

# FRANCESCA CARLOTTA CHITTARO

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## Professional address

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## Personal Data

Date of birth: September 2nd, 1979  
Birthplace: Ovada (AL), Italy  
Citizenship: Italian

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## 1 Curriculum Vitæ

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### 1.1 Present occupation

- Since September 2012: Maître de conférences (*Assistant Professor*) at IUT- Université de Toulon (France). Promoted to *Hors Classe* in September, 2022.

### 1.2 Post-doc fellowships

- October 2011 - August 2012: ATER (*research and teaching fellow*) at IUT- Université de Toulon (France). Scientific Advisor: Prof. J.-P. Gauthier.
- May-October 2011: post-doc fellowship at the Centre des Mathématiques Appliquées (CMAP) of École Polytechnique, Palaiseau (France). Scientific Advisor: Prof. Y. Chitour.
- November 2009 - May 2011: post-doc fellowship at the Laboratoire des signaux et systèmes (L2S), Supélec, Gif-sur-Yvette (France). Scientific Advisor: Prof. Y. Chitour.
- November 2007 - October 2009: post-doc fellowship (*assegno di ricerca*), Dipartimento di Matematica Applicata "G. Sansone", Università di Firenze, Italy. Scientific Advisor: Prof. G. Stefani.

### 1.3 Education

#### HDR in Mathematics

**Defense:** December 4th, 2018;

**Referees:** Prof. Claudio Altafini (Linköping University, Sweden), Prof. J.-B. Caillaud (Université de Nice- Côte d'Azur, France), Prof. A. Sarychev (Università di Firenze, Italy);

**Title of the Thesis:** *Méthodes géométriques en contrôle optimal et contrôle quantique.*

## PhD in Mathematics

November 2003 - October 2007 : PhD in Mathematics at SISSA/ISAS (sector of Functional Analysis and Applications), Trieste, Italy, with fellowship.

**Defense:** October 25th, 2007;

**Supervisor:** Prof. A. A. Agrachev (SISSA/ISAS, and Steklov Institut of Mathematics, Moscow, Russia);

**Referees:** Prof. L. Rifford (Université de Nice, France), Prof. A. Sarychev (Università di Firenze, Italy);

**Title of the Thesis:** *Hyberbolicity and Curvature in Dynamics and Control.*

## Degree

Degree in Theoretical Physics, Università degli Studi di Trieste, Italy.

**Defense:** September 29th, 2003

**Mark:** 110/110 cum laude.

**Supervisor:** Dr. Fabio Benatti (Università di Trieste);

**Title of the Thesis:** *Entropia dinamica in sistemi discreti con noise (Dynamical entropy in discrete systems with noise).*

## 1.4 Habilitations

**Abilitazione scientifica nazionale, SSD 01/A3 (Analisi Matematica, Probabilità e Statistica Matematica)**, (valid from 09/11/2020 to 09/11/2031)

**Abilitazione scientifica nazionale, SSD 01/A4 (Fisica Matematica)**, (valid from 09/11/2020 to 09/11/2031)

**Qualification aux fonctions de professeur des universités Section 25: Mathématiques**, n°19125330781 campagne de qualification 2018-2019

**Qualification aux fonctions de professeur des universités Section 26: Mathématiques Appliquées et applications des Mathématiques**, n°19126330781 campagne de qualification 2018-2019

## 1.5 Languages

Italian, English, French.

## 1.6 Prizes

Recipient of the PEDR, 2019-2023.

Recipient of RIPEC for scientific activity, 2023-2025.

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## 2 Scientific Activity

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**Keywords:** Geometric control theory, optimal control, quantum control, dynamical systems.

### 2.1 Talks

#### 2.1.1 Invited talks in conferences and workshops

- November 18th, 2021, Journée contrôle optimal et applications, Université d'Avignon, Avignon, France. Talk: *Optimality conditions for generalized  $L^1$  Optimal Control Problems*
- June 4th, 2021, Incontri di Analisi Matematica tra Firenze, Pisa e Siena, Florence, Italy. Talk: *Hamiltonian approach to sufficient optimality conditions*
- November, 8th-9th, 2018, Workshop on dynamical systems, calculus of variations and control, Florence, Italy. Talk: *Sub-Finsler geometry for three dimensional contact structures.*
- July, 1st-6th, 2018, International Symposium on mathematical programming, Bordeaux, France. Talk: *Strong local optimality for generalised  $L^1$  optimal control problems.*
- December, 8th-12th, 2016, International Conference on Geometric Analysis and Control Theory, Sobolev Institute of Mathematics, Novosibirsk, Russia. Talk: *Asymptotic ensemble stabilizability of the Bloch equation.*
- March, 9th-11th, 2015, Journées bisontines sur le contrôle quantique : systèmes d'EDPs et applications à l'IRM , LMB, Université de Franche Comté, Besançon. Talk: *Ensemble stabilizability for two-level quantum systems.*
- October 28th-30th, 2013, Journées scientifiques du Laboratoire LAROMAD, University of Tizi-Ouzou, Algeria. Talk: *Conditions suffisantes pour l'optimalité des extremaux singulières pour le problème du temps minimum.*
- April 18th–19th, 2013, Conference on Non Linear Control: Geometric Methods and Applications, Florence, Italy. Talk: *Minimum-time strong optimality of a singular arc: the multi-input non-involutive case.*
- January 31st–February 2nd, 2012, Workshop on Geometric Control for PDE's-GCPDES-2012, Beirut, Lebanon. Talk: *Quantum control via Adiabatic Theory.*
- September 12th–16th, 2011, 25th IFIP Conference on System Modeling and Optimization, Berlin, Germany. Talk: *Sufficient second order conditions for multi-input singular extremals.*
- April 3rd–8th, 2011, BIRS Workshop on Quantum Control, Banff, Canada. Talk: *Quantum control via Adiabatic Theory.*

### 2.1.2 Invited Seminars

- October 4th, 2023, LAAS-CNRS, Toulouse, *On the strong local optimality for state-constrained control-affine problems*
- April 7th, 2022, Laboratoire Paul Painlevé - Université de Lille, *Hamiltonian approach to sufficient optimality conditions*
- June 4th, 2021, seminario di Equazioni Differenziali, Università di Roma Tor Vergata, Rome, Italy. Talk: *Hamiltonian approach to sufficient optimality conditions*
- April 2nd, 2019, IRMA - Université de Strasbourg, *On the genericity of conical intersections for controlled Hamiltonians*
- February 6th, 2019, IMB - Université de Dijon, *Asymptotic ensemble stabilizability of the Bloch equation*
- May 22nd, 2018, Università degli Studi di Firenze, *Asymptotic ensemble stabilizability of the Bloch equation*
- December 17th, 2014, Seminars MODANT of Laboratoire Jean Kuntzmann, Université Joseph Fourier, Grenoble, *Control design for quantum systems.*
- June 23rd, 2014, Groupe de Travail en Physique Mathématique de Toulon, *Contrôle adiabatique de l'Équation de Schrödinger via intersections coniques des valeurs propres.*
- April, 4th, 2013, IMATH- Université du Sud Toulon-Var, *Minimum-time strong optimality of a singular arc: the multi-input non-involutive case.*
- December 20th, 2010, Université de Florence, Italie, *Modelli di Controllo Ottimo per la locomozione umana.*
- November 29th, 2007, Université de Nice, *Smooth optimal synthesis for infinite horizon variational problems.*

### 2.1.3 Contributed talks in conferences and workshops

- December, 12th-15th, 2017 56th IEEE Conference on Decision and Control, Melbourne, Australia. Talk: *Optimality Conditions for Extremals Containing Bang and Inactivated Arcs.*
- April, 3rd-5th, 2017, TUM-IAS Workshop on Quantum Control Theory: Mathematical Aspects and Physical Applications, TUM, Munich, Germany. Talk: *Asymptotic ensemble stabilizability of the Bloch equation.*
- December, 15th-18th, 2015 54th IEEE Conference on Decision and Control, Osaka, Japan. Talk: *Approximate controllability by adiabatic methods of the Schrödinger equation with nonlinear Hamiltonian.*
- December, 10th-13th, 2013 52nd IEEE Conference on Decision and Control, Florence, Italy. Talk: *Minimum-time strong optimality of a singular arc: extended Dubins Problem.*
- May 29th-31st, 2013, Workshop on Conical intersections in Mathematical Physics, IHP, Paris, France. Talk: *Geometry of conical intersections: constructive methods for adiabatic control.*
- June 29th-July 4th 2012, International Conference on Differential Equations and Dynamical Systems, Suzdal, Russian Federation. Talk: *Optimal control problems for the human locomotion: stability and robustness of minimizers.*

- December 8th–11th, 2010, Workshop on Quantum Control, IHP, Paris, France. Talk: *Quantum Control via Adiabatic Theory and intersection of eigenvalues*.
- October 24th–28th, 2010, Workshop on Nonlinear Control and Singularities, Porquerolles, France. Talk: *Quantum Control via Adiabatic Theory*.
- April 20th–21st, 2009, Meeting on Mathematical Control Theory: Controllability, Optimization, Stability (PRIN 2006), Turin, Italy. Talk: *Estremali singolari per problemi di tempo minimo con controlli vettoriali: una condizione sufficiente*.
- June 17th–22nd, 2008, International Conference on Differential Equations and Topology, Moscow, Russian Federation. Talk: *Optimal synthesis in infinite horizon problems*.
- May 30th–June 1st, 2007, Workshop on Control, Optimization and Stability di Non-linear Systems: Geometric and Analytic Methods, SISSA-ISAS, Trieste, Italy. Talk: *On the optimal synthesis for infinite horizon variational problems*.

## 2.2 Publications

### 2.2.1 Journals

1. F. C. Chittaro, L. Poggiolini, *On the strong local optimality for state-constrained control-affine problems*, Nonlinear Differential Equations and Applications NoDEA, 30, 60 (2023).
2. F. Harrache, F. C. Chittaro, M. Aidène. *Local  $L^1$  Sub-Finsler geometry in dimension 3: non-generic cases.*, J. Dynamical and Control Systems (2023).
3. V. Dutto, A. Choux, F. Chittaro, E. Busvelle, J.-P. Gauthier. *An estimation method of surface defects of LMJ microshells* Fusion Science and Technology Volume 78, 2022 - Issue 1 (2022).
4. F. C. Chittaro, L. Poggiolini, *Singular extremals in  $L^1$  optimal control problems: sufficient optimality conditions* ESAIM-COCV, 99 (2020).
5. F. C. Chittaro, P. Mason, *On the conicity of eigenvalues intersections for parameter-dependent self-adjoint operators* J. Math. Phys. 61, 053503 (2020)
6. F. Chittaro, L. Poggiolini *Strong local optimality for generalized  $L^1$  optimal control problems*, JOTA, 2018.
7. F. C. Chittaro, J.-P. Gauthier *Asymptotic ensemble stabilizability of the Bloch equation*, Syst. Contr. Lett., (2018), 113, 36–44.
8. F. C. Chittaro, P. Mason *Approximate controllability via adiabatic techniques for the three-inputs controlled Schrödinger equation*, SIAM J. Control Optim., (2017), 55(6), 4202–4226
9. R. Azouit, F. Chittaro, A. Sarlette, P. Rouchon *Towards generic adiabatic elimination for bipartite open quantum systems* Quantum Science and Technology, (2017) 2, No. 4
10. F. C. Chittaro, G. Stefani *Minimum-time strong optimality of a singular arc: the multi-input non involutive case* ESAIM-COCV, (2016), 22, No. 3, 786–810
11. F. Jean, P. Mason, F. C. Chittaro *On the inverse optimal control problems of the human locomotion: stability and robustness of the minimizers*, Journal of Mathematical Sciences, (2014) 195, 3 269–287
12. U. Boscain, F. C. Chittaro, P. Mason, M. Sigalotti *Quantum Control via Adiabatic Theory and intersection of eigenvalues*, IEEE-TAC, (2012) vol 57, n. 8, 1970–1983.

13. F. C. Chittaro, G. Stefani *Singular extremals in multi-input time-optimal problem: a sufficient condition*, Control and Cybernetics, (2010) **39**, No. 4, 1029–1068.
14. A. A. Agrachev, F. C. Chittaro *Smooth Optimal Synthesis for infinite horizon variational problems*, ESAIM-COCV, (2009), **1**, 173–188.
15. F. C. Chittaro *An estimate for the entropy of Hamiltonian flows*, J. Dynamical and Control Systems, (2007), **13**, 55–67.

### 2.2.2 Proceedings and conference papers

1. K. Verzhanska, F. C. Chittaro *Indirect Controllability of Two Interacting Qubits in Presence of Dissipation: A First Analysis*, 10th International Conference on Systems and Control (ICSC)
2. F. C. Chittaro, L. Poggiolini *Optimality Conditions for Extremals Containing Bang and Inactivated Arcs*, 56th IEEE Conference on Decision and Control, CDC 2017, Melbourne, Australia, December 2017
3. R. Azouit, F. Chittaro, A. Sarlette, P. Rouchon *Structure-preserving adiabatic elimination for open bipartite quantum systems* 20th IFAC World Congress, Toulouse, France, July 2017
4. F. C. Chittaro, P. Mason *Approximate controllability by adiabatic methods of the Schrödinger equation with nonlinear Hamiltonian*, 54th IEEE Conference on Decision and Control, CDC 2015, Osaka, Japan, December 2015
5. F. C. Chittaro, G. Stefani *Minimum-time strong optimality of a singular arc : extended Dubins problem* 52nd IEEE Conference on Decision and Control, CDC 2013, Firenze, Italy, December 2013
6. F. Jean, P. Mason and F. C. Chittaro *Geometric modeling of the movement based on an inverse optimal control approach* 52nd IEEE Conference on Decision and Control, CDC 2013, Firenze, Italy, December 2013
7. U. Boscain, F. C. Chittaro, P. Mason, R. and M. Sigalotti *Controllability of the Schrödinger equation via adiabatic methods and conical intersections of the eigenvalues*, 51st IEEE Conference on Decision and Control, CDC 2012, Maui, Hawaii - USA, December 2012
8. U. Boscain, F. C. Chittaro, P. Mason, R. Pacqueau and M. Sigalotti *Motion planning in quantum control via intersection of eigenvalues*, 49th IEEE Conference on Decision and Control, CDC 2010, Atlanta, USA, December 2010
9. Y. Chitour, F. Jean, P. Mason and F. C. Chittaro *Analysis of optimal control models for the human locomotion*, 49th IEEE Conference on Decision and Control, CDC 2010, Atlanta, USA, December 2010

### 2.2.3 Chapters

1. A. A. Agrachev, F. C. Chittaro *Extremals flows and infinite horizon optimization*, in *Mathematical Control Theory and Finance*, A. Sarychev A. Shiraev M. Guerra and M. do Rosário-Grossinho Eds., Springer-Verlag.

## 2.3 Student supervision

### 2.3.1 Master students

1. Toufeyili Mhoma, student of the Master 2 *Mathématiques Spé. Optimisation et Physique Mathématique* of Université de Toulon. Title of the manuscript: *Contrôlabilité de l'équation de Schrödinger bilinéaire*. (academic year 2014-2015)

2. Tetiana Klymchuk, student of the Master 2 *Mathématiques Spé. Optimisation et Physique Mathématique* of Université de Toulon. Title of the manuscript: *How many are multiple eigenvalues ?*. (academic year 2014-2015)
3. Dani Hammad, student of the Master 2 *Differential Geometry* of Lebanese University, Beirut. Co-supervision with Ali Wehbe and Amina Mortada. Title of the manuscript: *Sub-Finsler problem for Heisenberg distribution : the  $L^1$  norm*. (academic year 2015-2016)
4. Marwan Hariz, student of the Master 2 *Differential Geometry* of Lebanese University, Beirut. Co-supervision with Amina Mortada. Title of the manuscript: *Controllability of an ensemble of inverted pendula*. (academic year 2016-2017)
5. Mohamed Ousseine, student of the Master 2 *Mathématiques Spé. Optimisation et Physique Mathématique* of Université de Toulon. Title of the manuscript: *Régularité des vecteurs propres en présence d'intersections de valeurs propres*. (academic year 2018-2019)
6. Mohamed M'Madi, student of the Master 2 *Mathématiques Spé. Optimisation et Physique Mathématique* of Université de Toulon. Title of the manuscript: *Le grand Théorème de Picard*. (academic year 2018-2019)

### 2.3.2 PhD students

- (since october 2020) Kateryna Verzhanska, PhD student at Université de Toulon. Subject: *Contrôlabilité en temps zéro des systèmes quantiques*.
- October 2015-Mai 2022 Fazia Harrache, PhD student of Université Mouloud Mammeri, Tizi-Ouzou (Algeria) and Université de Toulon. Co-supervision with Mohamed Aidène (Université Mouloud Mammeri) and Jean-Paul Gauthier (Université de Toulon). Subject: *Sub-Finsler metrics in dimension 3*.  
PhD Thesis defended on Mai 18th, 2022.
- May 2017-November 2018 Vincent Dutto, PhD student of Université de Toulon. Co-supervision with Eric Busvelle (Université de Toulon) and Alexandre Choux (CEA). Subject: *Étude et développement d'un modèle mathématique pour la mesure et l'analyse par radiographie, des défauts géométriques de surface de microballons nécessaires aux expériences sur les laser de puissance*.  
PhD Thesis defended on November 18th, 2018.

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## 3 Administrative and teaching activity

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### 3.1 Administrative activity

- since January, 1st, 2024: adjoint head (*directrice adjointe*) of LIS.
- 2018-2023 Co-leader of the Pole *Analyse et contrôle des systèmes* of the laboratory LIS
- Organizer of workshops, seminars and conferences:
  - ★ international coordinator and member of the scientific committee of the school *CIMPA School on "Optimal control and applications in engineering"* Arba Minch (Ethiopia), March 19th– April 8th 2021 <https://cimpa.lis-lab.fr/>
  - ★ international coordinator and member of the scientific committee of the school *École de recherche CIMPA 2020 & Workshop "Optimal control and its applications in economics, engineering and the environment"* Rabat (Morocco), initially organised for July, 6th–17th 2020, postponed to July 2021 because of COVID19 <https://cimparabat.enim.ac.ma/>
  - ★ 2018–2021 Organizer of the Séminaire d'Analyse et des Systèmes of the laboratory LIS
  - ★ Organizer of the double session *Optimality conditions for control problems*, 58th IEEE Conference on Decision and Control, CDC 2019, Nice, France, december 2019
  - ★ Main Organizer (with L. Poggolini) of the *Workshop on Mathematical Control Theory - with a special session in honor of Gianna Stefani*, Porquerolles (France), June, 27th–30th, 2017. <http://mct.univ-tln.fr/>
  - ★ (since 2013) Organizer of the Séminaire de Théorie de Contrôle de Toulon. <http://www.lsis.org/seminaire-theoriecontrol/>
  - ★ Organizer of the *Workshop on Nonholonomic Mechanics and Geometric Control Theory*, IHP, Paris, November, 25th-28th, 2014. <http://nholmech-goc.lsis.org/>
  - ★ Organizer of the *Workshop on Geometrical Models in Vision*, IHP, Paris, 22nd-24th, 2014. <http://gmvision.lsis.org/>
  - ★ Organizer of the session *New trends in Control Systems*, 52nd IEEE Conference on Decision and Control, CDC 2013, Florence, Italy, december 2013
  - ★ Organizer of the international conference "BIO Inspired Optimal Systems", Toulon, 9th-10th April 2013. <http://glotin.univ-tln.fr/bio2s>
  - ★ Organizer of the *Workshop on Quantum Control*, IHP, Parigi (France), December 8th-11th, 2010. <http://www.cmapx.polytechnique.fr/~boscain/quantum-control.html>
- Participation to Scientific Committees
  - ★ Member of the committee for the PhD defense of Vartan Martikyan, Université de Bourgogne-Franche-Comté, december 2021.



- ★ Member of the committee for the PhD defense of Benoit Bonnet, Aix-Marseille Université, october 2019.
- ★ Member of the committee for the PhD defense of Nicolas Augier, École Polytechnique, september 2019.
- ★ Member of the committee for the PhD defense of Michaël Orioux, Université de Paris Dauphine, november 2018.
- ★ Member of the committee for the PhD defense of Vincent Dutto, Université de Toulon, november 2018.
- ★ Member of the committee for the PhD defense of Ouazna Oukacha, Université de Toulon, november 2017.
- ★ Member of the committee for the PhD defense of Marc-Aurèle Lagache, Université de Toulon, october 2017.
- Participation to research projects
  - ★ ANR DisQC *Calcul Quantique Distribué : Algorithmes et Implémentations* (ANR appel à projets générique 2022) (coordinator: Pr. Giuseppe Di Molfetta)
  - ★ ANR QUACO *Quantum Control: PDE systems and MRI applications* (ANR appel à projets générique 2017) (coordinator : Dr. T. Chambrion)
  - ★ Project *Partenariat Hubert Curien - Tassili 2015 PHC15MDU941 – Critères non-lisses en contrôle optimal* (coordinator : Pr. J.-P. Gauthier)
  - ★ PEPS CoMoMo (2010) *Contrôle et Modélisation de la Motricité* (coordinator : Dr. P. Mason)
  - ★ PRIN 2008 (National Interest Research Projects) project *Metodi geometrici per dinamica controllate e applicazioni (Geometrical Methods for controlled dynamics and applications)* (national coordinator: Prof. A. A. Agrachev).
  - ★ PRIN 2006 (National Interest Research Projects) projet *Teoria Matematica del Controllo: Controlabilità, Ottimizzazione, Stabilità (Mathematical Theory of Control: Controlability, Optimisation, Stability)* (national coordinator: Prof. A. A. Agrachev).

### 3.2 Teaching activity

In charge of courses of Automatic Control (exercise and lab sessions) and Applied Mathematics at IUT (*Institut Universitaire de Technologie*) of Toulon, Dep. GEII.

I also made the following interventions:

- Università degli Studi di Firenze (Italy), Faculty of Civil Engineering - exercise lectures (20 hours) in Calculus of function of several variables (in charge of the course: Prof. G. Stefani), and Faculty of Mechanical Engineering: exercise lectures (10 hours) in Calculus of function of several variables (in charge of the course: Prof. G. Anichini), academic year 2008-2009.
- *Master Image & Systèmes - spécialité SIS*, University of Marseille, **Optimal Control** (in charge of the course: Prof. N. M'Sirdi) , (8 hours) , academic years 2012-2013 and 2013-2014.

and I was in charge of the following courses:

- Polytech' Marseille, Diploma *Ingénieur Génie Industriel et Informatique* (5th year), **Optimal Control** (28 hours), academic year 2014-2015.

- Lebanese University (Lebanon), Master 2 in *Differential Geometry*, **Geometric Optimal Control** (14 hours), academic years 2015-2016, 2016-2017 and 2017-2018.
- Université de Toulon, Master 2 *Physique et Sciences de l'Ingénieur Spé. Vision Commande (VC)*, **Planification des trajectoires en robotique** (22 hours), academic year 2016-2017 and 2017-2018.
- Université de Toulon, Master 2 *Ingénierie des Systèmes Complexes - parcours Robotique et Objets Connectés (ROC)*, **Contrôle en robotique et planification**, (28 hours) since academic year 2018-2019.
- Université de Toulon, Master 2 *Mathématiques Spé. Optimisation et Physique Mathématique*, **Contrôle Géométrique**, (20 hours), academic years 2019-2020, 2020-2021 and 2021-2022.
- Arba Minch University (Ethiopia), *CIMPA graduate course*, **Introduction to Control Theory**, (25 hours) academic years 2018-2019 and 2019-2020.
- Université de Toulon, École Doctorale *Mer et Sciences*, **Introduction à l'Optimisation**, (8 hours), academic year 2018-2019 and 2020-2021.
- Università degli Studi di Firenze (Italy), *PhD in Mathematics, Computer Science, Statistics*, **Geometric Control Theory and introduction to sub-Riemannian Geometry** (22 hours) academic year 2018-2019.