Michele Villa

Email: michele.villa@ehu.eus
Born: March 16, 1992—Como, Italy.
Nationality: Italian.
Website: Here

Current positions

Feb 2024 Marie-Curie Research Fellow at EHU/UPV (Bilbao).
Feb 2024 Ikerbasque Research Fellow (research only tenure-track) at EHU/UPV (Bilbao).
Feb 2024 Affiliate professor, University of Oulu (Finland) (unpaid position).

Field of research

Mathematical analysis. More specifically, geometric measure theory, with focus on quantitative aspects of rectifiability. Also, geometric problems from harmonic analysis, for example boundedness of singular integral operators on non-smooth sets.

Previous positions

April 21-Feb 24 *Assistant professor* (tenure-track) at the University of Oulu.
Sept 22-Feb 24 *Academy of Finland postdoctoral researcher* at the University of Oulu. (This is a three years long research intensive position which will be held on top of the previous one, and is funded via a personal grant of the Academy of Finland, see 'Financial Support' section).
Sept 22-Feb 24 *Postdoctoral researcher* at the Universitat Autonoma de Barcelona, mentored by Xavier Tolsa (this position will be held together with the previous ones).
Sep 20-July 21 *Postdoctoral researcher* at the University of Jyväskylä, funded by an Academy of Finland grant with Tuomas Orponen as PI.
Mar-Sep 20 *Postdoctoral researcher* at the University of Helsinki, funded by an Academy of Finalnd grant with Tuomas Orponen as PI.

Education

Sep 16-June 20 *PhD in Mathematics* at the Maxwell Institute Graduate School in Analysis and its Applications (MIGSAA). Area of specialisation: geometric measure theory. Supervisor: Jonas Azzam. The external examiner at my difense was Guy David. PhD obtained in June 2020.
2012-2016 *BSc in Mathematics* at the University of Dundee, Scotland. Degree class: First with Honours.

Papers and Preprints

17. Hyde, M., Villa, M., Violo, I.Y. Ricci curvature bounded below and uniform rectifiability. ArXiv preprint, 2023. Accepted by **Ann. Fenn. Math.**

16. Fleschler, I., Tolsa, X., Villa, M. Carleson's ε^2-conjecture in higher dimensions. ArXiv preprint, 2023. Submitted to *Invent. Math.*

15. Fleschler, I., Tolsa, X., Villa, M. The Alt-Caffarelli-Friedman monotonicity formula and Carleson's ε^2 conjecture in higher dimensions. ArXiv preprint, 2023. Submitted to *Amer. J. Math.*

14. Azzam J., Mourgoglou M., and Villa M. Quantitative differentiation on uniformly rectifiable sets. ArXiv preprint, 2023.

13. Dąbrowski D. and Villa M. Analytic capacity of sets with plenty of big projections and Vitushkin conjecture. ArXiv preprint (2022). Accepted for publication by **Trans. Amer. Math. Soc.**

12. Chang A., Dąbrowski D., Orponen T. and Villa M. Structure of sets with nearly maximal Favard length. ArXiv preprint (2022). **Analysis & PDEs**.

11. Villa M. A note on Hausdorff dimension of sets with plenty of big projection. ArXiv preprint (2021).

10. Dąbrowski D., Orponen T. and Villa M. Integrability of orthogonal projections, and applications to Furstenberg sets. ArXiv preprint (2021). **Adv. Math.**

9. Hyde M. and Villa M. Cone and paraboloid points of arbitrary subsets of Euclidean space. ArXiv preprint (2021).

8. Orponen T. and Villa M. Sub-elliptic boundary value problems in flag domains. **Adv. Calc. Var.**.

7. Dąbrowski D. and Villa M. Necessary condition for the L^2 boundedness of the Riesz transform in Heisenberg groups. **Math. Proc. Cam. Phil. Soc.**

6. Villa M. A square function involving the center of mass and rectifiability. **Math. Zeitschrift**.

5. Jaye B., Tolsa X., and Villa M. A proof of Carleson ϵ^2-conjecture. **Ann. of Math.** Vol. 194, No. 1 (July 2021), pp. 97-161 (65 pages).

4. Villa M. Higher dimensional Jordan curves. Arxiv preprint (2019).

3. Villa M. Ω-symmetric measures and related singural integrals. **Rev. Mat. Iberoam.** Electronically published on January 18, 2021. doi: 10.4171/rmi/1245 (to appear in print)

2. Azzam J, and Villa, M. Quantitative comparisons of multiscale geometric properties. **Analysis & PDEs**. Vol. 14 (2021), No. 6, 1873–1904.

1. Villa M. Tangent points of d-lower content regular sets and β numbers. **J. Lond. Math. Soc.** Vol 101, Issue 2, April 2020, Pg. 530-555.

Talks

Dec 2024	Seminar talk, University of Warwick, UK.
Aug 2024	Invited talk, IWOTA, 35th International Workshop on Operator Theory and its Applications, University of Kent, Canterbury, UK.
Jul 2024	Invited talk, Geometry of measures and free boundary, conference in honour of T. Toro, Seattle.
May 2024	Invited talk, AGENT forum (Jyvaskyla, Finland).
Feb 2024	Talk at the Seminari a distanza di Analisi armonica.
Sept 2023	Invited talk at the XII congress of the Italian Mathematical Union. Pisa, Italy
July 2023	Invited talk at the $29th$ Nordic Congress of Mathematicians with EMS. Aalborg, Denmark
June 2023	Invited talk at Harmonic Analysis, PDEs, and GMT in Bilbao, Spain.
Feb 2023	Talk at the University of Trento, within a course thaught by A. Marchese.
Nov 2022	Seminar talk at the Princeton differential geometry and geometric analysis seminar.
Sept 2022	Workshop talk at the Applied Harmonic Analysis and Machine Learning summer school, Genova, Italy.
June 2022	Workshop talk at the Young research symposium in harmonic analysis. Satellite event of the conference Fourier Analysis At 200. Edinburgh, Scotland.
May 2022	Seminar talk at the Barcelona Analysis seminar. Barcelona, Spain.
Feb. 2022	Workshop talk at the HIM research trimester on PDEs, Harmonic analysis and geometric measure theory. Bonn, Germany.
Dec. 2021	Seminar talk at the Harmonic Analysis seminar of Université Paris-Saclay.
Dec. 2021	Seminar talk at the Bilbao Analysis and PDEs seminar.
October 2021	Talk at Rajchman, Zygmund, Marcinkiewicz conference. IM PAN, Warsaw (Poland).
August 2021	Invited speakers at Geometric measure theory and applications in Cortona (Italy).
May 2021	Seminar talk at the Analysis group seminar at Oulu university.
Oct. 2020	Seminar talk at the Geometry Seminar of the University of Jyväskylä.
June 2020	Seminar talk at the Virtual Harmonic Analysis seminar. Online seminar, organised by a network of UK-based mathematicians.
Nov. 2019	Seminar talk at the Analysis seminar of the Universtiy of Edinburgh.
Oct. 2019	*A proof of the Carleson ϵ^2-conjecture.* Talk at the workshop on Geometry and Analysis at IM PAN (Warsaw) in October 2019.
June 2019	*Ω-symmetric measures and related singular integrals.* Contributed talk at BAC2019, June 2019.
June 2019	Contributed talk at the HAPDE conference in Helsinki (June 2019).
May 2019	*A family of analyst's travelling salesman theorems.* Seminar talk at the joint Analysis Seminar of UAB-UB in Barcelona, 20/05/2019.
May 2017	*Towards a new characterisation of uniform rectifiability.* Talk given at the MIGSAA 2017 symposium.
April 2017	*Non-tangential behaviour and Carleson measures.* Talk given for the SMSTC (Scottish Mathematical Training Center) course of Harmonic Analysis.
June 2016	

Classification of three dimensional steady flow. Talk given at the Topological fluid dynamics seminar at the University of Dundee following VI Arnold's work on the subject.

Financial support and awards

Feb 24-Jan 29 **Ikerbasque Research Fellow**, at UPV/EHU (Bilbao). This is a research-only tenure-track position.

Feb 24-Jan 27 **MSCA Postdoctoral Fellowship**, at UPV/EHU (Bilbao). Score: 97.60/100.

Sept 22 - Aug 25 **Academy of Finland postdoctoral grant**. Three years of funding covering wage, travel money and various material. Total funding: 231241 Euros.

May 2021 **Certificate of Commendation** (PhD Thesis Prize) awarded by the Edinburgh Mathematical Society. This is a bi-yearly prize for the best doctoral theses in pure and applied mathematics in Scotland.

Apr.-Jul. 2019 Support from X. Tolsa's grant to finance a research stay at UAB (Catalonia), for a total sum of 2000 Euros.

March 2019 *Dr. Laura Wisewell Travel Scholarships.* A scholarship of £450 awareded to travel to Barcelona for a research visit to X. Tolsa.

Jan. 2019 *Erasmus + grant.* A grant to fund a four months long visit at UAB, Barcelona, for a total amount of £1550.

Nov. 2018 *Essay prize.* A yearly award to the best written mathematical essays in the department of mathematics at the University of Edinburgh. The award amounts to £400 for travelling.

July 2018 *Researcher Development Scholarship.* Travel fund of £800 to participate to the IAS/PCMI program in Park City, Utah.

July 2018 *IAS/PCMI scholarship.* Scholarship to fund fees, room and board for the Graduate program of IAS/PCMI in Park City, Utah.

Research Visits, Research Programs

Feb 2023 A week long research visit to A. Marchese, at the University of Trento, Italy.

Nov 2022 Two weeks long research visit at IAS (Princeton).

May 2022 One week long research visit to X. Tolsa, UAB. Barcelona, Spain.

Spring 2022 HIM research trimester. Research program at the Hausdorff Institute for Mathematics on Harmonic Analysis and Geometric Measure Theory. Bonn, Germany.

Oct 21-Jan 31 Research visit to Guy David, Université Paris-Saclay.

Sept. 2019 Simons Semester at IM PAN (Warsaw) on Geometry and Analysis in function and mapping theory on Euclidean and metric measure spaces. **Invited participant**.

Summer 2019 *Research visit at UAB, Barcelona.* A four months long (from April to August) research visit at UAB, under the supervision of Xavier Tolsa. Supported by Tolsa ERC grant and an Erasmus + grant.

July 2018 IAS/PCMI Research Program in Harmonic Analysis. Park City, Utah (US).

Conferences, Workshops

Sept 2022 Workshop on Applied Harmonic Analysis and Machine Learning, Genova, Italy.

Aug 2022 Conference on Geometric Measure Theory, Warwick, UK.

June 2022 11^{th} international conference on Harmonic Analysis, El Escorial, Spain.

June 2022 Fourier Analysis at 200. Edinburgh, Scotland.

June 2022 Young researcher symposium in harmonic analysis. Edinburgh, Scotland.

October 2021 Rajchman, Zygmund, Marcinkiewicz conference. IM PAN, Warsaw (Poland)

Aug 2021 Geometric measure theory and applications in Cortona (Italy).

Oct. 2019 Workshop on Geometry and Analysis at IM PAN (Warsaw).

June 2019 BAC2019. Barcelona Analysis conference.

June 2019 Harmonic analysis and PDEs workshop. One-day LMS meeting in Birmingham. 14th of June, 2019.

June 2019 Harmonic analysis in non-homogeneous spaces. Workshop in Birmingham, UK. June 2019.

June 2019 HAPDE 2019. Harmonic Analysis and PDEs conference. Helsinki, June 2019.

October 2017 *Harmonic Analysis and Geometric measure Theory.* Conference at CIRM, Marseilles, France.

July 2017 *Neurogeometry.* SMI Summer School, Cortona, Italy.

June 2017 *New trends on Analysis and Geometry in Metric Spaces.* CIME-CIRM Course in Levico Terme, Italy.

Dec. 2016 *Geometric PDEs at Warwick.* The week-long workshop aimed at presenting some current research in Geometric analysis and PDEs.

August 2016 *SMI Summer School* (University of Perugia, Italy). SMI is the Italian acronym for Iter-university Mathematical School. This summer school lasts the whole months of August and comprises lectures, exercises classes and mid-term and final exams. Participants need to choose between two courses. My choice was Introduction to PDEs (which covered the Elliptic and Parabolic theory of linear equation, following LC Evans' book), and Differential Geometry (following FW Warner's book).

Summer 2016 *Topological Fluid Dynamics reading group* (University of Dundee). Participant.

June 2016 *Fourth Scottish PDEs Colloquium.* Participant.

2014-2015 *1 year academic exchange* (University of Hamburg). Erasmus +.

Teaching experience and supervision

Autumn 2023 Master course **Biodiversity from the mathematical point of view**, at the University of Oulu.

Spring 2022 Supervision of the **Master thesis of Paul Le-Breton**, visiting from **ENS Paris-Saclay**.

Spring 2021 Teaching assistant for *Fourier Analysis* (online). Course for Master/PhD students, two-hours workshops. University of Jyväskylä.

Spring 2019 Workshops for *Honours Complex Analysis* (HCV, MATH10067, one-hour tutorial plus two-hour presentation skills). University of Edinburgh.

Autumn 2018 Workshops for *Honours Analysis* (HA, MATH10068, one-hour tutorial plus two-hour presentation skills). University of Edinburgh.

Spring 2018 Tutorials for Proofs and Problem Solving (PPS, MATH08059, two-hour tutorial).

Autumn 2017 Tutor for the SMSTC course *Measure and Integration* for first year PhD students. University of Edinburgh and Heriot-Watt University.

2015-2016 *MathDoctor, UK.* MathDoctor is an online company which provides online tutoring to students from primary school to university.

Other past projects

2016 *Mathematical theory of Finite Element Methods.* (MIGSAA Taster Project). The project, which was done in group, looked at the theoretical foundations of a finite element method.

2015-2016 *Smooth symmetries of vector fields (BSc Dissertation).* Project supervised by Prof Gunnar Hornig. The work is an investigation on the symmetries of a physical system. This area of research goes back to at least Emmy Noether's theorem, which states that for any physical system which have a continuous symmetry there exists a conservation law, and vice versa. In particular, the project looked at how the theory of the de Rham chomology provides information on the existence of such symmetries.

2014 *Modelling of binocular rivalry.* Summer project with Dr Hiroko Kamei. The aim of the project was to understand some existing models of binocular rivalry. This phenomenon consists in the cyclic switching of firing between the two main neuron bundles (one per eye) of the visual cortex. Such switching is brought about by changing in lighting conditions, object shapes, etc. It is natural to study the phenomenon using bifurcations theory.

Various other skills and interests

Languages spoken: Italian (native), English (fluent), Spanish (fluent), German (basic).
I have experience in working with the following: CAS Maple, MATLAB/GNU Octave, R, Latex, Python, Linux operating systems.