

# Gian Paolo Leonardi | CV

Edificio Matematica, via Campi 213/b – 41125 Modena – Italy

☎ (+39) 347 982 1377 • ☎ (+39) 059 205 5199 • ☎ (+39) 059 205 5235

✉ gianpaolo.leonardi@unimore.it

🌐 <http://personale.unimore.it/rubrica/dettaglio/gpleonardi>

last update: 22/01/2018

## Research Interests

---

### Main Research Lines.....

Calculus of Variations and Geometric Measure Theory in Euclidean and sub-Riemannian spaces.

- isoperimetric problems for sets and clusters, quantitative stability of minimizers;
- reconstruction of curvatures from discrete geometric data, using the theory of varifolds;
- abnormal geodesics and the isoperimetric problem in sub-Riemannian spaces.
- boundary behavior of solutions to capillary-type problems in non-smooth domains;
- the Cheeger problem and the characterization of Cheeger sets.

### Other Interests.....

- mathematical models for p2p streaming networks;
- numerical methods for flows in porous media.

## Academic Career

---

### University of Modena and Reggio Emilia

*Assistant Professor*

Department of Physics, Informatics and Mathematics

**Modena**

2005–today

### University of Padua

*Assistant Professor*

Department of Mathematical Models and Methods

**Padua**

2001–2005

### University of Trento

*PhD in Mathematics*

**Trento**

1995–1998

### University of Modena

*Degree in Mathematics*

**Modena**

1989–1994

## Fellowships and Research Contracts

---

### University of Paris VI

*CNRS Research Contract (2 months)*

Laboratoire J.L.Lions

**France**

01/05/2004 – 30/07/2004

### University of Paris VI

*TMR Research Contract (1 month)*

Laboratoire J.L.Lions

**France**

06/05/2003 – 06/06/2003

### University of Paris VI

*CNRS Research Contract (3 months)*

Laboratoire J.L.Lions

**France**

01/06/2002 – 01/09/2002

### University of Paris XI - Orsay

*CNR Research Fellowship*

Departement de Mathématiques

**France**

01/10/2001 – 01/03/2002

**University of Trento**  
*Post-doc Fellowship*  
Department of Mathematics

**Italy**  
01/07/1999 – 30/06/2001

## Invited Scholar / Professor

---

<b>University of Granada</b> <i>Departamento de Geometría y Topología, Invited Scholar</i>	<b>Spain</b> May 7–20, 2017
<b>University of Texas at Austin</b> <i>Department of Mathematics, Invited Scholar</i> This <b>2-months visit</b> has been sponsored by the NSF project <i>Vectorial and geometric problems in the Calculus of Variations</i> , NSF-DMS FRG Collaborative Research 1361122.	<b>Texas (US)</b> March–April 2016
<b>Carnegie Mellon University - Pittsburgh</b> <i>Department of Mathematics, Invited Scholar</i>	<b>Pennsylvania (US)</b> April 2016
<b>University of Texas at Austin</b> <i>Department of Mathematics, Invited Scholar</i>	<b>Texas (US)</b> April 2015
<b>Technische Universität Dresden</b> <i>Institut für Analysis, Invited Scholar</i>	<b>Germany</b> January 2015
<b>University of Köln</b> <i>Department für Mathematik, Invited Scholar</i>	<b>Germany</b> December 2014
<b>Czech Academy of Sciences - Prague</b> <i>Nuclear Physics Institute, Invited Scholar</i>	<b>Czech Republic</b> June 2014
<b>University of Jyväskylä</b> <i>Mathematics Department, Invited Scholar</i>	<b>Finland</b> May 2014
<b>University of Granada</b> <i>Departamento de Geometría y Topología, Invited Professor</i> This <b>1-month visit</b> has been sponsored by the Spanish Project <i>Desigualdades geométricas</i> MTM2010-21206-C02-01. During the visit, I have given a PhD course entitled <i>Regularity Theory for Lambda-minimizers of the Perimeter</i> .	<b>Spain</b> June 2013
<b>Universität Erlangen</b> <i>Department Mathematik, Invited Scholar</i>	<b>Germany</b> February 2013
<b>Technische Universität München</b> <i>Zentrum Mathematik, Invited Scholar</i>	<b>Germany</b> February 2013
<b>University of Granada</b> <i>Departamento de Geometría y Topología, Invited Professor</i> Two-lecture short course on <i>Quantitative Isoperimetric Inequalities</i> .	<b>Spain</b> June 2012
<b>University of Leipzig</b> <i>Max Planck Institute Mathematik, Invited Professor</i> Two-lecture short course on <i>Quantitative Isoperimetric Inequalities</i> .	<b>Germany</b> May 2012
<b>University of Nice Sophia Antipolis</b> <i>Laboratoire J.-A. Dieudonné, Invited Scholar</i>	<b>France</b> April 2011
<b>University of Lyon 1</b> <i>Institute Camille Jordan, Invited Professor</i> <i>Rencontres d'Analyse 2011</i> , course entitled <i>Quantitative Isoperimetric Inequalities: old and new</i> .	<b>France</b> March 2011

## Projects

---

**PRIN 2010-2011:** Calcolo delle Variazioni

**PRIN 2008:** Disuguaglianze e problemi variazionali in strutture metriche riemanniane e subriemanniane

**PRIN 2006:** Teoria geometrica della misura e problemi variazionali in strutture metriche riemaniane e subriemaniane

**PRIN 2004:** Calcolo delle Variazioni

**PRIN 2002:** Calcolo delle Variazioni

**GNAMPA 2016:** Variational problems and Geometric Measure Theory in metric spaces (**coordinator**)

**GNAMPA 2015:** Problemi isoperimetrici e Teoria Geometrica della Misura in spazi metrici

**GNAMPA 2014:** Problemi di regolarità e di Teoria Geometrica della Misura in spazi metrici

**GNAMPA 2012:** Problemi di evoluzione e Teoria Geometrica della Misura in spazi metrici

**GNAMPA 2010:** Problemi geometrici, variazionali ed evolutivi in strutture metriche (**coordinator**)

**GNAMPA 2009:** Metodi geometrici per analisi in spazi non Euclidei; spazi metrici doubling, gruppi di Carnot e spazi di Wiener

**GNAMPA 2008:** Mappe, misure e calcolo nonlineare nei gruppi stratificati

## Invited Talks (selection 2010 – today)

---

### University of Naples Federico II

Department of Mathematics

title: *Campi vettoriali a divergenza misura: rigidità, proprietà di traccia e applicazioni.*

Italy

November 2017

### Centro De Giorgi, Pisa

Workshop: *Curves and Networks in Geometric Analysis*

title: *A varifold approach to surface approximation.*

Italy

June 2017

### Levico Terme

XXVII Convegno di Calcolo delle Variazioni e Teoria Geometrica della Misura

title: *Weak normal traces, super-reduced boundary, and an application to the PMC equation.*

Italy

February 2017

### Carnegie Mellon University, Pittsburgh

Department of Mathematics

title: *Discrete varifolds: theory and applications.*

Pennsylvania (US)

April 2016

### University of Texas at Austin

Department of Mathematics

title: *Discrete varifolds: theory and applications.*

Texas (US)

April 2016

### University of Grenoble

Summer School on Geometric Measure Theory and Calculus of Variations

title: *Towards a unified theory of surface discretization.*

France

July 2015

### University of Texas at Austin

Department of Mathematics

title: *Cheeger sets and capillarity.*

Texas (US)

April 2015

### Technische Universität Dresden

Institut für Analysis

title: *Cheeger sets in strips and nonconvex domains.*

Germany

January 2015

### University of Köln

Department für Mathematik

title: *Cheeger sets in strips and nonconvex domains.*

Germany

December 2014

### Czech Academy of Sciences - Prague

Nuclear Physics Institute

title: *The Cheeger problem for non-convex domains.*

Czech Republic

June 2014

### University of Jyväskylä

Department of Mathematics

title: *The Cheeger problem: an overview.*

Finland

May 2014

<b>University of Ferrara</b> <i>Department of Mathematics</i> title: <i>Properties of Cheeger sets in non-convex domains.</i>	<b>Italy</b> April 2014
<b>Levico Terme</b> <i>XXIV Convegno di Calcolo delle Variazioni e Teoria Geometrica della Misura</i> title: <i>Properties of Cheeger sets in non-convex domains.</i>	<b>Italy</b> January 2014
<b>University of Erlangen</b> <i>Workshop: New trends in shape optimization</i> title: <i>The Cheeger problem in planar domains.</i>	<b>Germany</b> September 2013
<b>University of Granada</b> <i>Departamento de Geometria y Topologia</i> title: <i>Stability inequalities for perimeter-minimizing clusters.</i>	<b>Spain</b> May 2013
<b>Levico Terme</b> <i>XXIII Convegno di Calcolo delle Variazioni e Teoria Geometrica della Misura</i> title: <i>Stability inequalities for perimeter-minimizing clusters.</i>	<b>Italy</b> February 2013
<b>Centro De Giorgi, Pisa</b> <i>Workshop: Geometric Inequalities in Calculus of Variations</i> title: <i>Quantitative stability for perimeter-minimising clusters.</i>	<b>Italy</b> July 2012
<b>Ischia</b> <i>Workshop: Calculus of variations, continuum mechanics and geometric inequalities</i> title: <i>A new approach to quantitative isoperimetric inequalities.</i>	<b>Italy</b> June 2011
<b>University of Firenze</b> <i>Department of Mathematics</i> title: <i>A Selection Principle for quantitative isoperimetry.</i>	<b>Italy</b> November 2011
<b>University of Trento</b> <i>Department of Mathematics</i> title: <i>A variational approach to quantitative isoperimetry.</i>	<b>Italy</b> June 2010
<b>University of Nice</b> <i>Conference: New trends in Sub-Riemannian Geometry</i> title: <i>A regularity result for strictly abnormal minimisers.</i>	<b>France</b> March 2010
<b>Levico Terme</b> <i>XX Convegno di Calcolo delle Variazioni e Teoria Geometrica della Misura</i> title: <i>Su una congettura di Hall per la disuguaglianza isoperimetrica quantitativa.</i>	<b>Italy</b> February 2010

## Teaching

<b>Courses for the Degree / Master in Mathematics</b> .....
<b>2005 – today:</b> Calculus 1, Calculus 2, Functional Analysis, Partial Differential Equations, Measure Theory and Integration (University of Modena and Reggio Emilia)
<b>2001–2005:</b> Calculus 1, Calculus 2 (University of Padua)
<b>1998–2001:</b> Calculus 1, Calculus 2 (University of Trento)
<b>PhD Courses</b> .....
<b>2014–2015:</b> Regularity theory for Lambda-minimizers of the perimeter (University of Modena and Reggio Emilia).
<b>2013:</b> Regularity theory for Lambda-minimizers of the perimeter (University of Granada).
<b>2012:</b> Quantitative isoperimetric inequalities (University of Granada)
<b>2012:</b> Quantitative isoperimetric inequalities (Max Planck Institute - Leipzig, Germany)
<b>2011:</b> Quantitative isoperimetric inequalities ( <i>Rencontres d'analyse</i> , Institute Camille Jordan - University

of Lyon 1).

## Supervision of Graduate and PhD Students

---

### PhD Students

- Blanche Buet (co-advised with Simon Masnou at the University of Lyon 1), *Approximation des surfaces par des varifolds discrets: représentation, courbure, rectifiabilité* (2014).
- Giorgio Saracco, *Fine properties of Cheeger sets and the Prescribed Mean Curvature problem in weakly regular domains* (2017).
- Member of the jury for PhD defense of Efstratios Vernadakis, University of Granada (2014).
- Member of the jury for PhD defense of Matteo Galli, University of Granada (2012).

### Master Students

- Francesco Draisci, *Il problema di Cheeger nei domini convessi  $n$ -dimensionali* (2015).
- Maria Vittoria Iaderosa, *Bolle e pellicole di sapone: introduzione alla teoria ed esperienze di laboratorio* (2014).
- Federica Porta (co-tutored with Luca Zanni and Marco Prato), *Approcci duali alla ricostruzione di immagini mediante variazione totale* (2011).
- Daniela Rinaldi, *Il problema isoperimetrico nel piano: un percorso fra idee e tecniche dimostrative* (2010)
- Marco Bonacini, *Struttura delle  $m$ -bolle di perimetro minimo e il teorema della doppia bolla standard* (2009)

### Graduate Students

- Leonardo Pigoni, *Sul problema  $1/2$  di Besicovitch: un miglioramento della stima di  $\sigma_1$*  (2017).
- Annalaura Rebucci, *Traiettorie in geometria sub-riemanniana: il Teorema di Chow* (2017).
- Luca Benatti, *Corpi galleggianti con equilibrio indifferente e una congettura di Auerbach* (2016).
- Harman Saini, *Sviluppi asintotici per la funzione Gamma* (2015).
- Andrea Roccaverde, *Teoremi di ricoprimento in Teoria della Misura* (2012).
- Chiara Severini, *Sul controesempio di Hartman per il problema di Cauchy associato ad un'equazione differenziale ordinaria* (2012).
- Francesco Draisci, *Insiemi di perimetro finito e un metodo di slicing per la disuguaglianza isoperimetrica* (2011).
- Chiara Bussei, *Su un controesempio di Whitney per il Teorema di Morse-Sard* (2009).
- Dario Prandi, *Formule di area e coarea* (2008).

## Organization of Scientific Meetings and Courses

---

**2007:** *Focus Meeting on Geometric Measure Theory and Least-Area Problems*, University of Modena and Reggio Emilia (15/02/2007 – 17/02/2007). Lectures by G. David, N. Fusco, F. Morgan, M. Ritoré.

**2003–2005:** *Minicourses in Analysis*, University of Padua

### Dissemination

---

**2017:** UniJunior conference entitled *Matematica con le bolle*, see [web page](#).

**2015–2016:** Soap Bubble Lab for the European Researchers' Night in Modena.

**2010:** Soap bubble Lab for the European Researcher's Night in Trento.

**2005–today:** *Soap Bubble Laboratory* for high school students, sponsored by the PLS (Progetto Lauree Scientifiche) project.

**2007:** Public conference on soap bubbles and soap films at the University of Modena and Reggio Emilia, jointly with Prof. Frank Morgan, Williams College - USA.

## Referee Activity

---

Duke Math. J.; J. Eur. Math. Soc. (JEMS); Annali SNS; Calc. Var. PDE; SIAM J. Math. Anal.; J. Reine Angew. Math.; J. Geom. Anal.; Proc. AMS; Indiana Univ. Math. J.; NoDEA; Rev. Mat. Iberoam.; ESAIM COCV; Adv. Calc. Var.

## Awards and Evaluations

---

**Séminaire Bourbaki** (Institut Henry Poincaré - Paris, March 19, 2016).

*Speaker:* Ludovic Rifford.

*Title:* "Singulières minimisantes en géométrie sous-riemanniennes [d'après Hakavuori, Le Donne, Leonardi, Monti...]"

*The Séminaire Nicolas Bourbaki (Bourbaki Seminar) is a series of seminars (...) that has been held in Paris since 1948. It is one of the major institutions of contemporary mathematics, and a barometer of mathematical achievement, fashion, and reputation. (Wikipedia)*

**VQR 2011-2014:** M. Cicalese, G.P. Leonardi, *Best constants for the isoperimetric inequality in quantitative form* Journal of the European Mathematical Society, vol. 15, p. 1101-1129, 2013 (score: **1.00 excellent**); M. Cicalese, G.P. Leonardi, *A selection principle for the sharp quantitative isoperimetric inequality*, Archive for Rational Mechanics and Analysis, vol. 206, p. 617-643, 2012 (score: **1.00 excellent**).

**VQR 2004-2010:** G.P. Leonardi, S. Masnou, *On the isoperimetric problem in the Heisenberg group  $H^n$* , Annali di Matematica Pura e Applicata, vol. (4) 184, p. 533-553, 2005 (score: **1.00 excellent**); G.P. Leonardi, R. Monti, *End-point equations and regularity of sub-Riemannian geodesics*, Geometric and Functional Analysis (GAFA), vol. 18 (2), p. 552-582, 2008 (score: **0.8 good**); G.P. Leonardi, P. Tilli (2006), *On a constrained variational problem in the vector-valued case*, Journal de Mathématiques Pures et Appliquées, vol. 85 (2), p. 251-268, 2006 (score: **0.8 good**)

**Marie Curie Individual Fellowship (H2020-MSCA-IF-2014):** the project "IPERS" (Isoperimetric Problems: Existence, Regularity and Stability) has been shortlisted for funding with a score of 75/100.

## Publications

---

[1]Blanche Buet, Gian Paolo Leonardi, and Simon Masnou. Discrete varifolds and surface approximation. In *Topological Optimization and Optimal Transport: In the Applied Sciences*, volume 17, pages 159–170. Walter de Gruyter, 2017.

[2]Blanche Buet, Gian Paolo Leonardi, and Simon Masnou. A varifold approach to surface approximation. *Arch. Ration. Mech. Anal.*, 226(2):639–694, 2017.

[3]Marco Cicalese, Gian Paolo Leonardi, and Francesco Maggi. Sharp stability inequalities for planar double bubbles. *Interfaces Free Bound.*, 19(3):305–350, 2017.

[4]Gian Paolo Leonardi, Robin Neumayer, and Giorgio Saracco. The Cheeger constant of a Jordan domain without necks. *Calc. Var. Partial Differential Equations*, 56(6):56:164, 2017.

[5]G.P. Leonardi and F. Maggi. Improved convergence theorems for bubble clusters. ii. the three-dimensional case. *Indiana Univ. Math. J.*, 66:559–608, 2017.

[6]Enrico Le Donne, Gian Paolo Leonardi, Roberto Monti, and Davide Vittone. Extremal polynomials in stratified groups. to appear in *Communications in Analysis and Geometry*, 2016.

[7]Marco Cicalese, Gian Paolo Leonardi, and Francesco Maggi. Improved convergence theorems for bubble clusters. I. the planar case. *Indiana Univ. Math. J.*, 65:1979–2050, 2016.

- [8] Gian Paolo Leonardi and Aldo Pratelli. On the Cheeger sets in strips and non-convex domains. *Calc. Var. PDE*, 55(1):1–28, 2016.
- [9] Blanche Buet and Gian Paolo Leonardi. Recovering measures from approximate values on balls. *Annales Academiae Scientiarum Fennicae - Mathematica*, 41:947–972, 2016.
- [10] Gian Paolo Leonardi. An overview on the cheeger problem. In Aldo Pratelli and Guenter Leugering, editors, *New Trends in Shape Optimization*, volume 166, pages 117–139, . Birkhauser / Springer Basel DEU, 2015.
- [11] Gian Paolo Leonardi. Il mistero isoperimetrico di Zenodoro. In *Vedere la matematica...alla maniera di Mimmo Luminati*, pages 101–119. edizioni ETS, 2015.
- [12] Enrico Le Donne, Gian Paolo Leonardi, Roberto Monti, and Davide Vittone. Corners in non-equiregular sub-riemannian manifolds. *ESAIM: Control, Optimisation and Calculus of Variations*, 21(3):625–634, 2015.
- [13] Valentina Franceschi, Gian Paolo Leonardi, and Roberto Monti. Quantitative isoperimetric inequalities in  $H^n$ . *Calc. Var. PDE*, 54(3):3229–3239, 2015.
- [14] Blanche Buet, Gian Paolo Leonardi, and Simon Masnou. Discrete Varifolds: a unified framework for discrete approximations of surfaces and mean curvature. In *International Conference on Scale Space and Variational Methods in Computer Vision*, . Springer International Publishing, 2015.
- [15] Enrico Le Donne, Gian Paolo Leonardi, Roberto Monti, and Davide Vittone. Extremal curves in nilpotent lie groups. *Geometric and Functional Analysis*, 23(4):1371–1401, 2013.
- [16] Marco Cicalese and Gian Paolo Leonardi. Best constants for the isoperimetric inequality in quantitative form. *J. Eur. Math. Soc.*, 15:1101–1129, 2013.
- [17] Gian Paolo Leonardi, Severine Rigot, and Davide Vittone. Isodiametric sets in the Heisenberg group. *Revista Matemática Iberoamericana*, 28(4):999–1024, 2012.
- [18] Marco Cicalese and Gian Paolo Leonardi. A selection principle for the sharp quantitative isoperimetric inequality. *Archive for Rational Mechanics and Analysis*, 206(2):617–643, 2012.
- [19] Gian Paolo Leonardi. Un nuovo approccio alle disuguaglianze isoperimetriche quantitative. In *Bruno Pini Mathematical Analysis Seminar*, volume 2, 2011.
- [20] Maria Luisa Merani, Daniela Saladino, and Gian Paolo Leonardi. A model to seize the instantaneous performance of p2p streaming platforms: Simulative and experimental validation. In *Global Telecommunications Conference (GLOBECOM 2011)*, . IEEE, 2011.
- [21] Gian Paolo Leonardi and Valentino Magnani. Intersections of intrinsic submanifolds in the Heisenberg group. *J. Math. Anal. Appl.*, 378(1):98–108, 2011.
- [22] Maria Luisa Merani, Gian Paolo Leonardi, and Daniela Saladino. Scalability and peer churning in ip-tv: an analytical insight. In *Global Telecommunications Conference (GLOBECOM 2009)*, . IEEE, 2009.
- [23] Gian Paolo Leonardi and Simon Masnou. Locality of the mean curvature of a rectifiable varifold. *Advances in Calculus of Variations*, 2(1):17–42, 2009.
- [24] Gian Paolo Leonardi and Roberto Monti. End-point equations and regularity of abnormal sub-riemannian geodesics. *Geometric and Functional Analysis*, 18(2):552–582, 2008.
- [25] Paolo Ciatti, Eduardo Gonzalez, Massimo Lanza, and Gian Paolo Leonardi, editors. *Topics in Mathematical Analysis*. World Scientific Publisher, 2008.

- [26] Gian Paolo Leonardi and Paolo Tilli. On a constrained variational problem in the vector-valued case. *J. Math. Pures Appl.*, 85(2):251–268, 2006.
- [27] Gian Paolo Leonardi, Fabio Paronetto, and Mario Putti. Effective anisotropy tensor for the numerical solution of flow problems in heterogeneous porous media. In *Proc. CMWR XVI International Conference*, June 19-22 2006.
- [28] Gian Paolo Leonardi and Simon Masnou. On the isoperimetric problem in the Heisenberg group. *Ann. Mat. Pura Appl.*, 184(4):533–553, 2005.
- [29] Gian Paolo Leonardi and Severine Rigot. Isoperimetric sets on carnot groups. *Houston J. Math.*, 29(3):609–637, 2003.
- [30] Gian Paolo Leonardi. Gamma-convergence of constrained Dirichet functionals. *Boll. UMI*, 6-B(8):339–351, 2003.
- [31] Gian Paolo Leonardi and Italo Tamanini. Metric spaces of partitions and Caccioppoli partitions. *Adv. Math. Sci. Appl.*, 12(2):725–753, 2002.
- [32] Gian Paolo Leonardi. Partitions with prescribed mean curvatures. *Manuscripta Mathematica*, 107(1):111–133, 2002.
- [33] Gian Paolo Leonardi. Infiltrations in immiscible fluids systems. *Proc. Roy. Soc. Edinburgh*, 131A:425–436, 2001.
- [34] Gian Paolo Leonardi and Italo Tamanini. On minimizing partitions with infinitely many components. *Annali dell'Università di Ferrara. Sezione 7: Scienze Matematiche*, XLIV:41–57, 1998.
- [35] Gian Paolo Leonardi. *Optimal subdivisions of n-dimensional domains*. PhD thesis, Trento, 1998.