

# Dario Prandi

Charge de recherche CNRS at Université Paris-Saclay



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## 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.
- 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

- 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, UPMC, 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

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

## Supervision

- Ongoing PhD thesis supervision:
  - 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 8 “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](#)

### Peer-reviewed journals

- [1] Worst Exponential Decay Rate for Degenerate Gradient flows subject to persistent excitation  
Yacine Chitour, Paolo Mason, Dario Prandi  
*To appear on SIAM Journal on Control and Optimization* (2021), arXiv: [2006.02935](#) [math.OC]
- [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](#)
- [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](#)

- [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] An Auditory Cortex Model for Sound Processing  
Rand Asswad, Ugo Boscain, Giuseppina Turco, Dario Prandi, Ludovic Sacchelli  
*To appear on Geometric Science of Information*, 2021
- , [2] 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>
- [3] A bio-inspired geometric model for sound reconstruction (Extended Abstract)  
Ugo Boscain, Ludovic Sacchelli, Dario Prandi, Giuseppina Turco  
*20th IFAC World Congress*, 2020
- , [4] A Cortical-Inspired Model for Orientation-Dependent Contrast Perception: A Link with Wilson-Cowan Equations  
Marcelo Bertalmío, Luca Calatroni, Valentina Franceschi, Benedetta Franceschiello, Dario Prandi  
*Scale Space and Variational Methods in Computer Vision*, 2019, Springer International Publishing
- , [5] 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)
- [6] 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)

- [7] 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)
- [8] 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)
- [9] 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] 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]
- [2] Weyl's law for singular Riemannian manifolds  
Yacine Chitour, Dario Prandi, Luca Rizzi  
arXiv: [1903.05639](https://arxiv.org/abs/1903.05639) [math.DG]
- [3] 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 essential self-adjointness of singular sub-Laplacians  
Mini-workshop "Self-adjoint extensions in new settings", MFO, Oberwolfach, Germany. 10 October 2019.
- [2] Weyl law for singular Laplace-Beltrami operators  
Asymptotic Analysis & Spectral Theory, University Paris-Sud, Orsay, France. 02 October 2019.
- [3] Weyl law for singular Riemannian manifolds  
EquaDiff2019, Leiden, The Netherlands. 08 July 2019.
- [4] Weyl law for singular Riemannian manifolds  
Journées sous-riemanniennes, Grenoble, France. 16 October 2018.
- [5] Weyl law for singular elliptic operators  
A sub-Riemannian day in Padova, Italy. 14 September 2018.
- [6] Cortical-inspired functional lifting for image inpainting  
SIAM conference on Imaging Science, Bologna, Italy. 5 June 2018.
- [7] Anthropomorphic image reconstruction via sub-Riemannian geometry and hypoelliptic diffusion  
Delays and constraints in distributed parameter systems, Gif-sur-Yvette, France. 24 November 2017.
- [8] Quantum confinement and spectral analysis of degenerate operators on Riemannian manifolds  
VII Partial differential equations, optimal design and numerics, Benasque, Spain. 22 August 2017.
- [9] 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.
- [10] Image processing in the semidiscrete group of rototranslations  
2nd Conference on Geometric Science of Information, École Polytechnique. 20 October 2015.
- [11] 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.
- [12] Self-adjointness of intrinsic diffusions in almost-Riemannian structures  
Thematic day on Analysis and geometry of almost-Riemannian manifolds, IHP, Paris. 03 December 2014.
- [13] Intrinsic hypoelliptic diffusions in sub-Riemannian and almost-Riemannian geometry  
Thematic day on Hypoelliptic diffusion: analysis and control, IHP, Paris. 06 November 2014.

- [14] Spectral properties and Aharonov-Bohm effect on Grushin-like structures  
First International Joint Meeting, Bilbao, Spain. 02 July 2014.
- [15] The Laplace-Beltrami operator on conic and anti-conic surfaces  
Geometry and Control, Steklov Institute, Moscow, Russia. 17 April 2014.
- [16] Heat and Schrödinger equation on conical and anticonical-type manifolds  
Control of PDEs, CNAM, Paris. 02 April 2014.
- [17] Complexity in control-affine systems  
Mathematical Control in Trieste, SISSA, Trieste, Italy. 05 December 2013.
- [18] Dynamics of a quantum particle on a conical-like surface  
Conical Intersections in Mathematical Physics, IHP, Paris. 31 May 2013.
- [19] The Laplace-Beltrami operator on conic-type surfaces  
Non Linear Control: Geometric Methods and Applications, Firenze, Italy. 19 April 2013

## Other talks

- [1] On the regularity of abnormal minimizers for rank 2 sub-Riemannian structures  
Moscow seminar on geometric theory of optimal control. 14 April 2021.
- [2] Point interactions for 3D sub-Laplacians  
Oberseminar Analysis/Numerik, Universität Oldenburg. 14 January 2021.
- [3] Point interactions for 3D sub-Laplacians  
Sub-riemannian international online seminar. 08 January 2021.
- [4] Self-adjointness e teoria spettrale per (sub-)laplaciani singolari  
Seminario FIM, Università di Modena e Reggio Emilia, Italy. 25 January 2018.
- [5] 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.
- [6] Sur le caractère auto-adjoint et la théorie spectrale des opérateurs de type Hörmander singuliers  
Séminaire d'Analyse, Université de Tours. 09 November 2017.
- [7] Quantum confinement and spectral theory of (sub-)Laplacians  
Séminaire de Géométrie sous-riemannienne, IHP, Paris. 04 October 2017.
- [8] Quantum confinement in non-complete Riemannian manifolds  
25e colloque Jeunes Chercheurs Alain Bouyssy, Orsay, Paris. 02 March 2017.
- [9] Neuro-geometry of vision and applications to image processing  
Seminario FIM, Università di Modena e Reggio Emilia, Italy. 11 February 2016.
- [10] 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.
- [11] Reconstruction and pattern recognition via the Citti-Petitot-Sarti model  
Séminaire "Statistique et imagerie", Université Paris-Dauphine. 19 January 2015.
- [12] Complexity of control-affine motion planning  
Séminaire de Théorie du Contrôle de Toulon, Université de Toulon. 30 January 2014.
- [13] The heat and Schrödinger equations on conic and anticonic-type  
Gdt Problèmes spectraux et physique mathématique, Université Paris Sud-Orsay. 18 December 2013.
- [14] Complexity of control-affine motion planning  
Séminaire de Géométrie sous-riemannienne, IHP, Paris. 02 October 2013.
- [15] The heat and Schrödinger equations on conic and anticonic-type surfaces  
A geometry day in Bicocca, Milan, Italy. 27 September 2013.
- [16] Complexity in affine control systems  
Journée GECO, UPMC, Paris. 25 June 2012.
- [17] 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**