 3808-3827.
- 92) Stability results on the smoothness of optimal transport maps with general costs (with S. Chen), J. Math. Pures Appl. (9) 106 (2016), no. 2, 280-295.
- 93) Weak KAM Theory for a Weakly Coupled System of Hamilton-Jacobi Equations (with D. Gomes and D. Marcon), Calc. Var. Partial Differential Equations 55 (2016), no. 4, 55-79.
- 94) Universality in several-matrix models via approximate transport maps (with A. Guionnet), *Acta Math.* 217 (2016), no. 1, 81-176.
- 95) Characterization of isoperimetric sets inside almost-convex cones (with E. Baer), Discrete Contin. Dyn. Syst. 37 (2017), no. 1, 1-14.
- 96) Quantitative stability of the Brunn-Minkowski inequality for sets of equal volume (with D. Jerison), *Chin. Ann. Math. Ser. B* 38 (2017), no. 2, 393-412.
- 97) Rigidity and stability of Caffarelli's log-concave perturbation theorem (with G. De Philippis), *Nonlinear Anal.* 154 (2017), 59-70.
- 98) Partial  $W^{2,p}$  regularity for optimal transport maps (with S. Chen), J. Funct. Anal. 272 (2017), no. 11, 4588-4605.
- 99) On the regularity of the free boundary in the *p*-Laplacian obstacle problem (with B. Krummel and X. Ros-Oton), *J. Differential Equations* 263 (2017), no. 3, 1931-1945.
- 100) Quantitative stability for the Brunn-Minkowski inequality (with D. Jerison), Adv.  $Math.\ 314\ (2017),\ 1-47.$
- 101) Regularity and Bernstein-type results for nonlocal minimal surfaces (with E. Valdinoci), J. Reine Angew. Math. 729 (2017), 263-273.
- 102) Infinite speed of propagation and regularity of solutions to the fractional porous medium equation in general domains (with M. Bonforte and X. Ros-Oton), *Comm. Pure Appl. Math.* 70 (2017), no. 8, 1472-1508.
- 103) Regularity of codimension-1 minimizing currents under minimal assumptions on the integrand, *J. Diff. Geom.* 106 (2017), no. 3, 371-391.
- 104) Lipschitz changes of variables between perturbations of log-concave measures (with M. Colombo and Y. Jhaveri), Ann. Sc. Norm. Super. Pisa Cl. Sci., (5) 17 (2017), no. 4, 1491-1519.
- 105) Geometry of minimizers for the interaction energy with mildly repulsive potentials (with J. A. Carrillo and F. S. Patacchini), Ann. Inst. H. Poincaré Anal. Non Linéaire, 34 (2017), no. 5, 1299-1308.
- 106) On the Lagrangian structure of transport equations: the Vlasov-Poisson system (with L. Ambrosio and M. Colombo), *Duke Math. J.* 116 (2017), no. 18, 3505-3568.
- 107) Symplectic G-capacities and integrable systems (with J. Palmer and Á. Pelayo), Ann. Sc. Norm. Super. Pisa Cl. Sci. (5) 18 (2018), no. 1, 65-103.
- 108) Rigidity and sharp stability estimates for hypersurfaces with constant and almost-constant nonlocal mean curvature (with G. Ciraolo, F. Maggi, and M. Novaga), *J. Reine Angew. Math.* 741 (2018), 275-294.

- 109) A quantitative analysis of metrics on  $\mathbb{R}^n$  with almost constant positive scalar curvature, with applications to fast diffusion flows (with G. Ciraolo and F. Maggi), *Int. Math. Res. Not. IMRN* 2018, no. 21, 6780-6797.
- 110) Global regularity for the free boundary in the obstacle problem for the fractional Laplacian (with B. Barrios and X. Ros-Oton), *Amer. J. Math.* 140 (2018), no. 2, 415-447.
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- 112) Global well-posedness of the spatially homogeneous Kolmogorov-Vicsek model as a gradient flow (with M.-J. Kang and J. Morales), *Arch. Ration. Mech. Anal.* 227 (2018), no. 3, 869-896.
- 113) An obstacle problem for conical deformations of thin elastic sheets (with C. Mooney), *Arch. Ration. Mech. Anal.* 228 (2018), no. 2, 401-429.
- 114) Sharp global estimates for local and nonlocal porous medium-type equations in bounded domains (with M. Bonforte and J. L. Vazquez), *Anal. PDE* 11 (2018), no. 4, 945-982.
- 115) The sharp quantitative Euclidean concentration inequality (with F. Maggi and C. Mooney), Camb. J. Math. 6 (2018), no. 1, 59-87.
- 116) Sharp boundary behaviour of solutions to semilinear nonlocal elliptic equations (with M. Bonforte and J. Vázquez), *Calc. Var. Partial Differential Equations* 57 (2018), no. 2, Art. 57, 34 pp.
- 117) On the Continuity of Center-Outward Distribution and Quantile Functions, *Non-linear Anal.* 177 (2018), part B, 413-421.
- 118) Gradient stability for the Sobolev inequality: the case  $p \ge 2$  (with R. Neumayer), J. Eur. Math. Soc. (JEMS) 21 (2019), no. 2, 319-354.
- 119) A rigorous derivation from the kinetic Cucker-Smale model to the pressureless Euler system with nonlocal alignment (with M.-J. Kang), *Anal. PDE* 12 (2019), no. 3, 843-866.
- 120) On the fine structure of the free boundary for the classical obstacle problem (with J. Serra), *Invent. Math.*, 215 (2019), no. 1, 311-366.
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- 122) Regularity of monotone transport maps between unbounded domains (with D. Cordero-Erausquin), *Discrete Contin. Dyn. Syst.*, 39 (2019), no. 12, 7101-7112.
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- 124) On the sharp stability of critical points of the Sobolev inequality (with F. Glaudo), *Arch. Ration. Mech. Anal.*, 237 (2020), no. 1, 201–258.
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- 126) On the obstacle problem for the 1D wave equation (with X. Fernández-Real), *Math. Eng.*, 2 (2020), no. 4, 584-597.
- 127) Symmetry results for critical anisotropic p-Laplacian equations in convex cones (with G. Ciraolo and A. Roncoroni), Geom. Funct. Anal., 30 (2020), no. 3, 770-803.
- 128) Stable solutions to semilinear elliptic equations are smooth up to dimension 9 (with X. Cabré, X. Ros-Oton, and J. Serra), *Acta Math.*, 224 (2020), no. 2, 187–252.
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- 130) Sharp Extinction Rates for Fast Diffusion Equations on Generic Bounded Domains (with M. Bonforte), *Comm. Pure Appl. Math.*, 74 (2021), no. 4, 744–789.

- 131) A sharp Freiman type estimate for semisums in two and three dimensional Euclidean spaces (with D. Jerison), Ann. Sci. Éc. Norm. Supér., (4) 54 (2021), no. 1, 235–257.
- 132) The power of quantum neural networks (with A. Abbas, D. Sutter, C. Zoufal, A. Lucchi, and S. Woerner), *Nat. Comput. Sci.*, 1 (2021), 403–409.
- 133) Strategic execution trajectories (with G. Bordigoni, A. Ledford, and P. Ustinov), *Appl. Math. Finance*, 29 (2022), no. 4, 288-330.
- 134) Strong stability for the Wulff inequality with a crystalline norm (with Y. Ru-Ya Zhang), Comm. Pure Appl. Math., 75 (2022), no. 2, 422–446.
- 135) Lipschitz Regularity in Vectorial Linear Transmission Problems (with S. Kim and H. Shahgholian), *Nonlinear Anal.*, 221 (2022), no. 112911.
- 136) Sharp gradient stability for the Sobolev inequality (with Y. Ru-Ya Zhang), *Duke Math. J.*, 171 (2022), no. 12, 2407–2459.
- 137) Strong Sard Conjecture and regularity of singular minimizing geodesics for analytic sub-Riemannian structures in dimension 3 (with A. Belotto da Silva, A. Parusiński, and L. Rifford), *Invent. Math.*, 229 (2022), no. 1, 395–448.
- 138) On the prescribed negative Gauss curvature problem for graphs (with C. Kehle), Discrete Contin. Dyn. Syst., 43 (2023), no. 3-4, 1420–1435.
- 139) Regularity properties of monotone measure-preserving maps (with Y. Jhaveri), *Adv. Nonlinear Stud.*, 23 (2023), no. 1, Paper No. 20220057, 11 pp.
- 140) The Cauchy-Dirichlet Problem for the Fast Diffusion Equation on Bounded Domains, *Nonlinear Anal.*, 239 (2024), no. 113394.
- 141) Uniform boundedness for finite Morse index solutions to supercritical semilinear elliptic equations (with Y. Ru-Ya Zhang), *Comm. Pure Appl. Math.*, 77 (2024), no. 1, 3–36.
- 142) The singular set in the Stefan problem (with X. Ros-Oton and J. Serra), *J. Amer. Math. Soc.*, 37 (2024), no. 2, 305–389.
- 143) A quantitative stability result for the Prékopa-Leindler inequality for arbitrary measurable functions (with K. J. Böröczky and J. P. G. Ramos), Ann. Inst. H. Poincaré Anal. Non Linéaire, 41 (2024), no. 3, 565–614.
- 144) Constraint Maps with Free Boundaries: the Obstacle Case (with S. Kim and H. Shahgholian), Arch. Ration. Mech. Anal., 248 (2024), no. 5, Paper No. 79, 36 pp.
- 145) Infinite-width limit of deep linear neural networks (with L. Chizat, M. Colombo, and X. Fernández-Real), Comm. Pure Appl. Math., 77 (2024), no. 10, 3958–4007.
- 146) Complete classification of global solutions to the obstacle problem (with S. Eberle and G.S. Weiss) *Ann. of Math.*, (2) 201 (2025), no. 1, 167–224.
- 147) Sharp stability for Sobolev and log-Sobolev inequalities, with optimal dimensional dependence (with J. Dolbeault, M. J. Esteban, R. L. Frank, and M. Loss) *Camb. J. Math.*, 13 (2025), no. 2, 359–430.
- 148) Improved stability versions of the Prékopa–Leindler inequality (with J. P. G. Ramos), J. Convex Anal., 32 (2025), no. 1, 291–320.
- 149) Global sensitivity analysis via optimal transport (with E. Borgonovo, E. Plischke, and G. Savaré), *Management Science*, to appear
- 150) Constraint maps with free boundaries: the Bernoulli case (with A. Guerra, S. Kim, and H. Shahgholian), J. Eur. Math. Soc. (JEMS), to appear
- 151) A two-scale complexity measure for deep learning models (with M. Datres, G. Leonardi, and D. Sutter), *NeurIPS* 2024, to appear
- 152) On optimal transport maps between 1/d-concave densities (with G. Carlier and F. Santambrogio), Ann. Inst. H. Poincaré Anal. Non Linéaire, to appear
- 153) Serrin's overdetermined problem in rough domains (with Y. Ru-Ya Zhang), *J. Eur. Math. Soc. (JEMS)*, to appear

#### Submitted papers

- 1) Effective dimension of machine learning models (with A. Abbas, D. Sutter, and S. Woerner)
- 2) Strong stability of convexity with respect to the perimeter via a quantitative Alexandrov theorem with optimal decay (with Y. Ru-Ya Zhang)
- 3) Regularity theory for nonlocal obstacle problems with critical and subcritical scaling (with X. Ros-Oton and J. Serra)
- 4) Sharp quantitative stability of the Brunn-Minkowski inequality (with P. van Hintum and M. Tiba)
- 5) Sharp stability of the Brunn-Minkowski inequality via optimal mass transportation (with P. van Hintum and M. Tiba)
- 6) Constraint maps: singularities vs free boundaries (with A. Guerra, S. Kim, and H. Shahgholian)
- 7) Generic regularity of equilibrium measures for the logarithmic potential with external fields (with G. Colombo)
- 8) Sharp Quantitative Stability for the Prékopa-Leindler and Borell-Brascamp-Lieb Inequalities(with P. van Hintum and M. Tiba)
- 9) Global Stable Solutions to the Free Boundary Allen–Cahn and Bernoulli Problems in 3D are One-Dimensional(with H. Chan, X. Fernández-Real, and J. Serra)

#### Surveys and lecture notes

- 1) Optimal transport, Euler equations, Mather and DiPerna-Lions theories, *Mémoire d'Habilitation à Diriger de Recherche* (HDR). Nice, 2009.
- 2) Cédric Villani reçoit un prix de la Société Mathématiques Européenne. (French) [Cédric Villani, 2008 European Mathematical Society Prize] (with L. Desvillettes), Gaz. Math. No. 120 (2009), 76-81
- 3) Regularity of optimal transport maps [after Ma-Trudinger-Wang and Loeper], Séminaire Bourbaki. Vol. 2008/2009. Exposés 997-1011. Astérisque No. 332 (2010), Exp. No. 1009, ix, 341-368.
- 4) Optimal Transport. Old and New. [book review], Bull. Amer. Math. Soc. (N.S.) 47 (2010), no. 4, 723-727.
- 5) Almost everywhere well-posedness of continuity equations with measure initial data (with L. Ambrosio), C. R. Math. Acad. Sci. Paris 348 (2010), no. 5-6, 249-252.
- 6) Optimal Transport and Curvature (with C. Villani), Nonlinear PDE's and applications, 171-217, Lecture Notes in Math. 2028, Springer, Heidelberg, 2011.
- 7) Quantitative isoperimetric inequalities, with applications to the stability of liquid drops and crystals, Concentration, functional inequalities and isoperimetry, 77-87, Contemp. Math. 545, Amer. Math. Soc. Providence, RI, 2011.
- 8) Existence and uniqueness results for the continuity equation and applications to the chromatography system (with L. Ambrosio, G. Crippa, and L. V. Spinolo), *Nonlinear conservation laws and applications*, 195-204, IMA Vol. Math. Appl. 153, Springer, New York, 2011.
- 9) Stability in geometric and functional inequalities, *Proceedings of the 6th European Congress of Mathematics*, 2012.
- 10) Variational models for the incompressible Euler equations (with S. Daneri), *HCDTE* lecture notes. Part II. Nonlinear hyperbolic PDEs, dispersive and transport equations, 51 pp., AIMS Ser. Appl. Math., 7, Am. Inst. Math. Sci. (AIMS), Springfield, MO, 2013.
- 11) Aubry sets, Hamilton-Jacobi equations, and Mañé Conjecture (with L. Rifford), Geometric analysis, mathematical relativity, and nonlinear partial differential equations, 83-104, Contemp. Math. 599, Amer. Math. Soc., Providence, RI, 2013.
- 12) Lecture notes on variational models for incompressible Euler equations (with L. Ambrosio), Optimal transportation, 58-71, London Math. Soc. Lecture Note Ser. 413, Cambridge Univ. Press, Cambridge, 2014.

- 13) Sobolev regularity for the Monge-Ampère equation, with application to the semi-geostrophic equations, Zap. Nauchn. Sem. S.-Peterburg. Otdel. Mat. Inst. Steklov. (POMI) 411 (2013), Teoriya Predstavlenii Dinamicheskie Sistemy, Kombinatornye Metody. XXII, 103-118, 242; translation in J. Math. Sci. (N. Y.) 196 (2014), no. 2, 175-183.
- 14) The Monge-Ampère equation and its link to optimal transportation (with G. De Philippis), Bull. Amer. Math. Soc. (N.S.) 51 (2014), no. 4, 527-580
- 15) Partial regularity results in optimal transportation (with G. De Philippis), *Trends in Contemporary Mathematics*, Springer INdAM Series, Volume 8, (2014), 293-307
- 16) Quantitative stability results for the Brunn-Minkowski inequality, *Prooceedings of the International Congress of Mathematicians*, 2014.
- 17) Stability results for the Brunn-Minkowski inequality, Colloquium De Giorgi 2013 and 2014, 119-127, Colloquia 5, Ed. Norm., Pisa, 2014.
- 18) Perimeter of sets and *BMO*-type norms (with L. Ambrosio, J. Bourgain, and H. Brezis), *C. R. Math. Acad. Sci. Paris* 352 (2014), no. 9, 697-698.
- 19) An overview of unconstrained free boundary problems (with H. Shahgholian), *Philos. Trans. A* 373 (2015), no. 2050, 20140281, 11 pp.
- 20) A transportation approach to universality in random matrix theory, *Boll. Unione Mat. Ital.* 10 (2017), no. 1, 55-74.
- 21) Regularity theory for local and nonlocal minimal surfaces: an overview (with M. Cozzi), Nonlocal and nonlinear diffusions and interactions: new methods and directions, 117-158, Lecture Notes in Math., 2186, Fond. CIME/CIME Found. Subser., Springer, Cham, 2017.
- 22) Global existence for the semigeostrophic equations via Sobolev estimates for Monge-Ampère, *Partial differential equations and geometric measure theory*, 1-42, Lecture Notes in Math., 2211, Fond. CIME/CIME Found. Subser., *Springer, Cham*, 2018.
- 23) Regularity of interfaces in phase transitions via obstacle problems, *Prooceedings of the International Congress of Mathematicians*, 2018.
- 24) On the Monge-Ampère equation,  $S\'{e}minaire~Bourbaki$ . Vol. 2017/2018. Exposé 1136-1150 (2019), Exp. No. 1148, 477–504.
- 25) Free boundary regularity in obstacle problems, *Journées équations aux dérivées partielles* 2018, Talk no. 2, 24 p.
- 26) The Continuous Formulation of Shallow Neural Networks as Wasserstein-Type Gradient Flows (with X. Fernández-Real), In: Avila, A., Rassias, M.T., Sinai, Y. (eds) Analysis at Large., *Springer, Cham*, 2022
- 27) An introduction to optimal transport and Wasserstein gradient flows, *Optimal transport on quantum structures*, 1–28, Springer, Cham, 2024.
- 28) A short review on improvements and stability for some interpolation inequalities, Proceedings of ICIAM 2023
- 29) Constraint Maps and Free Boundaries (with A. Guerra, S. Kim, and H. Shahgholian), *Notices AMS*, 72 (2025), no. 5, 494–503.

#### Books

- 1) Optimal transportation and action-minimizing measures. Thesis, Scuola Normale Superiore, Pisa, 2007. Tesi. Scuola Normale Superiore di Pisa (Nuova Series) [Theses of Scuola Normale Superiore di Pisa (New Series)], 8. Edizioni della Normale, Pisa, 2008. xx+254 pp.
- 2) Autour des inégalités isopérimétriques. (French) [On isoperimetric inequalities] (with W. Bench, C. de Franchis, L. Deproit, S. Gilles, B. Oh, A. Tenne, and K. Webster), Edited and with a preface by Figalli. Éditions de l'École Polytechnique, Palaiseau, 2011. 124 pp.
- 3) The Monge-Ampère Equation and its Applications. Zürich Lectures in Advanced Mathematics. European Mathematical Society (EMS), Zurich, 2017.

4) An Invitation to Optimal Transport, Wasserstein Distances, and Gradient Flows. (with F. Glaudo), EMS Textbooks in Mathematics. European Mathematical Society (EMS), Zurich, 2021. 144pp

# Teaching

# Undergraduate and graduate classes

- 2025 2026 (fall) Analysis I: One Variable, undergraduate class (ETH Zürich)
- 2023 2024 (fall) Analysis I: One Variable, undergraduate class (ETH Zürich)
- 2022 2023 (spring) Variational Problems and PDEs, graduate class (ETH Zürich)
  - 2021 2022 (fall) Harmonic Analysis, graduate class (ETH Zürich)
- 2020 2021 (spring) An Introduction to the Calculus of Variations, graduate class (ETH Zürich)
  - 2019 2020 (fall) Optimal transport, graduate class (ETH Zürich)
- 2018 2019 (spring) Topics in Partial Differential Equations, graduate class (ETH Zürich)
  - 2018 2019 (fall) Analysis III, undergraduate class (ETH Zürich)
  - 2017 2018 (fall) Analysis III, undergraduate class (ETH Zürich)
- 2016 2017 (spring) Topics in the calculus of variations, graduate class (ETH Zürich)
  - 2016 2017 (fall) Free Boundary Problems, graduate class (ETH Zürich)
- 2015 2016 (spring) Hamilton-Jacobi equations and dynamics, graduate class (UT Austin)
- 2015 2016 (spring) PDE II, graduate class (UT Austin)
- 2014 2015 (spring) PDE II, graduate class (UT Austin)
  - 2014 2015 (fall) The Monge-Ampère equation and its applications, Nachdiplom Lectures (ETH Zürich)
- 2013 2014 (spring) Topics in nonlinear analysis, graduate class (UT Austin)
- 2012 2013 (spring) Optimal transport, graduate class (UT Austin)
  - 2012 2013 (fall) Topics in Differential Equations, graduate class (MIT)
- 2011 2012 (spring) Calculus of Variations, graduate class (UT Austin)
- 2011 2012 (spring) PDE II, graduate class (UT Austin)
- 2010 2011 (spring) Geometric Measure Theory, graduate class (UT Austin)
- 2010 2011 (spring) PDE II, graduate class (UT Austin)
- 2008 2009 (spring) Transport optimal et applications (in french), graduate class (Université Paris-Sud)
  - 2008 2009 (fall) Equations différentielles et systèmes dynamiques (in french), undergraduate class (Ecole Polytechnique)

#### Invited graduate or research-level courses

- Sep 2022 An introduction to classical optimal transport, Erdös Center Alfréd Rényi Institute of Mathematics (Budapest, Hungary)
- Jun 2018 Free boundary regularity in obstacle problems, Journées EDP 2018 (Obernai, France)
- Nov 2017 The obstacle problem, Conference on Particle Systems and PDE's (Nice, France)
- Sep 2017 The obstacle problem, "Summer School" at OxPDE (Oxford, UK)
- Jul 2016 Regularity results for local and non-local energy interactions, CIME Summer School on "Nonlocal and nonlinear diffusions and interactions: new methods and directions" (Cetraro, Italy)
- Feb 2016 Flow of nonsmooth vector fields and applications, "The 6th Korea PDE school" at NIMS (Daejeon, Korea)
- Jul 2015 Flow of nonsmooth vector fields and applications, "International Workshop on Elliptic and Kinetic Partial Differential Equations" at IMPA (Rio de Janeiro, Brazil)
- Mar 2015 The Monge-Ampère equation, "Thomas Wolff Memorial Lectures in Mathematics" at Caltech (Pasadena, CA, USA)

- Dec 2014 Nonlocal minimal surfaces, School-Workshop "Nonlocal days in Basel" (Basel, Switzerland)
- Jun 2014 Regularity results in free boundary problems, EMS Summer School on "Interactions between Dynamical Systems and Partial Differential Equations" (Barcelona, Spain)
- Jun 2014 Trasporto ottimale ed equazioni di tipo MongeAmpère, 1º Corso Intensivo di Calcolo delle Variazioni (Catania, Italy)
- Jun 2014 Monge-Ampère type equations and applications, CIME Summer School on "Partial Differential Equations and Geometric Measure Theory" (Cetraro, Italy)
- May 2014 Stability results for geometric and functional inequalities, "Nirenberg Lectures in Geometric Analysis" at the CRM (Montreal, Canada)
- May 2014 Regularity for the Monge-Ampère equation, with applications to the semigeostrophic equations, School-Workshop on "Kinetics, non standard diffusions and stochastics: emerging challenges in the sciences" (Austin, TX, USA)
- Jul 2013 Stability results for geometric inequalities, Summer School on "Geometric Measure Theory and Optimal Transport" at ICTP (Trieste, Italy)
- Jan 2012 Stabilité dans les inégalités fonctionnelles, transport optimal et EDP, Cours Peccot at the Collège de France (Paris, France)
- Jun 2011 Optimal transport, functional inequalities and Riemannian geometry, Summer School on "Aubry Mather Theory and Optimal Transport" (Lisbon, Portugal)
- Jun 2011 Free boundaries in variational problems, ERC-Summer School on "Calculus of Variations, Continuum Mechanics and Geometric Inequalities" (Ischia, Italy)
- May 2011 Variational models for the incompressible Euler equations, Summer School during the Trimester Program on "Nonlinear Hyperbolic PDEs, Dispersive and Transport Equation: Analysis and Control" (Trieste, Italy)
- Sep 2010 Applications of optimal transport to isoperimetric inequalities and Riemannian geometry, Summer School on "Optimal mass transport and geometric inequalities" (Haus Bergkranz, Austria)
- Apr 2010 Optimal transport and applications, 2009-2010 Salomon Bockner Lectures in Mathematics (Houston, TX, USA)
- Jun 2009 Variational models for the incompressible Euler equations, Summer School on "Optimal Transportation: Theory and Applications" (Grenoble, France)
- Sep 2007 Variational models for the incompressible Euler equations, Summer School on "Optimal transportation structures, gradient flows and entropy methods for applied PDE's" (Vienna, Austria)

(D.L.196/03).

Zurich, October 16, 2025