Giovanni Eugenio Comi

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PERSONAL STATEMENT

Research topics

My main interest is Geometric Measure Theory. One of my current researches, started during my PhD under the supervision of Prof. L. Ambrosio, concerns a new distributional characterization of the notion of sets of finite fractional perimeter, which leads to a new space of functions of fractional bounded variation. In addition, I am studying the theory of divergence-measure fields and the generalizations of the Gauss-Green formulas in non-Euclidean contexts, such as stratified groups and general metric measure spaces.

Other topics which are of interest for me are Calculus of Variation, Harmonic Analysis and Optimal Transport.

WORK EXPERIENCE

Assistant Professor (RTD-b)
Università degli Studi di Bologna [28/10/2022 – Current]

City: Bologna
Country: Italy

Research Grant Holder
Scuola Normale Superiore [01/04/2022 – 27/10/2022]

City: Pisa
Country: Italy

Scientific supervisor: Prof. Andrea Malchiodi.

Research Grant Holder
Università degli Studi di Pisa [01/04/2021 – 31/03/2022]

City: Pisa
Country: Italy

Scientific supervisor: Prof. Giovanni Alberti.

Postdoc
Universität Hamburg [01/04/2019 – 31/03/2021]

City: Hamburg
Country: Germany

Scientific supervisor: Prof. Thomas Schmidt.

EDUCATION AND TRAINING

PhD in Mathematics (cum Laude)
Scuola Normale Superiore [01/11/2015 – 28/02/2019]

Address: Pisa (Italy)

Thesis: "Refined Gauss-Green formulas and evolution problems for Radon measures", defended on 12/02/2020.
Supervisors: Prof. Luigi Ambrosio and Prof. Mark A. Peletier.

One semester Erasmus
Rheinische Friedrich-Wilhelms-Universität Bonn [01/04/2014 – 31/08/2014]

Address: Bonn (Germany)

Master Degree in Mathematics (110/110 cum Laude)
Università degli Studi di Milano Statale [24/09/2013 – 16/07/2015]

Address: Milano (Italy)

Thesis: "Divergence-measure fields: generalizations of Gauss-Green formula with application", defended on 16/07/2015.
Supervisor: Prof. Kevin R. Payne.

Bachelor Degree in Mathematics (110/110 cum Laude)
Università degli Studi di Milano Statale [08/09/2010 – 23/07/2013]

Address: Milano (Italy)

Classical Lyceum Diploma (100/100)
Liceo classico Giosuè Carducci [05/09/2005 – 02/07/2010]

Address: Milano (Italy)

PUBLICATIONS

Papers

- G. E. Comi and G. Stefani, A distributional approach to fractional Sobolev spaces and fractional variation: asymptotics I, *Rev. Mat. Complut.* (2022).
- G. E. Comi, D. Spector and G. Stefani, The fractional variation and the precise representative of BV^{alpha, p} functions, *Fract. Calc. Appl. Anal.* 25, 520-558 (2022).
- G. E. Comi and G. Stefani, Leibniz rules and Gauss-Green formulas in distributional fractional spaces, *J. Math. Anal. Appl.,* Volume 514, Issue 2, 126312 (2022).
- V. Buffa, G. E. Comi and M. Miranda Jr., On BV functions and essentially bounded divergence-measure fields in metric spaces, *Rev. Mat. Iberoamericana,* Volume 38, Issue 3, pp. 883-946 (2022).
- E. Bruè, M. Calzi, G. E. Comi and G. Stefani, A distributional approach to fractional Sobolev spaces and fractional variation: asymptotics II, *C. R. Math.,* Volume 360, pp. 589-626 (2022).
- G. E. Comi and G. Stefani, Failure of the local chain rule for the fractional variation, *Portugalie Mathematica* (2022).
- G. E. Comi, G. Crasta, V. De Cicco and A. Malusa, Representation formulas for pairings between divergence-measure fields and BV functions, *preprint* (2022).
- A. Carbotti and G. E. Comi, A note on Riemann-Liouville fractional Sobolev spaces, *Communications on Pure and Applied Analysis* 20(1): 17-54 (2021).
- G. E. Comi and V. Magnani, The Gauss-Green theorem in stratified groups, *Adv. Math.* 360: 106916 (2020).
- A. Nikishova, G. E. Comi and A. G. Hoekstra, Sensitivity analysis based dimension reduction of multiscale models, *Mathematics and Computers in Simulation,* 170: 205-220 (2020).
- G. E. Comi and G. Stefani, A distributional approach to fractional bounded variation: existence of blow-up, *Journal of Functional Analysis*, 277(10):3373--3435 (2019).
- G.-Q. G. Chen, G. E. Comi and M. Torres, Cauchy fluxes and Gauss-Green formulas for divergence-measure fields over general open sets, *Archive for Rational Mechanics and Analysis*, 233(1):87--166 (2019).
- G. E. Comi, BMO-type norms and anisotropic surface measures, *Atti Accad. Naz. Lincei Rend. Lincei Mat. Appl.*, 29(3):431--437 (2018).
- G. E. Comi, R. J. Fitzner, S. Kolumbán, F. P. Pijpers, R. M. Pires da Silva Castro, R. A. J. Post and A. J. Vromans, Causal effects of government decisions on earthquakes in Groningen, In *Proceedings of Study Group Mathematics with Industry 2018* (2018).
- G. E. Comi and K. R. Payne, On locally essentially bounded divergence measure fields and sets of locally finite perimeter, *Adv. Calc. Var.* 13, no. 2, 179–217 (2020, published online in 2017).
- G. E. Comi and M. Torres, One-sided approximation of sets of finite perimeter, *Atti Accad. Naz. Lincei Rend. Lincei Mat. Appl.*, 28(1):181--190 (2017).

Chapters

- L. Ambrosio and G. E. Comi, Anisotropic surface measures as limits of volume fractions, In *Current Research in Nonlinear Analysis: In Honor of Haim Brezis and Louis Nirenberg*, 1--32, Springer Optim. Appl., 135, *Springer, Cham* (2018).

TEACHING AND TUTORING

Teaching activity:

- Lecture class of the course "Analisi Matematica I" in the Dipartimento di Ingegneria Informatica of the Università degli Studi di Bologna (Winter Semester 2022/2023)
- Co-teaching of the course "Analisi Matematica I" in the Dipartimento di Ingegneria Civile e Industriale of the Università di Pisa (Winter Semester 2021/2022)
- Lecture class of the course "Calculus of Variations" in the Mathematics Department of the Universität Hamburg (Winter semester 2020/2021)
- Exercise class of the course "Partial Differential Equations" in the Mathematics Department of the Universität Hamburg (Winter semester 2020/2021)
- Seminar on "BV Functions and the Calculus of Variations" in the Mathematics Department of the Universität Hamburg (Summer semester 2020)
- Exercise class of the course "Harmonic Analysis/PDEs" in the Mathematics Department of the Universität Hamburg (Summer semester 2020)
- Lecture and exercise class of the course "BV functions and sets of finite perimeter" in the Mathematics Department of the Universität Hamburg (Winter semester 2019/2020)
- Seminar on "Selected Topics in Harmonic Analysis" in the Mathematics Department of the Universität Hamburg (Winter semester 2019/2020)
- Exercise class of the course "Harmonic Analysis" in the Mathematics Department of the Universität Hamburg (Summer semester 2019)

Tutoring

- Supervisor of a Master thesis with title "Methods in Quantum Optimal Transport" (April 2020 - June 2021)
- Second referee of a Master thesis with title "Bounds for Rayleigh-Bénard convection between planar and rough boundaries" (May 2020 - January 2021)
- Second referee of a Bachelor thesis with title "Differentiationssätze für Maße, p-Kapazitäten und feine Stetigkeitseigenschaften von Sobolev-Funktionen" (September 2020 - October 2020)
- Tutoring of first year bachelor students of the Scuola Normale Superiore (2015 - 2018)

RESEARCH RELATED TRAVELS

Research visits

- 03/10/2022 – 07/10/2022: Sapienza Università di Roma, Roma, Italy. Invited by Prof. Francesco Petitta.
- 10/07/2022 – 15/07/2022: Sapienza Università di Roma, Roma, Italy. Invited by Prof. Virginia De Cicco.
- 03/07/2022 – 08/07/2022: University of Vienna, Vienna, Austria. Invited by Prof. Ulisse Stefanelli and Dr. Stefano Buccheri.
- 29/05/2022 – 01/06/2022: Università di Trento, Trento, Italy. Invited by Prof. Gian Paolo Leonardi.
- 02/05/2022 – 06/05/2022: SISSA, Trieste, Italy. Invited by Prof. Luca Rizzi and Dr. Giorgio Stefani.
- 07/11/2021 – 14/11/2021: Universität Hamburg, Hamburg, Germany. Invited by Prof. Camilla Nobili.
- 11/02/2020 – 14/02/2020: Università di Pisa, Pisa, Italy. Invited by Prof. Valentino Magnani.
- 22/09/2019 – 04/10/2019: National Chiao Tung University, Hsinchu, Republic of China (Taiwan). Invited by Prof. Daniel Spector.
- 10/06/2019 – 14/06/2019: Sapienza Università di Roma, Roma, Italy. Invited by Prof. Virginia De Cicco.
- 11/05/2019 – 16/05/2019: Aalto University, Espoo, Finland. Invited by Prof. Juha Kinnunen and Dr. Vito Buffa.
- 15/07/2018 – 20/07/2018: Università degli Studi di Ferrara, Ferrara, Italy. Invited by Prof. Michele Miranda Jr.
- 07/05/2018 – 09/05/2018: Università degli Studi di Modena e Reggio Emilia, Modena, Italy. Invited by Prof. Gian Paolo Leonardi.
- 04/06/2017 – 09/06/2017: Mathematical Institute, University of Oxford, Oxford, United Kingdom. Invited by Prof. Gui-Qiang G. Chen.
- 24/05/2016 – 27/05/2016: Technische Universität Dresden, Dresden, Germany. Invited by Prof. Friedemann Schuricht.

Visiting student

- 01/05/2017 – 13/07/2017: Technische Universiteit Eindhoven, Eindhoven, Netherlands. Invited by Prof. Mark A. Peletier.

GRANTS AND FUNDING

GNAMPA Project 2022 - "Problemi di semicontinuità: la riscoperta di alcuni strumenti classici e nuovi sviluppi"

With Giovanni Scilla, Graziano Crasta, Virginia De Cicco, Ilaria Fragalà and Annalisa Malusa.

SCIENTIFIC TALKS

Conferences and workshops

- "Refined Gauss-Green formulas", at the First UMI meeting of PhD students, Padova, Italy, 27 May 2022.
- "Fractional Leibniz rules and Gauss-Green formulas", at the XXXI Convegno Nazionale di Calcolo delle Variazioni, Levico Terme, Italy, 10 May 2022.
- "Leibniz rules in distributional fractional spaces", at the workshop "PDEs in presence in Rome 2022", Rome, Italy, 16 February 2022.
- "A distributional approach to fractional Sobolev spaces and fractional variation: existence of blow-up", at the workshop "Some topics of Geometric Analysis and Geometric Measure Theory", Pisa, Italy, 17 April 2019.
- "A distributional approach to fractional Sobolev spaces and fractional variation: existence of blow-up", at the XXIX Convegno Nazionale di Calcolo delle Variazioni, Levico Terme, Italy, 4 February 2019.
- "The Gauss-Green theorem in stratified groups", at the workshop "Vector Fields, Surfaces and Perimeters in Singular Geometries", Ferrara, Italy, 27 February 2018.
- "Anisotropic surface measures as limits of volume fractions", at the workshop "From Regensburg to Pisa: two days of Analysis under the Leaning Tower", Pisa, Italy, 1 July 2017.
- "Anisotropic surface measures as limits of volume fractions", at the XXVII Convegno Nazionale di Calcolo delle Variazioni, Levico Terme, Italy, 6 February 2017.

Invited talks

- "Fractional Leibniz rules and Gauss-Green formulas", Analysis Seminar, at the SISSA, Trieste, Italy, 3 May 2022.
- "Distributional fractional Sobolev and BV spaces: fine properties and Leibniz rules", Spring 2022 Nonlinear Analysis Seminar Series, at the National Taiwan Normal University, Taipei, Taiwan, 22 March 2022.
- "Distributional fractional Sobolev and BV spaces" at the Università di Pisa, Pisa, Italy, 3 March 2022.
- "Fractional Sobolev and BV spaces: a distributional approach" at the University of Western Australia, Perth, Australia, 14 October 2020.
- "Refined Gauss-Green formulas" at the Universität Hamburg, Hamburg, Germany, 26 May 2020.
- "A distributional approach to fractional variation: asymptotics" at the Universität Hamburg, Hamburg, Germany, 12 November 2019.
- "An overview on divergence-measure fields and weak integration by parts formulas", at the National Center for Theoretical Sciences, Taipei, Republic of China (Taiwan), 03 October 2019.
- "Fractional Sobolev spaces and fractional variation from a distributional point of view", at the Dipartimento SBAI, Sapienza Università di Roma, Roma, Italy, 12 June 2019.
- "Integration by parts formulas under weak regularity assumptions", at the Universität Hamburg, Hamburg, Germany, 21 May 2019.
- "A distributional approach to fractional Sobolev spaces and fractional variation", at the Aalto University, Espoo, Finland, 15 May 2019.
- "A distributional approach to fractional Sobolev spaces and fractional variation: existence of blow-up", at the Universität Hamburg, Hamburg, Germany, 9 April 2019.
- "A distributional approach to fractional Sobolev spaces and fractional variation: existence of blow-up", at the Scuola Normale Superiore, Pisa, Italy, 29 November 2018.
- "The Gauss-Green formulas for divergence-measure fields and sets of finite perimeter", at the Università degli Studi di Ferrara, Ferrara, Italy, 18 July 2018.
- "Divergence-measure fields and the Gauss-Green formulas", at the Università degli Studi di Modena e Reggio Emilia, Modena, Italy, 8 May 2018.
- "Divergence-measure fields: an overview of the generalizations of the Gauss-Green formulas", at the Mathematical Institute, Oxford, United Kingdom, 8 June 2017.

- "Divergence-measure fields: generalizations of Gauss-Green formula", at the Technische Universität Dresden, Dresden, Germany, 26 May 2016.
- "Divergence-measure fields: generalizations of Gauss-Green formula with applications", at the Università di Pisa, Pisa, Italy, 2 March 2016.

PARTICIPATION TO CONFERENCES, WORKSHOPS AND SUMMER SCHOOLS

Conferences

- Anisotropic Isoperimetric Problems, Rome, Italy: September 2022.
- Isoperimetric Problems, Pisa, Italy: June 2022.
- First UMI meeting of PhD students, Padova, Italy: May 2022.
- 100 Years Unione Matematica Italiana - 800 Years Università di Padova, Padova, Italy: May 2022.
- XXXI Convegno Nazionale di Calcolo delle Variazioni, Levico Terme, Italy: May 2022.
- XXX Convegno Nazionale di Calcolo delle Variazioni, Levico Terme, Italy: February 2020.
- XXIX Convegno Nazionale di Calcolo delle Variazioni, Levico Terme, Italy: February 2019.
- Alessio Figalli, Fields Medallist 2018, Pisa, Italy: January 2019.
- XXVIII Convegno Nazionale di Calcolo delle Variazioni, Levico Terme, Italy: February 2018.
- Sub-Riemannian Geometry Harmonic Analysis, PDE and Applications, Bologna, Italy: January 2018.
- XXVII Convegno Nazionale di Calcolo delle Variazioni, Levico Terme, Italy: February 2017.
- Lecce Conference in Calculus of Variations and Partial Differential Equations, Lecce, Italy: October 2016.
- A Mathematical Tribute to Ennio De Giorgi, Pisa, Italy: September 2016.
- XXVI Convegno Nazionale di Calcolo delle Variazioni, Levico Terme, Italy: January 2016.

Workshops

- Another Pisan workshop in Geometric Analysis, Pisa, Italy: September 2022.
- Geometric Analysis in Metric Measure Spaces, Levico Terme, Italy: June 2022.
- PDEs in presence in Rome 2022, Rome, Italy: February 2022.
- What do we prove tonight? Session on hyperbolic equations, Pisa, Italy: September 2021.
- Dispersive and subelliptic PDEs, Pisa, Italy: February 2020.
- Some topics of Geometric Analysis and Geometric Measure Theory, Pisa, Italy: April 2019.
- Optimal transport and applications, Pisa, Italy: November 2018.
- Vector Fields, Surfaces and Perimeters in Singular Geometries, Ferrara, Italy: February 2018.
- SWI 2018, "Study Group Mathematics With Industry 2018", Eindhoven, Netherlands: January-February 2018.
- From Regensburg to Pisa: two days of Analysis under the Leaning Tower, Pisa, Italy: June-July 2017.
- CASA day, Eindhoven, Netherlands: April 2017.
- Optimal transport and applications, Pisa, Italy: November 2016.
- Advances in Nonlinear Problems from Materials Science and Shape Optimization, Pisa, Italy: June 2016.

Summer schools

- 12th School on Analysis and Geometry in Metric Spaces, Levico Terme, Italy: June 2022.
- CIME-CIRM Course on New Trends on Analysis and Geometry in Metric Spaces, Levico Terme, Italy: June 2017.
- Summer course in Geometric Measure Theory with SMI (Interuniversity School of mathematics), Cortona, Italy: August 2016.
- Summer course in Mathematics with SMI (Interuniversity School of Mathematics), Perugia, Italy: August 2015.