Michele Villa

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Born: March 16, 1992—Como, Italy.
Nationality: Italian.

Current position

Postdoctoral researcher at the University of Helsinki, funded by an Academy of Finalnd grant with Tuomas Orponen as PI.

Areas of interest

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.

Education

2016-2020 *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.

2012-2016 *BSc in Mathematics* at the University of Dundee, Scotland. Degree class: First with Honours.

Papers and Preprints

1. **Necessary condition for the L^2 boundedness of the Riesz transform in Heisenberg groups**. Joint work with D. Dabrowski. Arxiv preprint.
2. **A square function involving the center of mass and rectifiability**. Arxiv preprint.
3. **A proof of Carleson ϵ^2-conjecture**. Joint work with B. Jaye and X. Tolsa. Arxiv preprint.
4. **Sets with topology, the Analyst's TST, and applications**. Arxiv preprint.
5. **Ω-symmetric measures and related singural integrals**. To appear in *Revista Matematica Iberoamericana.*
6. **Quantitative comparisons of multiscale geometric properties**. Joint paper with Jonas Azzam. To appear in *Analysis and PDEs.*
7. **Tangent points of d-lower content regular sets and β numbers**. Published in *J. Lond. Math. Soc.*

Talks

Nov. 2019 Seminar talk at 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.* Conributed 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.

Events/Travel

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

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.

June 2019 *BAC2019.* Conference in Barcelona.

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.* Conference in Helsinki, June 2019.

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.

July 2018 *IAS/PCMI Graduate School in Harmonic Analysis.* Park City, Utah (US).

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).

Scholarships, awards and other financial support

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.

Work experience in mathematics

2015-2016 *MathDoctor, UK.* MathDoctor is an online company which provides online tutoring to students from primary school to university. I mostly teach to A-levels students, IB students and 1st year university students.

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), German (basic).

I have experience in working with the following: CAS Maple, MATLAB/GNU Octave, R, Latex, Python, Linux operating systems.