CURRICULUM VITAE OF MARIA MANFREDINI

Academic Career

Current Position: since September 2019 I am an Associate Professor of Mathematical Analysis at the University of Modena and Reggio Emilia.

- **September 2014:** Associate Professor of Mathematical Analysis at the University of Bologna.
- **July 1995:** Assistant Professor (Researcher) in the Mat/05 group, at the Faculty of Engineering of the University of Bologna.
- **June 1995:** Ph.D. in Mathematics.
- **June 1990:** Degree (Laurea) in Mathematics at the University of Modena with a grade of 100/100 cum laude.

Institutional Activities

- since February 2020: Representative of the FIM Department for Equal Opportunities;
- from April 2022 to September 2024: Member of the Joint Student-Staff Committee (Commissione Paritetica) of the FIM Department;
- since September 2022: Representative of the FIM Department for University Outreach and Orientation;
- since September 2024: Chair of the Third Mission Commission of the FIM Department;
- Member of the Department Board (Giunta) and of the Quality Assurance Committee of the FIM Department.

Main Research Interests

My research activity has focused primarily on the study of second-order degenerate partial differential equations, both linear and nonlinear. More precisely, it has concerned the study of equations that can be written as a sum of squares of vector fields, regularity problems of solutions, and geometric measure theory problems in Riemannian and sub-Riemannian structures.

There is a rich literature on operators defined through smooth fields, whereas a general theory for nonlinear or non-smooth fields does not exist. A significant part of my recent research activity has therefore been dedicated to developing a theory for this type of operators.

1 List of Publications

Asymptotic estimates for variational equations.

- **[1]** M. Manfredini, *Asymptotic behavior of solutions of variational equations*, Rend. Circ. Mat. Palermo, II. Ser. 41, No.3, (1992) 441-465.
- **[2]** G. Leoni, M. Manfredini, P. Pucci, *Stability properties for solutions of general Euler-Lagrange systems*, Differ. Integral Equ. 5, No.3, (1993) 537-552.

Kolmogorov-type equations

- **[3]** M. Bramanti, M. C. Cerutti, M. Manfredini, *L^p estimates for some ultraparabolic operators with discontinuous coefficients*, J. Math. Anal. Appl. 200, No.2, (1996) 332-354.

- **[4]** M. Manfredini, *The Dirichlet problem for a class of ultraparabolic equation*, Adv. Diff. eq., 2, (1997) 831-866.

- **[5]** M. Manfredini, S. Polidoro, *Interior regularity for weak solutions of ultraparabolic equations in divergence form with discontinuous coefficients*, Boll. Unione Mat. Ital., Sez. B, Artic. Ric. Mat. (8) 1, No.3, (1998) 651-675.

Measure theory in Lie groups.

- **[6]** G. Citti, M. Manfredini, *Blow-Up in Non-Homogeneous Lie Groups and Rectifiability*, Houston Journal of Mathematics, 31, No. 2, (2005) 333-353.

- **[7]** G. Citti, M. Manfredini, *Implicit function theorem in Carnot-Carathéodory spaces*, Commun. Contemp. Math. 8 no. 5, (2006) 657-680.

A priori estimates for degenerate equations.

- **[8]** M. Manfredini, *Compact embedding theorems for generalized Sobolev spaces*, Atti Accad. Naz. Lincei, Cl. Sci. Fis. Mat. Nat., IX. Ser., Rend. Lincei, Mat. Appl. 4, No.4, (1993) 251-263.

- **[9]** M. Manfredini, A. Pascucci, *A priori estimates for quasilinear degenerate parabolic equations*, Proceedings of the American Mathematical Society, 131 (2003) 1115-1120.

- **[10]** G. Citti, M. Manfredini, *Uniform estimates of the fundamental solution for a family of hypoelliptic operators*, Potential Anal., 25, (2) (2006) 147-164.

- **[11]** M. Manfredini, *Uniform Schauder estimates for regularized hypoelliptic equations*, Ann. Mat. Pura ed Applicata, 188, (2009) 417-428.

Riemannian mean curvature flow.

- **[12]** G. Citti, M. Manfredini, *Long time behavior of Riemannian mean curvature flow*, Journal of Mathematical Analysis and Applications, 273, (2002) 353-369.

- **[13]** G. Citti, M. Manfredini, *A degenerate parabolic equation arising in image processing*, Communication on Applied Analysis, 8, 1, (2004) 125-141.

The Mumford-Shah functional.

- **[14]** A. Sarti, G. Citti, M. Manfredini, *From neural oscillations to variational problems in the visual cortex*, Journal of Physiology Paris, vol. 97, n.2-3, (2003) 379-385.

- **[15]** G. Citti, M. Manfredini, A. Sarti, *Neuronal oscillation in the visual cortex: Gamma-convergence to the Riemannian Mumford-Shah functional*, SIAM Journal Mathematical Analysis, vol. 36, n.6, (2004) 1394-1419.

- **[16]** G. Citti, M. Manfredini, A. Sarti, *Finite difference approximation of the Mumford and Shah functional in a contact manifold of the Heisenberg space*, Commun. Pure Appl. Anal. 9, no. 4,(2010) 905-927.

Mean curvature equations in the Heisenberg group.

- **[17]** L. Capogna, G. Citti, M. Manfredini, *Regularity of minimal surfaces in the one-dimensional Heisenberg group*, Bruno Pini Mathematical Analysis Seminar, University of Bologna Department of Mathematics: Academic Year 2006/2007 (Italian), 147-162, Tecnoprint, Bologna, 2008.

- **[18]** L. Capogna, G. Citti, M. Manfredini, *Smoothness of Lipschitz minimal intrinsic graphs in Heisenberg groups* $\mathbb{H}^n$*,* $n > 1$, J. Reine Angew. Math. 648, (2010) 75-110.

- **[19]** L. Capogna, G. Citti, M. Manfredini, *Regularity of non-characteristic minimal graphs in the Heisenberg group* $\mathbb{H}^1$, Indiana Univ. Math. J. 58, no. 5, (2009) 2115-2160.

- **[20]** L. Capogna, G. Citti, M. Manfredini, *Uniform Gaussian bounds for subelliptic heat kernels and an application to the total variation flow of graphs over Carnot groups*, Anal. Geom. Metr. Spaces 1 (2013), 255-275.

3 Vector fields with non-smooth coefficients.

- **[21]** M. Manfredini, *Step-two nonsmooth vector fields: the Poincaré inequality and the fundamental solution of the associated operator*, Bruno Pini Mathematical Analysis Seminar, University of Bologna Department of Mathematics: Academic Year 2008/2009 (Italian), 111-123, Tecnoprint, Bologna, 2009.

- **[22]** M. Manfredini, *A note on the Poincaré inequality for Lipschitz vector fields of step two*, Proc. Amer. Math. Soc. 138, no. 2, (2010) 567-575.

- **[23]** M. Manfredini, *Fundamental solutions for sum of square vector fields operators with* $C^{1,\alpha}$ *coefficients*, Forum Mathematicum 24, Issue 5, (2012) 973-1011.

- **[24]** G. Citti, M. Manfredini, A. Pinamonti, F. Serra Cassano, *Smooth approximation for intrinsic Lipschitz functions in the Heisenberg group*, Calc. Var. Partial Differential Equations 49 (2014), no. 3-4, 1279-1308.

- **[25]** L. Capogna, G. Citti, M. Manfredini, *Uniform Gaussian Bounds for Subelliptic Heat Kernels and an Application to the Total Variation Flow of Graphs over Carnot Groups.* ANALYSIS AND GEOMETRY IN METRIC SPACES, vol. 1, (2013), p. 255-275.

- **[26]** L. Capogna, G. Citti, M. Manfredini, *Regularity of mean curvature flow of graphs on Lie groups free up to step 2.* NONLINEAR ANALYSIS, vol. 126, (2015), p. 437-450.

- **[27]** Bonfiglioli A., Citti G., Cupini G., Manfredini M., Montanari A., Morbidelli D., Pascucci A., Uguzzoni F., Polidoro S. *The Role of Fundamental Solution in Potential and Regularity Theory for Subelliptic PDE.* In: Geometric Methods in PDE. SPRINGER INDAM SERIES, vol. 13, p. 341-373, Springer, (2015).

- **[28]** G. Citti, M. Manfredini, A. Pinamonti, F. Serra Cassano, *Poincaré-type inequality for Lipschitz continuous vector fields in the Heisenberg group*, JOURNAL DE MATHÉMATIQUES PURES ET APPLIQUÉES, vol. 103, (2016), p. 265-292.

- **[29]** M. Bramanti, L. Brandolini, M. Manfredini, M. Pedroni, *Fundamental solutions and local solvability for nonsmooth Hörmander's operators*, Mem. Amer. Math. Soc. 249 (2017), no. 1182, v + 79 pp.

4 Recent papers.

- **[30]** M. Manfredini, *Intrinsic fractional Taylor formula*, Bruno Pini Mathematical Analysis Seminar, 12(1), (2021), 1-14.
- **[31]** M. Manfredini, M. Piccinini, S. Polidoro, *The Dirichlet problem for a family of totally degenerate differential operators*, under review.
- **[32]** M. Manfredini, M. Piccinini, S. Polidoro, G. Palatucci, *Hölder continuity and boundedness estimates for nonlinear fractional equations in the Heisenberg group*, accepted for publication.
- **[33]** G. Citti, M. Manfredini, Y. Sire, *Hölder regularity for weak solutions of Hörmander type operators*, preprint.

Recent Teaching Activity

A.Y. 2015/2016:

- Instructor of the course “Mathematical Analysis T-1” for the Degree in Building Engineering (Ravenna Campus) (9 ECTS credits, 90 lecture hours).
- Module of 30 out of 90 hours for the course “Mathematical Analysis T-2” for the Degrees in Automation Engineering and Electrical Energy Engineering.

A.Y. 2016/2017:

- Instructor of the course “Mathematical Analysis T-1” for the Degree in Building Engineering (Ravenna Campus) (9 ECTS credits, 90 lecture hours).
- Instructor of the course “Mathematical Analysis T-B” for the Degree in Management Engineering (6 ECTS credits, 60 lecture hours).

A.Y. 2017/2018:

- Instructor of the course “Mathematical Analysis T-1” for the Degree in Building Engineering (Ravenna Campus) (9 ECTS credits, 90 lecture hours).
- Instructor of the course “Mathematical Analysis T-B” for the Degree in Management Engineering (6 ECTS credits, 60 lecture hours).
- Instructor of the course “Partial Differential Equations” for the Ph.D. program in Mathematics of Bologna, XXXIII cycle (30 lecture hours).

A.Y. 2018/2019:

- Instructor of the course “Mathematical Analysis T-2” for the Degree in Building Engineering (Ravenna Campus) (9 ECTS credits, 90 lecture hours).
- Instructor of the course “Mathematical Analysis T-B” for the Degree in Management Engineering (6 ECTS credits, 60 lecture hours).
- Lecture series “Partial Differential Equations” for the Ph.D. program in Mathematics of Unimore (18 hours).
- Instructor of the course “Mathematical Analysis I” for the Degree in Computer Engineering at Unimore (9 ECTS credits, 81 lecture hours).

A.Y. 2019/2020:

- Instructor of the course "Mathematical Analysis I" for the Degree in Computer Engineering (9 ECTS credits, 81 lecture hours).
- Instructor of the courses "Complementi di analisi matematica" (for Physics) and "Analisi matematica B" (for Mathematics) (6 ECTS credits, 48 lecture hours).
- Module of 54 out of 81 hours for the course "Mathematical Analysis II" for Vehicle Engineering.
- Lecture series for the course "Hypoelliptic Partial Differential Equations" for the Ph.D. program in Mathematics (18 hours).

A.Y. 2020/2021:

- Instructor of the course "Mathematical Analysis I" for the Degree in Computer Engineering (9 ECTS credits, 81 lecture hours).
- Instructor of the courses "Complementi di analisi matematica" (for Physics) and "Analisi matematica B" (for Mathematics), Bachelor's Degree (6 ECTS credits, 48 lecture hours).
- Module of 40 out of 90 hours for the course "Mathematical Analysis II" at the Military Academy of Modena.
- Module of 18 out of 36 hours for the course "Partial Differential Equations", Master's Degree in Mathematics.
- Lecture series for the course "Hypoelliptic Partial Differential Equations" for the Ph.D. program in Mathematics (18 hours).

A.Y. 2021/2022:

- Instructor of the course "Mathematical Analysis I" for the Degree in Computer Engineering (9 ECTS credits, 81 lecture hours).
- Instructor of the courses "Complementi di analisi matematica" (for Physics) and "Analisi matematica B" (for Mathematics), Bachelor's Degree (6 ECTS credits, 48 lecture hours).
- Module of 27 out of 81 hours for the course "Mathematical Analysis II" for Vehicle Engineering.
- Module of 50 out of 90 hours for the course "Mathematics II" at the Military Academy of Modena.
- Lecture series for the course "Hypoelliptic Partial Differential Equations" for the Ph.D. program in Mathematics (18 hours).

A.Y. 2022/2023:

- Instructor of the course "Mathematical Analysis I" for the Degree in Computer Engineering (9 ECTS credits, 81 lecture hours).
- Instructor of the courses "Complementi di analisi matematica" (for Physics) and "Analisi matematica B" (for Mathematics), Bachelor's Degree (6 ECTS credits, 48 lecture hours).
- Module of 27 out of 81 hours for the course "Mathematical Analysis II" for Vehicle Engineering.
- Module of 50 out of 90 hours for the course "Mathematics II" at the Military Academy of Modena.

- Lecture series for the course “Hypoelliptic Partial Differential Equations” for the Ph.D. program in Mathematics (18 hours).
- Module of 18 out of 36 hours for the course “Partial Differential Equations”, Master’s Degree in Mathematics.

A.Y. 2023/2024:

- Instructor of the course “Mathematical Analysis II” for the Degree in Vehicle Engineering (9 ECTS credits, 81 lecture hours).
- Instructor of the courses “Complementi di analisi matematica” (for Physics) and “Analisi matematica B” (for Mathematics), Bachelor’s Degree (6 ECTS credits, 48 lecture hours).
- Module of 45 out of 90 hours for the course “Mathematics I” at the Military Academy of Modena.
- Module of 50 out of 90 hours for the course “Mathematics II” at the Military Academy of Modena.
- Lecture series for the course “Hypoelliptic Partial Differential Equations” for the Ph.D. program in Mathematics (18 hours).

A.Y. 2024/2025:

- Instructor of the course “Mathematical Analysis II” for the Degree in Vehicle Engineering (9 ECTS credits, 81 lecture hours).
- Instructor of the courses “Complementi di analisi matematica” (for Physics) and “Analisi matematica B” (for Mathematics), Bachelor’s Degree (6 ECTS credits, 48 lecture hours).
- Module of 45 out of 90 hours for the course “Mathematics I” at the Military Academy of Modena.
- Module of 50 out of 90 hours for the course “Mathematics II” at the Military Academy of Modena.
- Module of 27 out of 54 hours for the course “Mathematical Methods and Models for Electronic Engineering”.

A.Y. 2025/2026:

- Instructor of the course “Mathematical Analysis II” for the Degree in Vehicle Engineering (9 ECTS credits, 81 lecture hours).
- Module of 21 out of 48 hours for the course “Complementi di analisi matematica” (for Physics) and “Analisi matematica B” (for Mathematics), Bachelor’s Degree (6 ECTS credits, 48 lecture hours).
- Module of 45 out of 90 hours for the course “Mathematics I” at the Military Academy of Modena.
- Module of 50 out of 90 hours for the course “Mathematics II” at the Military Academy of Modena.
- Instructor of the course “Mathematical Methods and Models for Electronic Engineering” (54 hours).
- Lecture series for the course “Hypoelliptic Partial Differential Equations” for the Ph.D. program in Mathematics (18 hours).

Brief description of the most recent publications

The main results I have obtained concern nonlinear partial differential equations of Hörmander type, and in particular mean curvature equations. Specifically, I have studied:

(i) properties of regular or rectifiable surfaces in groups;

(ii) properties of fundamental solutions of Hörmander-type operators conceived as limits of elliptic operators or operators with non-smooth coefficients;

(iii) asymptotic properties of solutions of the Riemannian mean curvature flow;

(iv) regularity of minimal surfaces, and limits of Riemannian minimal surfaces;

(v) minimizers of the Mumford-Shah functional in this setting (this problem is closely related to the previous ones since the jump sets of the minimizers of the functional are minimal surfaces).

These results play a role in models of the primary visual cortex. Indeed, the cortex was modeled by Petitot and Tondut in the group $SE(2)$ of rigid motions of the plane. In this setting, minimal surfaces model subjective surfaces, while differential equations describe the neural propagation of the visual signal.

(i) Surfaces in non-homogeneous Lie groups.

The model structures for developing the theory of Hörmander operators in $\mathbb{R}^n$

$$L = \sum_{i=1}^{m} X_i^2, \quad 1 \leq m \leq n \tag{1}$$

are Lie groups; in particular, the theory is simplified in the case of homogeneous groups, called Carnot groups, for which natural dilations compatible with the group law are defined. The notion of intrinsic regular surface was introduced in Carnot groups only in 2001 by Franchi, Serapioni, and Serra Cassano. A regular surface is the zero set of a function whose intrinsic gradient is non-zero. There is a rich literature, always by the same authors, regarding the study of surfaces in homogeneous groups. In the work [6], a rectifiability result is proved for surfaces in non-homogeneous environments, introducing a notion of reduced boundary analogous to that of De Giorgi for the Euclidean case, and of Franchi, Serapioni, and Serra Cassano for homogeneous groups. The main difficulty is due to the fact that in non-homogeneous groups, natural dilations are not defined, and it was therefore necessary to first introduce approximating dilations, which allow for a blow-up procedure, and thus introduce the notions of tangent planes and rectifiability in the intrinsic sense. The main result of the paper guarantees that the (intrinsic) reduced boundary of a Caccioppoli set in the sense of the group is rectifiable. In the work [7], for surfaces of class C^1 in the intrinsic sense, an implicit function theorem was proved. Our result is contemporary with, but more general than, that of Ambrosio, Serra Cassano, and Vittone in the Heisenberg group. The implicit function u turns out to be differentiable with respect to a family of suitable nonlinear fields:

$$X_{i,u} = \sum_{j=1}^{n} a_{ij}(u)\partial_{x_j}. \tag{2}$$

(ii) Estimates and construction of fundamental solutions.

It is well known that linear operators of type (1) have a fundamental solution Γ, see the article by Rothschild and Stein of 1977. On the other hand, degenerate operators of type (1) can be formally thought of as the limit as $\epsilon \to 0$ of Riemannian regularization operators depending on a parameter ϵ:

$$L_\epsilon = L + \epsilon\Delta$$

where Δ is the Laplace operator in $\mathbb{R}^n$. In the work [10], we provide a priori estimates that are uniform in ϵ for the fundamental solution Γ_ϵ of L_ϵ, and we prove that Γ is the limit of Γ_ϵ as $\epsilon \to 0$. The proof of these estimates is based on a lifting procedure different from the classical one of Rothschild and Stein, and consists in lifting the operators L_ϵ to an operator independent of ϵ, whose fundamental solution provides the desired estimates for the fundamental solutions of the operators L_ϵ. Using this technique, uniform a priori Schauder-type estimates for solutions of the problem $L_\epsilon u = f$ were obtained in [11]. In this context, the estimates for solutions of a wide class of quasilinear degenerate parabolic equations demonstrated in the work [9] also fit.

The operators studied in these works are expressed in terms of C^∞ fields. However, in the study of quasilinear equations, the fields depend on the solution, and it is not generally possible to assume that they are smooth, nor to simply think of them as perturbations of known linear operators. An axiomatic theory for non-smooth fields of this type is presented by Sawyer and Wheeden, but it cannot be applied to fields of type (2). In the work [23], nonlinear fields of type (2) with u Lipschitz continuous in the intrinsic sense are considered, a local fundamental solution is constructed using Levi's parametrix method, and estimates of its derivatives are provided. In [29], I considered sum of squares operators of non-smooth Hörmander vector fields of step r. In this paper, a local fundamental solution is constructed and estimates of its derivatives up to order two are provided. This allows us to prove a priori Schauder-type estimates and address the study of local solvability.

The fundamental solution of the operator obtained by freezing the coefficients of the fields via a first-order (intrinsic) Taylor expansion of the coefficients was used as a parametrix.

As is well known, the Poincaré inequality is an essential tool in Moser's iterative method for proving the Hölder regularity of solutions. For smooth fields, it was proved by Jerison. For non-smooth fields of diagonal type, it was proved by Franchi and Lanconelli. More recently, Lanconelli and Morbidelli proved the Poincaré inequality under a condition on the metric balls. Developing this method, Montanari and Morbidelli prove the Poincaré inequality assuming that the fields and their second-order commutators are Lipschitz continuous and span the entire space. However, in many situations, this type of regularity is not satisfied. For instance, it is not satisfied for the vector fields (2) involved in the study of minimal surfaces in Heisenberg, which have only Lipschitz coefficients, or for the fields considered by Rios, Sawyer, and Wheeden. The aim of the work [22] is to fill this gap by proving a Poincaré inequality for fields with only Lipschitz coefficients.

Still in this context, in the work [24] it is shown that Lipschitz continuous functions (in the intrinsic sense) can be approximated, together with their gradients, by smooth functions. The proof consists in providing a smooth approximation of the finite perimeter of a set whose boundary is the intrinsic graph of the function to be approximated.

(iii) Asymptotic estimates for the Riemannian mean curvature flow.

The motion of a surface where each point moves in the normal direction with velocity equal to its curvature is called mean curvature flow. In the Euclidean and Riemannian settings, the problem has been extensively studied, mainly by Ecker and Huisken. It is well known that solutions to the Riemannian mean curvature flow with fixed boundary data tend to the solution of the minimal surface equation with the same data. In particular, if the boundary data is zero, the solution tends to zero. In the work [12], we prove that the solution, properly normalized, instead tends to the first eigenvector of a Laplace-Beltrami-type operator, i.e., of type (1) with $n = m$. This result is of interest for applications to image processing and stability. Another differential equation describing a geometric flow of fronts, which arises in image processing, is studied in [13]. The main difficulty is due to the fact that the equation is non-local, and the proof of the existence and stability of the solutions is obtained through a viscosity technique.

(iv) Mean curvature equations in the Heisenberg group: nonlinear fields.

The prescribed mean curvature equation in the Heisenberg group $\mathbb{H}^n$ is formally presented as the Riemannian analog, in terms of nonlinear fields of type (2):

$$\sum_{i=1}^{2n-1} X_{i,u}\left(\frac{X_{i,u}u}{\sqrt{1+|\nabla_{X,u}u|^2}}\right) = f, \quad x \in \Omega \subset \mathbb{R}^{2n} \tag{3}$$

where $\nabla_{X,u} = (X_{1,u}, \ldots, X_{2n-1,u})$. A regular surface is called minimal if it satisfies the equation with $f \equiv 0$. For this problem, conceived as critical points of the perimeter functional, Garofalo and Nhieu prove regularity in bounded variation spaces and Pauls demonstrates regularity in Sobolev spaces. Subsequently, in the case $n > 1$, Cheng, Hwang, and Yang prove that weak C^1 solutions of (3) are of class C^2, while in the case $n = 1$, Ritoré provides examples of non-regular minimal surfaces. Finally, regarding low regularity, Bigolin and Serra Cassano prove the Lipschitz continuity of solutions. On the other hand, the problem of high regularity was completely open. In the works [18] and [19] (attached to the application), we require the Lipschitz continuity of the solutions as an assumption and prove that they are infinitely differentiable in the intrinsic sense. More precisely, in [18], for the case $n > 1$, we show that Lipschitz viscosity solutions of the curvature equation are of class C^∞, while, in [19], for the case $n = 1$, we prove that they are C^∞ in the intrinsic sense. The behavior is therefore radically different in the two cases. Indeed, if $n > 1$, a weak Hörmander condition holds: the Lie algebra generated by the fields and their first-order commutators coincides with the whole space at each point, whereas if $n = 1$, this condition is violated. The proof essentially exploits the possibility of approximating the sub-Riemannian curvature operator with the analogous Riemannian operator, and the approximation results of section (ii) which allow for representing the fundamental solution of a sum of squares operator as the limit of the fundamental solution of Riemannian operators.

In the work [20], an equation for the evolution of fronts in a step-s group is studied, which differs from the mean curvature flow because it is variational, namely the total variation:

$$\partial_t u = \sum_{i=1}^{m} X_i\left(\frac{X_i u}{\sqrt{1+|\nabla_X u|^2}}\right) \quad \text{in } \mathbb{R}^n \times [0, +\infty[. \tag{4}$$

An existence result for all times of a smooth solution of the equation on a bounded convex open set with assigned boundary data is established. Furthermore, it is proved that the solution tends to the solution of the minimal surfaces problem as $t \to +\infty$.

(v) Minimizers of the Mumford-Shah functional.

Minimal surfaces can also be determined as the jump set of the minimizers of the Mumford-Shah functional in the Riemannian and sub-Riemannian settings. In [15], the problem of the existence of minimizers is addressed using Gamma-convergence tools, and a convergence result of a family of discrete functionals to the Mumford-Shah functional in a Riemannian space is proved. The work generalizes to this setting the proof of a conjecture by De Giorgi in the Euclidean case. Subsequently, in [16], the study of the Mumford-Shah functional in the sub-Riemannian metric modeling the visual cortex is addressed.

Modena, July 14, 2026

Sincerely,
Maria Manfredini