

Dario Prandi

Charge de recherche CNRS at Université Paris-Saclay



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Professional experience

- Chargé de Recherche CNRS**, Université Paris-Saclay, CentraleSupélec, L2S 2016–now
Researcher in Section 07.
- Post-doc**, CEREMADE, Université Paris-Dauphine, Paris 2015–2016
Supervisors: [G. Peyré](#) and [J.-M. Mirebeau](#).
- Post-doc**, LSIS, Université de Toulon, Toulon 2014–2015
Grant of the LabEx Archimède (Aix-Marseille Université). Supervisor: [J.-P. Gauthier](#).

Education

- Philosophiae Doctor (Ph.D.)**, École Polytechnique, Palaiseau 2010–2013
[Geometry and analysis of control-affine systems: motion planning, heat and Schrödinger evolution.](#)
Supervisors: [Ugo Boscain](#), [Frédéric Jean](#), and [Mario Sigalotti](#).
- Master of Science (M.Sc.)**, Dep. of Mathematics, Univ. di Padova, Italy 2008 – 2010
Final grade 110/110 *cum laude*. Specialised curriculum in mathematical analysis.
Subject of the dissertation: Rearrangements in Metric Spaces. Supervisor: [Roberto Monti](#).
- Bachelor of Science (B.Sc.)**, Dep. of Mathematics, Univ. di Modena e Reggio Emilia, Italy 2005 – 2008
Final grade 110/110 *cum laude*. General curriculum in mathematics.
Subject of the dissertation: Area and coarea formulae. Supervisor: [Gian Paolo Leonardi](#).

Grants and awards

- ANR JCJC**, “Redundancy-free neuro-biological design of visual and auditory sensing” 2021–2024
Financing for 160k€. PI of the project.
- Dispositif de Soutien aux Collaborations avec l'Afrique Subsaharienne (DSCA)**, “Neural dynamics via mean-field models” 2021–2022
Financing for 17k€. PI of the project.
- Emergence en Recherche de IDEX Université de Paris**, “BioSpeech” 2019
Financing for 20k€. Principal investigator: Giuseppina Turco, in collaboration with U. Boscain
- Financing from iCODE institut**, “Control theoretical modelling of contrast perception” 2019
Financing for 12k€. “Porteur” of the project, in collaboration with V. Franceschi and L. Calatroni
- PEPS INS2I**, “Lifting approaches for cortical inspired methods in imaging (LiftME)” 2018
Financing for 10k€. “Porteur” of the project, in collaboration with V. Franceschi and L. Calatroni
- PEPS INS2I**, “Cortical Inspired Non-holonomic Control for Imaging (CINCIN)” 2017
Financing for 8k€. “Porteur” of the project, in collaboration with J.-P. Gauthier, V. Franceschi, L. Calatroni.
- ERC Proof of Concept**, “An artificial visual cortex for image processing (ARTIV1)” 2016
Financing for 150k€. Principal investigator: Ugo Boscain. In collaboration with J.-P. Gauthier and M. Sigalotti.

Organization

- NFW 23: Neural fields equations, from Wilson-Cowan to neural engineering**, LJLL, Paris. 19–20 jun 2023
Website: <https://nfwparis2023.sciencesconf.org/registration>.
- Geometry and Control in Cortona**, Cortona, Italy 27–31 mar 2023
Website: <https://indico.math.cnrs.fr/event/7106/>.
- Séminaire d'Automatique du Plateau de Saclay**, L2S, CentraleSupélec, Gif-sur-Yvette. oct 2016 – now
Website: <https://icode-seminars.github.io>. Co-organised with N. Amini.
- Cortical models for visual perception and imaging applications**, LJLL, Paris. 22 nov 2018
Website: <https://liftme.sciencesconf.org/>. Co-organised with L. Calatroni, V. Franceschi, and B. Franceschiello.

- Cortical Inspired Non-holonomic Control for Imaging**, Institut Henri Poincaré, Paris. 28 nov 2017
Co-organised with L. Calatroni and V. Franceschi.
- A day in control theory**, CMAP, École Polytechnique, Palaiseau. 2 may 2017
Thematic day in honour of A. Agrachev 65th birthday. Co-organised with F. Chittaro and R. Ghezzi.
- INDAM meeting on Geometric Control and sub-Riemannian Geometry**, Cortona, Italy. may 2012
Website: <http://www.cmap.polytechnique.fr/geometric-control-srg/>.

Teaching

- Lecturer**, Geometric Control Theory (CM, 12h). 2018 – now
Master course, Université Paris-Sud Orsay / ENSTA.
- Lecturer**, Analyse et Topologie (CM and TD, 60h). 2015 – now
Bachelor course (L2). PSL Research University, Paris.
- Teaching assistant**, Contrôle Géométrique (TD, 10h). 2013 & 2016
Master course, Université Paris-Sud Orsay.
- Teaching assistant**, Outils Logiciels (TP, 50h). 2014
Bachelor course, IUT de Toulon.

Supervision

- Ongoing PhD thesis supervision:
 - Adel Annabi (2022–prés.).
Co-supervised with J.-B. Pomet and L. Sacchelli. Title: “Observability and observer synthesis for Wilson-Cowan equations”.
 - Roman Vanlaere (2022–prés.).
Co-supervised with P. Lissy. Title: “Controllability of the heat equation on sub-Riemannian manifolds”.
 - Pierre-Jean Ménabé (2021–prés.).
Co-supervised with Y. Chitour. Title: “Regularity of optimal trajectories for control-affine systems”.
 - Cyprien Tamekue (2020–prés.). Thesis financed by the “[Financement Jean-Pierre Aguilar](#)”.
Co-supervised with Y. Chitour. Title: “Control of hallucinatory patterns in the primary visual cortex”.
- Completed PhD thesis supervision:
 - Amine Bohi (2014–2017). Co-supervised with F. Bouchara, J.-P. Gauthier, V. Guis.
Title: “Descripteurs de Fourier inspirés de la structure du cortex visuel primaire humain. Application à la reconnaissance de navires dans le cadre de la surveillance maritime”
- Supervised 10 “stage de master” since 2018.
- Supervised a student in the “parcours recherche” of CentraleSupélec (2017–2020)

Publications

Books and edited proceedings

- [1] A semidiscrete version of the Petitot model as a plausible model for anthropomorphic image reconstruction and pattern recognition
Dario Prandi, Jean-Paul Gauthier,
SpringerBriefs in Mathematics (2018), Springer International Publishing, doi: [10.1007/978-3-319-78482-3](https://doi.org/10.1007/978-3-319-78482-3)

Peer-reviewed journals

- [1] Worst Exponential Decay Rate for Degenerate Gradient Flows Subject to Persistent Excitation
Paolo Mason, Yacine Chitour, Dario Prandi
SIAM Journal on Control and Optimization 59.4 (2021), pp. 3040–3067, doi: [10.1137/20M1343427](https://doi.org/10.1137/20M1343427)
- [2] A Cortical-Inspired Sub-Riemannian Model for Poggendorff-Type Visual Illusions
Emre Baspinar, Luca Calatroni, Valentina Franceschi, Dario Prandi
Journal of Imaging 7.3 (2021), doi: [10.3390/jimaging7030041](https://doi.org/10.3390/jimaging7030041)

- [3] A bio-inspired geometric model for sound reconstruction
Ugo Boscain, Dario Prandi, Ludovic Sacchelli, Giuseppina Turco
The Journal of Mathematical Neurosciences 11 (2 2021), doi: <https://doi.org/10.1186/s13408-020-00099-4>
- [4] Point interactions for 3D sub-Laplacians
Riccardo Adami, Ugo Boscain, Valentina Franceschi, Dario Prandi
Annales de l'Institut Henri Poincaré C, Analyse non linéaire (2020), doi: <https://doi.org/10.1016/j.anihpc.2020.10.007>
- [5] Cortical-inspired Wilson-Cowan-type equations for orientation-dependent contrast perception modelling
Marcelo Bertalmio, Luca Calatroni, Valentina Franceschi, Benedetta Franceschiello, Dario Prandi
J. Math. Imaging Vision (2020), doi: <https://doi.org/10.1007/s10851-020-00960-x>
- [6] Visual illusions via neural dynamics: Wilson-Cowan-type models and the efficient representation principle
Marcelo Bertalmio, Luca Calatroni, Valentina Franceschi, Benedetta Franceschiello, Alexander Gomez-Villa, Dario Prandi
Journal of Neurophysiology (2020), doi: <https://doi.org/10.1152/jn.00488.2019>
- [7] Hardy-Type Inequalities for the Carnot–Carathéodory Distance in the Heisenberg Group
Valentina Franceschi, Dario Prandi
The Journal of Geometric Analysis (Jan. 2020), doi: [10.1007/s12220-020-00360-y](https://doi.org/10.1007/s12220-020-00360-y)
- [8] On the regularity of abnormal minimizers for rank 2 sub-Riemannian structures
Davide Barilari, Yacine Chitour, Frédéric Jean, Dario Prandi, Mario Sigalotti
Journal de Mathématiques Pures et Appliquées (Apr. 2018), doi: [10.1016/j.matpur.2019.04.008](https://doi.org/10.1016/j.matpur.2019.04.008)
- [9] A sub-Riemannian Santaló formula with applications to isoperimetric inequalities and first Dirichlet eigenvalue of hypoelliptic operators
Dario Prandi, Luca Rizzi, Marcello Seri
J. Differential Geom. 111.2 (Feb. 2019), pp. 339–379, Lehigh University, doi: [10.4310/jdg/1549422105](https://doi.org/10.4310/jdg/1549422105)
- [10] On the Essential Self-Adjointness of Singular Sub-Laplacians
Valentina Franceschi, Dario Prandi, Luca Rizzi
Potential Analysis (Jan. 2019), doi: [10.1007/s11118-018-09760-w](https://doi.org/10.1007/s11118-018-09760-w)
- [11] Quantum confinement on non-complete Riemannian manifolds
Dario Prandi, Luca Rizzi, Marcello Seri
J. Spectr. Theory (July 2018), doi: [10.4171/JST/226](https://doi.org/10.4171/JST/226)
- [12] Highly Corrupted Image Inpainting Through Hypoelliptic Diffusion
Ugo V. Boscain, Roman Chertovskih, Jean-Paul Gauthier, Dario Prandi, Alexey Remizov
J. Math. Imaging Vision (Apr. 2018), doi: [10.1007/s10851-018-0810-4](https://doi.org/10.1007/s10851-018-0810-4)
- [13] Self-adjoint extensions and stochastic completeness of the Laplace-Beltrami operator on conic and anti-conic surfaces
Ugo Boscain, Dario Prandi
J. Differential Equations 260.4 (2016), pp. 3234–3269, doi: [10.1016/j.jde.2015.10.011](https://doi.org/10.1016/j.jde.2015.10.011)
- [14] Spectral analysis and the Aharonov-Bohm effect on certain almost-Riemannian manifolds
U. Boscain, D. Prandi, M. Seri
Comm. Partial Differential Equations 41.1 (2016), pp. 32–50, doi: [10.1080/03605302.2015.1095766](https://doi.org/10.1080/03605302.2015.1095766)
- [15] Fourier descriptors based on the structure of the human primary visual cortex with applications to object recognition
Amine Bohi, Dario Prandi, Vincente Guis, Frédéric Bouchara, Jean-Paul Gauthier
J. Math. Imaging Vision 57.1 (2017), pp. 117–133, doi: [10.1007/s10851-016-0669-1](https://doi.org/10.1007/s10851-016-0669-1)
- [16] Complexity of control-affine motion planning
F. Jean, D. Prandi
SIAM J. Control Optim. 53.2 (2015), pp. 816–844, doi: [10.1137/130950793](https://doi.org/10.1137/130950793)
- [17] Hölder equivalence of the value function for control-affine systems
Dario Prandi
ESAIM: COCV 20.4 (2014), pp. 1224–1248, doi: [10.1051/cocv/2014014](https://doi.org/10.1051/cocv/2014014)

Peer-reviewed conferences and workshops

- [1] Cortical origins of MacKay-type visual illusions. A case for the non-linearity
Cyprien Tamekue, Dario Prandi, Yacine Chitour
To appear on 21st IFAC World Congress, 2023
- [2] Reproducing Sensory Induced Hallucinations via Neural Fields

- [3] An Auditory Cortex Model for Sound Processing
Rand Asswad, Ugo Boscain, Giuseppina Turco, Dario Prandi, Ludovic Sacchelli
Geometric Science of Information, 2021, Springer International Publishing, doi: [10.1007/978-3-030-80209-7_7](https://doi.org/10.1007/978-3-030-80209-7_7)
- [4] On the decay rate for degenerate gradient flows subject to persistent excitation
Yacine Chitour, Paolo Mason, Dario Prandi
IFAC-PapersOnLine 53.2 (2020), pp. 1709–1714, doi: <https://doi.org/10.1016/j.ifacol.2020.12.2246>
- [5] A bio-inspired geometric model for sound reconstruction (Extended Abstract)
Ugo Boscain, Ludovic Sacchelli, Dario Prandi, Giuseppina Turco
20th IFAC World Congress, 2020
- [6] A Cortical-Inspired Model for Orientation-Dependent Contrast Perception: A Link with Wilson-Cowan Equations
Marcelo Bertalmio, Luca Calatroni, Valentina Franceschi, Benedetta Franceschiello, Dario Prandi
Scale Space and Variational Methods in Computer Vision, 2019, Springer International Publishing
- [7] Cortical-inspired image reconstruction via sub-Riemannian geometry and hypoelliptic diffusion
Boscain, Ugo, Chertovskih, Roman, Gauthier, Jean-Paul, Prandi, Dario, Remizov, Alexey
SMAI 2017 – ESAIM: ProcS 64 (2018), pp. 37–53, doi: [10.1051/proc/201864037](https://doi.org/10.1051/proc/201864037)
- [8] Image inpainting via a control-theoretical model of human vision
Ugo V. Boscain, Jean-Paul Gauthier, Dario Prandi
2018 14th IEEE International Conference on Control Automation (ICCA), 2018, doi: [10.1109/ICCA.2018.8444289](https://doi.org/10.1109/ICCA.2018.8444289)
- [9] Recent results on the essential self-adjointness of sub-Laplacians, with some remarks on the presence of characteristic points
Dario Prandi Valentina Franceschi, Luca Rizzi
Séminaire de Théorie spectrale et géométrie (Grenoble), 33, 2015-2016, doi: [10.5802/tsg.311](https://doi.org/10.5802/tsg.311)
- [10] Image processing in the semidiscrete group of rototranslations
Dario Prandi, Ugo Boscain, Jean-Paul Gauthier
Geometric science of information, 2015, Springer, Cham, doi: [10.1007/978-3-319-25040-3_67](https://doi.org/10.1007/978-3-319-25040-3_67)
- [11] Image reconstruction via non-isotropic diffusion in Dubins/Reed-Shepp-like control systems
U. Boscain, J. P. Gauthier, D. Prandi, A. Remizov
53rd IEEE Conference on Decision and Control, 2014, doi: [10.1109/CDC.2014.7040056](https://doi.org/10.1109/CDC.2014.7040056)

Preprints

- [1] Beyond ℓ_1 sparse coding in V1
Ilias Rentzeperis, Luca Calatroni, Laurent Perrinet, Dario Prandi
arXiv: [2301.10002](https://arxiv.org/abs/2301.10002) [q-bio.NC]
- [2] Horizontal magnetic fields and improved Hardy inequalities in the Heisenberg group
Biagio Cassano, Valentina Franceschi, David Krejcirik, Dario Prandi
arXiv: [2110.13775](https://arxiv.org/abs/2110.13775) [math.SP]
- [3] Weyl's law for singular Riemannian manifolds
Yacine Chitour, Dario Prandi, Luca Rizzi
arXiv: [1903.05639](https://arxiv.org/abs/1903.05639) [math.DG]
- [4] Generalized Fourier-Bessel operator and almost-periodic interpolation and approximation
J.-P. Gauthier, D. Prandi
arXiv: [1612.00056](https://arxiv.org/abs/1612.00056) [math.NA]

Talks in international conferences

- [1] On the decay rate for degenerate gradient flows subject to persistent excitation
Congrès SMAI 2021 - 10ième Biennale Française des Mathématiques Appliquées et Industrielles. La Grande Motte, France. 24 June 2021
- [2] On the essential self-adjointness of singular sub-Laplacians
Mini-workshop "Self-adjoint extensions in new settings", MFO, Oberröschach, Germany. 10 October 2019.
- [3] Weyl law for singular Laplace-Beltrami operators

Asymptotic Analysis & Spectral Theory, University Paris-Sud, Orsay, France. 02 October 2019.

- [4] Weyl law for singular Riemannian manifolds
EquaDiff2019, Leiden, The Netherlands. 08 July 2019.
- [5] Weyl law for singular Riemannian manifolds
Journées sous-riemanniennes, Grenoble, France. 16 October 2018.
- [6] Weyl law for singular elliptic operators
A sub-Riemannian day in Padova, Italy. 14 September 2018.
- [7] Cortical-inspired functional lifting for image inpainting
SIAM conference on Imaging Science, Bologna, Italy. 5 June 2018.
- [8] Anthropomorphic image reconstruction via sub-Riemannian geometry and hypoelliptic diffusion
Delays and constraints in distributed parameter systems, Gif-sur-Yvette, France. 24 November 2017.
- [9] Quantum confinement and spectral analysis of degenerate operators on Riemannian manifolds
VII Partial differential equations, optimal design and numerics, Benasque, Spain. 22 August 2017.
- [10] A variational formulation of the sub-Riemannian model of the primary visual cortex
Geometric Analysis in Control and Vision Theory, Voss, Norway. 11 May 2016.
- [11] Image processing in the semidiscrete group of rototranslations
2nd Conference on Geometric Science of Information, École Polytechnique. 20 October 2015.
- [12] A sub-Riemannian Santaló formula with applications to isoperimetric inequalities and Dirichlet spectral gap of hypoelliptic operators
PGMO Days 2015, ENSTA ParisTech, Palaiseau. 28 October 2015.
- [13] Self-adjointness of intrinsic diffusions in almost-Riemannian structures
Thematic day on Analysis and geometry of almost-Riemannian manifolds, IHP, Paris. 03 December 2014.
- [14] Intrinsic hypoelliptic diffusions in sub-Riemannian and almost-Riemannian geometry
Thematic day on Hypoelliptic diffusion: analysis and control, IHP, Paris. 06 November 2014.
- [15] Spectral properties and Aharonov-Bohm effect on Grushin-like structures
First International Joint Meeting, Bilbao, Spain. 02 July 2014.
- [16] The Laplace-Beltrami operator on conic and anti-conic surfaces
Geometry and Control, Steklov Institute, Moscow, Russia. 17 April 2014.
- [17] Heat and Schrödinger equation on conical and anticonical-type manifolds
Control of PDEs, CNAM, Paris. 02 April 2014.
- [18] Complexity in control-affine systems
Mathematical Control in Trieste, SISSA, Trieste, Italy. 05 December 2013.
- [19] Dynamics of a quantum particle on a conical-like surface
Conical Intersections in Mathematical Physics, IHP, Paris. 31 May 2013.
- [20] The Laplace-Beltrami operator on conic-type surfaces
Non Linear Control: Geometric Methods and Applications, Firenze, Italy. 19 April 2013

Other talks

- [1] Reproducing sensory induced visual hallucinations via neural fields
Imaging in Paris Seminar, IHP, Paris. 15 December 2022.
- [2] Reproducing sensory induced visual hallucinations via neural fields
Séminaire McTAO, INRIA Sophia-Antipolis. 25 May 2022.
- [3] A sub-Riemannian Santaló formula with applications to isoperimetric inequalities and Dirichlet spectral gap of hypoelliptic operators
Floris Takens Seminar, University of Groningen, Netherlands. 25 January 2022.
- [4] Cortical-inspired Wilson-Cowan-type equations for orientation-dependent contrast perception modelling
Université de l'Artois, Lens. 16 Decembre 2021.
- [5] On the regularity of abnormal minimizers for rank 2 sub-Riemannian structures
Moscow seminar on geometric theory of optimal control. 14 April 2021.

- [6] Point interactions for 3D sub-Laplacians
Oberseminar Analysis/Numerik, Universität Oldenburg. 14 January 2021.
- [7] Point interactions for 3D sub-Laplacians
Sub-riemannian international online seminar. 08 January 2021.
- [8] Self-adjointness e teoria spettrale per (sub-)laplaciani singolari
Seminario FIM, Università di Modena e Reggio Emilia, Italy. 25 January 2018.
- [9] Loi de Weyl avec reste et estimés du noyau de la chaleur sur variétés riemanniennes non-completes
Séminaire de Théorie spectrale et géométrie, Institut Fourier, Grenoble. 30 November 2017.
- [10] Sur le caractère auto-adjoint et la théorie spectrale des opérateurs de type Hörmander singuliers
Séminaire d'Analyse, Université de Tours. 09 November 2017.
- [11] Quantum confinement and spectral theory of (sub-)Laplacians
Séminaire de Géométrie sous-riemannienne, IHP, Paris. 04 October 2017.
- [12] Quantum confinement in non-complete Riemannian manifolds
25e colloque Jeunes Chercheurs Alain Bouyssy, Orsay, Paris. 02 March 2017.
- [13] Neuro-geometry of vision and applications to image processing
Seminario FIM, Università di Modena e Reggio Emilia, Italy. 11 February 2016.
- [14] A variational formulation of the sub-Riemannian model for the primary visual cortex
Séminaire "Analyse numérique et EDP", Université Paris Sud-Orsay. 26 November 2015.
- [15] Reconstruction and pattern recognition via the Citti-Petitot-Sarti model
Séminaire "Statistique et imagerie", Université Paris-Dauphine. 19 January 2015.
- [16] Complexity of control-affine motion planning
Séminaire de Théorie du Contrôle de Toulon, Université de Toulon. 30 January 2014.
- [17] The heat and Schrödinger equations on conic and anticonic-type
Gdt Problèmes spectraux et physique mathématique, Université Paris Sud-Orsay. 18 December 2013.
- [18] Complexity of control-affine motion planning
Séminaire de Géométrie sous-riemannienne, IHP, Paris. 02 October 2013.
- [19] The heat and Schrödinger equations on conic and anticonic-type surfaces
A geometry day in Bicocca, Milan, Italy. 27 September 2013.
- [20] Complexity in affine control systems
Journée GECO, UPMC, Paris. 25 June 2012.
- [21] Complexity in affine control systems
Functional Analysis sector's seminar, SISSA, Trieste, Italy. 19 April 2012.

Posters

- [1] Hardy-type inequalities and spectral bounds for hypoelliptic operators of Hörmander type
Contrôle des EDP et applications, CIRM, Marseille. 10 November 2015
- [2] Highly corrupted image inpainting through hypoelliptic diffusion
Workshop on Geometrical Models in Vision, IHP, Paris. 23 October 2014.

Languages

Mothertongue: **Italian**, Fluent: **English, French**