Gianmarco BROCCHI

Curriculum Vitæ atque Studiorum

Updated: September, 2024

PERSONAL DETAILS

Born on 9th October 1990 in Taranto, Italy
ADDRESS:
    Mathematical Sciences,
    Chalmers University of Technology
    and the University of Gothenburg,
    SE-412 96, Göteborg, Sweden

CITIZENSHIP: Italian
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MAIN EDUCATION

OCT 2021   Ph.D. in PURE MATHEMATICS, **University of Birmingham**, UK
    Thesis: "Sharp and Optimal Inequalities in Harmonic Analysis"
    Supervisors: Dr. Maria Carmen REGUERA and Prof. Jonathan BENNETT

SEPT 2017   M.Sc. in MATHEMATICS, **University of Bonn**, Germany
    Thesis: "Sharp Fourier restriction theory and Strichartz estimates"
    Advisor: Dr. Diogo OLIVEIRA E SILVA

OCT 2014   B.Sc. in MATHEMATICS, **University of Pisa**, Italy
    Thesis: "Condizioni Tauberiane e Spazi di Hardy"
    Advisor: Prof. Vladimir GEORGIEV

APPOINTMENTS

2022 – 2024   Wallenberg **Postdoc** with Andreas Rosén
    at Chalmers University of Technology and the University of Gothenburg

2021 – 2022   **Teaching Fellow** at the University of Birmingham

PREPRINTS & PUBLICATIONS

5. THE METRIC FOR MATRIX DEGENERATE KATO SQUARE ROOT OPERATORS,
    with Andreas Rosén, arXiv:2404.09580

4. REFINED TWO WEIGHT ESTIMATES FOR THE BERGMAN PROJECTION,
    in *Collectanea Mathematica* (2023), arXiv:2110.15936

3. QUADRATIC SPARSE DOMINATION AND WEIGHTED ESTIMATES FOR NON-INTEGRAL SQUARE FUNCTIONS,
    with Julian Bailey and Maria Carmen Reguera, *The Journal of Geometric Analysis*, 33, # 20 (2023).

2. A SPARSE QUADRATIC $T1$ THEOREM,
    New York J. Math. 26 (2020), 1232–1272.

1. SHARP STRICHARTZ INEQUALITIES FOR FRACTIONAL AND HIGHER ORDER SCHRÖDINGER EQUATIONS,
    with Diogo Oliveira e Silva and René Quilodrán, *Analysis & PDE* 13 (2020) 477–526. arXiv:1804.11291

Proceedings

- WHAT IS SPARSE DOMINATION AND WHY IS IT SO PLENTIFUL? ,
  Proceedings of the 3rd BYMAT conference (2020) TEMat monográficos (ISSN 2660-6003)

GRANTS AND AWARDS

2018: 2nd prize in the poster competition, awarded by the University of Birmingham.

2017–2021: EPSRC Doctoral training grant. Three and a half year grant for tuition fees and stipend.

2015–2016: One year ERASMUS+ scholarship, awarded by the University of Pisa.

OTHER KEY ACADEMIC MERITS

Referee for the *Journal of Mathematical Analysis and Applications* (1), the *Journal of Fourier Analysis and Applications* (1), *The Journal of Geometric Analysis* (1), and *Publicacions Matemàtiques* (1).

Co-organiser	of the *Analysis and Probability seminar* at Chalmers, the *Analysis Reading Seminar* at the University of Birmingham, and the following workshops:
June 2019	Harmonic Analysis in non-homogeneous settings and applications with *Julian Bailey and Maria Carmen Reguera* Funded by: the Heilbronn Institute For Mathematical Research; the (EPSRC) Engineering and Physical Sciences Research Council; the University of Birmingham; and The London Mathematical Society
Apr 2019	British Young Mathematicians Colloquium 2019 with *Alexander Brune, Jen Duncan, Cara Neal, Jack Saunders, Karoline van Gemst* Funded by the Magic Maths Consortium and the University of Birmingham

TEACHING EXPERIENCE

As **Teaching Fellow** at the University of Birmingham (2021–2022)

I organised and held weekly tutorials for Year 1 and Year 2 students covering

- Real Analysis, Mechanics, Vectors, Geometry & Linear Algebra, Sequences and Series
- Multivariable & Vector Analysis, Real & Complex Analysis, Differential Equations

I was in charge of marking exams in

- *Multivariable and Vector Analysis*, 226 scripts, half of the questions
- *Sequences and Series*, 228 scripts
- *Vectors, Geometry & Linear Algebra* $\sim$ 140 scripts
- *Real Analysis* (Year 1), 62 scripts, half of the questions
- *Differential Equations* (Year 2), $\sim$ 50 scripts

I have organised **resit support sessions** in *Real Analysis, Probability & Statistics,* and *Sequences and Series,* and served as **Senior Invigilator** for Supplementary examinations.

As **Teaching Assistant** at the University of Birmingham (2017–2021)

- *Differential Equations* (Year 2), Spring 2021

- *Computer lab & Programming* (Year 3), Spring 2020

- *Real and Complex Analysis* (Year 2), Winter 2019

- *Numerical Methods & Programming* (Year 2), Spring 2019

- *Support classes Mathematics* (Year 1), Winter 2020, Spring 2019

- *Methods in Partial Differential Equations* (Year 3), Spring 2018

- *Mathematics in Industry* (Year 2), Tutorial and marking, Winter 2020, Spring 2018

- *Continuum Mechanics* (Year 3), Tutorial and marking, Winter 2017

- *Mathematical Modelling and Problem Solving* (Year 1), Winter 2017

I was **grader** for homework in

- *Real and Complex Analysis*, Spring 2020

- *Engineering Mathematics*, Winter 2019, Spring 2019, Winter 2018

As **Teaching assistant** at the University of Pisa

- *Complementi di Analisi Matematica* (Calculus Year 2), Spring 2015
  Department of Energy, Systems, Territory and Construction Engineering

Support activities and **outreach**

2017–2020	**Volunteer** in the *Maths Support Center* Drop-in support aimed at undergraduate students.
Feb 2015	**Tutor** at *XI Settimana Matematica*
Feb 2012	**Tutor** at *VIII Settimana Matematica* Open week at the Department of Mathematics, University of Pisa, Italy.

Seminars

In winter 2023 I co-organised a reading seminar on **Decoupling inequalities** at *Chalmers University of Technology*. Seminars on my original research•, expository°, and by invitation are indicated with ☆.

- **Degenerate Boundary Value Problems**

July 2024	*Recent advances in Harmonic Analysis*, Málaga
☆ June 2024	*Equadiff*, Karlstad, Sweden
☆ Mar 2024	*Analysis seminar*, BCAM, Bilbao
☆ Feb 2024	*Analysis seminar*, Lund
☆ Jan 2024	*III Young Researchers Workshop in Harmonic Analysis*, Università di Genova

- **Kato square root problem on pasta**

☆ Jun 2023	*Seminari M.A.P*, University of Pisa

- **Kato & Cauchy**

☆ Jan 2023	*Young Researchers Workshop in Harmonic Analysis*, Politecnico di Torino

- **The Stoilow factorisation theorem**

☆ Oct 2022	Summer School on *Nodal domains and landscape functions*, Kopp, Germany

- **A sharp k-plane Strichartz estimate**

May 2022 | *XLI Convegno di Analisi Armonica*, Genova

○ **Induction on scales**
☆ *May 2022* | *Pure Détours*, Graduate seminars at the University of Birmingham

○ **Optimal orders of the best constants in the Littlewood–Paley inequalities**
☆ *Mar 2022* | *Harmonic analysis working group*
| after Q. Xu, presented together with Odysseas Bakas

● **Two weight estimates for the Bergman projection**
☆ *Jan 2022* | *Analysis seminar*, Bonn
☆ *Oct 2021* | *Workshop CHAP: Complex and Harmonic Analysis in Padova*

○ **The real Kempf–Ness theorem**, [1, 2]
Sept 2021 | *Summer School on Brascamp-Lieb inequalities*, Kopp, Germany

● **Sparse $T1$ theorems**
☆ *Jun 2021* | *Harmonic Analysis E-Seminars*, (virtual seminar)
Jul 2020 | *British Early Career Mathematicians' Colloquium*, (virtual colloquium)
☆ *Jun 2020* | *Virtual Harmonic Analysis Seminars*, UK Harmonic Analysis group, on Zoom

● **What is Sparse Domination and why is it so plentiful?**
Dec 2020 | *BYMAT 2020: Bringing Young Mathematicians Together*

● **Quadratic Sparse Domination**
☆ *May 2022* | *Miniworkshop on Harmonic Analysis*, Lund, Sweden
☆ *Dec 2020* | *LMS Harmonic Analysis and PDEs Meeting*

○ **Random shifted dyadic grids and what they can do for you**
☆ *May 2020* | *Analysis & PDE Working Seminar*, University of Minnesota, on Zoom

○ **The Bourgain–Milman (via Hörmander's) theorem**, [3]
Oct 2019 | *Summer School on Sphere Packings and Optimal Configurations*, Kopp, Germany
| Presented with Constantin Bilz

○ **Sparse domination via sizes and outer measures**
Nov 2018 | *Analysis Reading Seminar*, University of Birmingham

● **What does extremise a Strichartz estimate?**
☆ *Feb 2021* | *Graduate Analysis Seminar*, University of Toronto, Canada
☆ *Mar 2019* | *Pure Maths Postgraduate Seminar*, University of Sheffield, UK

○ **Estimates for a $\bar{\partial}$-problem**, [4]
Sept 2018 | *Summer School on Unique Continuation and Inverse Problems*, Kopp, Germany
| Presented with Xian Liao and Pavel Zorin-Kranich

● **Existence of extremizers for a Strichartz estimate for the 4$^{\text{th}}$ order Schrödinger equation**
July 2018 | *Mini-courses in Mathematical Analysis*, Padova, Italy
June 2018 | *BMC 2018* (speed talk), St Andrews, Scotland
May 2018 | *ICMAT*, Madrid, Spain
Apr 2018 | *BYMC 2018*, University of Birmingham, England
☆ *Feb 2018* | *Workshop on Harmonic analysis and Nonlinear Evolution Equations*, Pisa, Italy

July 2017 | Master Thesis seminar, Universität Bonn, Germany

○ **Behaviour of the Schrödinger evolution for initial data near** $H^{\frac{1}{4}}$, [5], [6]

Oct 2017 | *Summer School on Decoupling and Polynomial Methods in Analysis*, Kopp, Germany

○ **Modulation spaces and Brownian motion**, [7]

July 2017 | Summer School on Harmonic Analysis and Partial Differential Equations
BCAM, Bilbao, Spain

July 2017 | *Graduate seminar on Time-Frequency Analysis and Its Applications*,
Universität Bonn, Germany

○ **Extremizers for Strichartz estimates for perturbed Schrödinger equations**, [8]

Mar 2017 | *Atelier d'Analyse Harmonique*, University of Nantes, France

○ **Endpoint Strichartz Estimates**, [9]

Feb 2017 | *Course "Geometric Aspects of Harmonic Analysis"*, University of Bonn, Germany

○ **Controlling rough paths**, [10].

Sept 2016 | *Summer School on Paraproducts and Analysis of Rough Paths*, Kopp, Germany
Presented with Cristina Benea

○ **Asymptotics, frequency modulation,**
and low regularity ill-posedness for canonical defocusing equations, [11]

Dec 2015 | *Graduate seminar on Nonlinear Fourier Transform*, University of Bonn, Germany

○ **Minimax methods and geodesics**, after Michael Struwe

Sept 2015 | *Course in Calculus of Variations*, University of Pisa, Italy

REFERENCES FOR THE EXPOSITORY° TALKS.

[1]   G. Kempf and L. Ness, in, Vol. 732, Lecture Notes in Math. (1979), pp. 233–243.
[2]   C. Böhm and R. A. Lafuente, *Real geometric invariant theory*, (2017)
[3]   F. Nazarov, in , Vol. 2050, Lecture Notes in Math. (Springer, Heidelberg, 2012), pp. 335–343.
[4]   A. I. Nachman, I. Regev, and D. I. Tataru, 2017.
[5]   L. Carleson, in, Vol. 779, Lecture Notes in Math. (Springer, Berlin, 1980), pp. 5–45.
[6]   B. E. J. Dahlberg and C. E. Kenig, in, Vol. 908, Lecture Notes in Math. (Springer, Berlin-New York, 1982), pp. 205–209.
[7]   Á. Bényi and T. Oh, Adv. Math. **228**, 2943 (2011).
[8]   D. Oliveira e Silva and R. Quilodrán, Trans. Amer. Math. Soc. **370**, 6871 (2018).
[9]   M. Keel and T. Tao, Amer. J. Math. **120**, 955 (1998).
[10] M. Gubinelli, J. Funct. Anal. **216**, 86 (2004).
[11] M. Christ, J. Colliander, and T. Tao, Amer. J. Math. **125**, 1235 (2003).

CONFERENCES, SCHOOLS AND WORKSHOPS

Partial◇ and full☆ financial support received from the institution is acknowledged.

July 2024 ◇ Recent advances in Harmonic Analysis
Málaga, Spain

Jan 2024 III Young Researchers Workshop in Harmonic Analysis
Università di Genova, Italy

June 2024 Equadiff,
Karlstad, Sweden

July 2023 Summer School on Unique Continuation and Applications
Castro Urdiales, Cantabria

April 2023 Some conjectures and questions in Harmonic Analysis. Lectures by Anthony Carbery
Padova, Italy

Nov 2022 Operator-Adapted Spaces in Harmonic Analysis and PDEs
☆ Oberwolfach, Germany

Sept 2021 Summer School on Brascamp-Lieb inequalities
Kopp, Germany. ◇ Hausdorff Center

Sept 2019 Summer School on Sphere Packings and Optimal Configurations
Kopp, Germany. ◇ Hausdorff Center

July 2019 4th BCAM-UPV/EHU summer school on harmonic analysis and PDEs: Restriction theory. Bilbao, Spain

June 2019 Mini-courses in Mathematical Analysis
University of Padova, Italy

May 2019 Lectures in Fourier Analysis. A conference in honour of Andreas Seeger
☆ University of Madison, Winsconsin

Feb 2019 Explorations in Harmonic Analysis and other realms. A conference honoring Alexander Olevskii's 80th birthday
☆ Weizmann Institute of Science, Israel

Sept 2018 Summer School on Unique Continuation and Inverse Problems
Kopp, Germany. ◇ Hausdorff Center ◇ UoB

July 2018 Mini-courses in Mathematical Analysis
University of Padova, Italy

June 2018 Geometric Aspects of Harmonic Analysis: a conference on the occasion of Fulvio Ricci's 70th birthday
Cortona, Italy ◇ INdAM

June 2018 British Mathematical Colloquium 2018
St Andrews, Scotland ◇ LMS

May – June 2018 Real HA and its Applications to PDEs and GMT: on the occasion of the 60th birthday of Steve Hofmann ◇ ICMAT, Madrid

Apr 2018 British Young Mathematicians Colloquium 2018
University of Birmingham

Apr 2018 Young Researchers Workshop in Harmonic Analysis
Politecnico di Torino, Italy

Feb 2018 Workshop on Harmonic analysis and Nonlinear Evolution Equations
☆ Università di Pisa, Italy

Dec 2017 LMS Network on Harmonic Analysis and PDEs University of Warwick, UK

Sept 2017 Summer School in Harmonic Analysis, PDE and Spectral theory
◇ Università La Sapienza, Roma, Italy

July 2017 Harmonic analysis and its interactions: in honour of Tony Carbery
☆ ICMS, University of Edinburgh, UK

July 2017 Third Summer School on Harmonic Analysis and Partial Differential Equations ◇ BCAM, Bilbao, Spain

Mar 2017 Atelier d'Analyse Harmonique
☆ University of Nantes, France

Dec 2016 Workshop "Young Women in Harmonic Analysis and PDE"
Universität Bonn, Germany

Nov 2016 Fall School on "PDEs and Probability"
AIMS, Mbour, Senegal. ☆ DAAD grant

Oct 2016 Workshop: New trends in Partial Differential Equations
Centro di Ricerca Ennio De Giorgi, Pisa, Italy

Sept 2016 Mathematics and Its Applications
PISA-HOKKAIDO Summer School
University of Pisa and Scuola Normale Superiore, Pisa, Italy

Sept 2016	Summer School on Paraproducts and Analysis of Rough Paths
	Kopp, Germany ◇ Hausdorff Center
July 2016	Summer School on Spectral theory and applications
	☆ Université Laval, Québec City, Canada

Aug 2015	Summer School on Differential Equations and Differential Geometry
	◇ Hokkaido University, Sapporo, Japan
July 2015	Summer School on Mathematical and Statistical Models of Economic Growth
	◇ Hokkaido University, Sapporo, Japan

LANGUAGES

ITALIAN (mother-tongue), ENGLISH (fluent), SWEDISH (intermediate), GERMAN (basic).

COMPUTER SKILLS

Advanced	GNU/LINUX, Bash, git, LaTeX, HTML, CSS
Intermediate	C, Python, FORTRAN, LaTeX BEAMER, OCTAVE
Basic	TikZ, OCAML, C++, Vala

SOFTWARE PROJECTS

Hashtags, Tweets analyser in C
∼ 1000 lines, (2014)

Face Feature Extraction, FORTRAN, Python, Bash
∼ 800 lines, (2013)

Iterative Filtering in Reputation Systems, FORTRAN 95
∼ 300 lines, (2012)