Curriculum vitae

Name: BEAUCHARD
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born 27/11/1978
French
married
2 children, born 2008 and 2011

Contents

1 Short bio

I defended my PhD thesis in December 2005 and I was appointed **junior researcher at CNRS** in September 2006, in ENS Cachan. I defended my habilitation thesis in November 2010 and I moved to Ecole Polytechnique (2011-2014), where I taught 4 years (2010-2014). I was appointed **full professor at ENS Rennes** in September 2014, where I have been the head of the mathematics department since September 2018.

I taught the **'Cours Peccot' at Collège de France** in 2008 , I received the scientific excellence bonus (PES/PEDR) from 2011 and the **Michel Montpetit prize from Académie des Sciences** in 2017. I have been **junior member of Institut Universitaire de France** since 2018.

I was advisor of 4 PhD (3 defended, 1 under progress) and 1 post-doc. I led an ANR funded project (2012-2015), and a CNRS research group (GDR, 2014-2017). I was invited to deliver talks or mini-courses in 43 international conferences. I am associate editor in 4 international journals. I organized 3 international conferences and 4 workshops.

My research activities concern analysis and control of partial differential equations, related to various application fields like quantum mechanics or fluid mechanics. More precisely, I got specialized in :

- bilinear control systems related to quantum control problems: exact controllability, approximate controllability and feedback stabilization of Schrödinger and Bloch equations; here the nonlinearity of the control system is the main difficulty,
- null controllability of degenerate parabolic equations of hypoelliptic type (Grushin, Kolmogorov, Heisenberg, Ornstein- Uhlenbeck equations); here, the main difficulties are the ineffectiveness of usual parabolic techniques (Carleman estimates) and the appearance of hyperbolic effects such as minimal control time and geometric condition,
- inverse problems: stability estimates, design and convergence of asymptotic observers for industrial applications,
- interaction between geometry (Lie brackets structure) and analysis in the control of ordinary differential equations, and its generalization to partial differential equations.

To answer these questions, a thorough analysis of the equation is required. It often leads to profound results about its well posedness and its dynamics, that can be useful for other purposes.

The references **[Aj, Pj, Procj,Oj]** below refer to my publication list in Section 3.1.

I started my career by studying, during my PhD, bilinear control problems for the Schrödinger equation. In this framework, I proved the first positive exact controllability result in 2005, by means of the Nash-Moser theorem, to deal with an apparent loss of regularity **[A1]**. In 2010, with Camille Laurent, I proved an unexpected smoothing effect that allows to obtain the same result via the classical inverse mapping theorem **[A11]**. Along my career, I solved other problems (approximate controllability, feedback stabilization, minimal time) for other equations modeling quantum systems (Bloch equation, Schrödinger-Poisson system) **[A1–6, 9–13, 15, 16, 18, 22, 24, 27, 28, 32, O1]**.

When I was hired as a junior researcher at CNRS, I started working on degenerate parabolic equations of hypoelliptic type **[A8]**. In 2010, with Piermarco Cannarsa and Roberto Guglielimi, I proved the first result emphasizing an hyperbolic behavior of these equations, precisely, the requirement of a minimal time for the null controllability of the Grushin equation **[A17]**. Then, I extended this study to other hypoelliptic equations: Kolmogorov, Heisenberg, Ornstein-Uhlenbeck **[A19, 20,**

23, 25, 26, 29, 30, 33, 36, P1 Proc4–5]. I am interested, in general, in the analysis of systems mixing transport with dissipation **[A14]** or diffusion **[A35]**.

In parallel, I studied several inverse problems for industrial problems **[A21, Proc2, Proc3]**. I am one of the 5 inventors of a patent filed by a start-up, about inertial data fusion.

More recently, with Frederic Marbach, I worked on the interaction between geometry (Lie brackets structure) and analysis in the control of ordinary differential equations. In 2018, I proved a complete classification of the quadratic obstructions to small time local controllability in finite dimension **[A31]**, and unexpected quadratic behaviors in infinite dimension **[34]**.

1.1 Description of the article [A11]

"**[A11]** K. Beauchard and C. Laurent,
Local controllability of linear and nonlinear Schrödinger equations with bilinear control,
Journal de Mathématiques Pures et Appliquées, vol. 94, n. 5, pages 520-554, November 2010."

We consider a linear Schrödinger equation, on a bounded interval, with a bilinear control u , that represents a quantum particle in an electric field (the control)

$$\left\{ \begin{array}{ll} (i\partial_t + \partial_x^2)\psi(t,x) = u(t)\mu(x)\psi(t,x)\,, & x \in (0,1) \\ \psi(t,0) = \psi(t,1) = 0\,, & \\ \psi(0,.) = \psi_0 \in \mathcal{S}\,. & \end{array} \right. \tag{1}$$

The state $\psi(t,.)$ lives in the $L^2((0,1),\mathbb{C})$-sphere $\mathcal{S}$. Let $-\Delta_D$ be the Dirichlet-Laplacian on $(0,1)$: $D(-\Delta_D) = H^2 \cap H_0^1((0,1),\mathbb{C})$ and $(-\Delta_D)\varphi = -\varphi''$.

We prove the exact controllability of this system, in any positive time, locally around the ground state $\psi_1(t,x) = \sqrt{2}\sin(\pi x)e^{-i\pi^2 t}$, in an appropriate spaces. Precisely, for every $T > 0$, there exists $\delta > 0$ such that, for every $\psi_0, \psi_f \in D((-\Delta_D)^{3/2}) \cap \mathcal{S}$ with $\|\psi_0 - \psi_1(0)\|_{H^3} < \delta$, $\|\psi_f - \psi_1(T)\|_{H^3} < \delta$, there exists $u \in L^2((0,T),\mathbb{R})$ such that the solution of (1) satisfies $\psi(T,.) = \psi_f$.

I had previously proved similar results, for particular functions μ, in non-optimal spaces (H^7 instead of H^3), in long time T and the proof relied on the Nash-Moser implicit function theorem in order to deal with an a priori loss of regularity (see **[A1, A2, A4]**). In this article, the model is more general, the spaces are optimal, there is no restriction on the time and the proof relies on the classical inverse mapping theorem. A hidden regularizing effect is emphasized, showing there is actually no loss of regularity.

Then, the same strategy is applied to nonlinear Schrödinger equations and nonlinear wave equations, showing that the method works for a wide range of bilinear control systems.

1.2 Description of the article [A14]

"**[A14]** K. Beauchard and E. Zuazua,
Large time asymptotics for partially dissipative hyperbolic systems,
Archive for Rational Mechanics and Analysis, vol. 199, pp. 177-227, 2011."

This work is concerned with (n-component) hyperbolic systems of balance laws in m space dimensions. First, we consider linear systems with constant coefficients and analyze the possible behavior of solutions as t goes to infinity. Using the Fourier transform, we examine the role that control theoretical tools, such as the classical Kalman rank condition, play. We build Lyapunov functionals allowing us to establish explicit decay rates depending on the frequency variable. In this way we extend the previous analysis by Shizuta and Kawashima under the so-called algebraic condition (SK). In particular, we show the existence of systems exhibiting more complex behavior than the one that the (SK) condition allows. We also discuss links between this analysis and previous literature in the context of damped wave equations, hypoellipticity and hypocoercivity. To conclude, we analyze the existence of global solutions around constant equilibria for nonlinear systems of balance laws. Our analysis of the linear case allows proving existence results in situations that the previously existing theory does not cover.

1.3 Description of the article [A17]

"**[A17]** K. Beauchard, P. Cannarsa and R. Guglielmi,
Some controllability results for the 2D Grushin equations,
Journal of the European Mathematical Society, vol. 16, no. 1, p. 67-101, 2014. "

We study the null controllability of the parabolic equation associated with the Grushin-type operator in the rectangle $\Omega = (-1,1) \times (0,1)$, under an additive control u supported in an open subset ω of $(0,1) \times (0,1)$.

$$\begin{cases} (\partial_t - \partial_x^2 - |x|^{2\gamma}\partial_y^2)f(t,x,y) = u(t,x,y)1_\omega(x,y)\,, & (x,y) \in \Omega\,, \\ f(t,x,y) = 0\,, & (x,y) \in \partial\Omega\,, \\ f(0,x,y) = f_0(x,y)\,, \end{cases} \tag{2}$$

where $\gamma > 0$. We prove that the equation is null controllable in any positive time T for $\gamma < 1$ and that there is no time for which it is null controllable for $\gamma > 1$. In the transition regime $\gamma = 1$ and when ω is a vertical strip $\omega = (a,b) \times (0,1)$ with $0 < a < b < 1$, a positive minimal time $T_{min} \geqslant \frac{a^2}{2}$ is required for null controllability. Our approach is based on the fact that, thanks to the particular geometric configuration of Ω , null controllability is closely linked to the one-dimensional observability of the Fourier components of the solution of the adjoint system, uniformly with respect to the Fourier frequency.

1.4 Description of the articles [A31, A34]

"**[A31]** K. Beauchard, F. Marbach,
Quadratic obstructions to small time local controllability for scalar-input systems,
J. Differential Equations, 264(5):3704-3774, 2018."

"**[A34]** K. Beauchard, F. Marbach
Unexpected quadratic behaviors for the small-time local null controllability of scalar-input parabolic equations,
Journal de Mathématiques Pures et Appliquées, to appear, arXiv 1712.09790 "

Let us consider an affine control system with state $x(t) \in \mathbb{R}^n$ at time $t \in [0,T]$, whose evolution is described by the ODE

$$\dot{x} = f_0(x) + uf_1(x) \tag{3}$$

where $f_0, f_1 \in C^1(\mathbb{R}^n, \mathbb{R}^n)$, $f_0(0) = 0$ and $u : [0,T] \to \mathbb{R}$ is the control. A **key question** in control theory, is that of the *small-time local controllability*, i.e. whether for every $T > 0$, the input-output map $\mathcal{F}_T : u \in L^\infty(0,T) \mapsto x(T) \in \mathbb{R}^n$ is locally onto near 0. It is deeply linked to the Lie brackets of f_0 and f_1. Let $\mathcal{S}_k$ be the vector subspace of $\mathbb{R}^n$ spanned by the evaluation at 0 of these involving f_1 at most k times. $\mathcal{S}_k$ is linked to the k-th term in the power series expansion of $\mathcal{F}_T$.

When the linearized system around 0 is controllable (i.e. $\mathcal{S}_1 = \mathbb{R}^n$), then, by the inverse-mapping theorem, the nonlinear system (3) is locally controllable. Otherwise ($\mathcal{S}_1 \neq \mathbb{R}^n$), to recover the missing directions, one has to use higher order terms in the power series expansion of $\mathcal{F}_T$. Along a direction (say φ) missed at the linear level, the quadratic contribution is a quadratic form of the control. If it is signed, then $x(t)$ drifts along φ in one sense only (provided the cubic remainder be negligible wrt the drift), which prevents controllability. The most famous obstruction happens when $[f_1, [f_1, f_0]](0) \notin \mathcal{S}_1$ (Sussman SICON 1983) and $x(t)$ drifts of a distance proportional to $\|u\|^2_{H^{-1}}$.

In **[A31]**, we proved the **complete classification of the quadratic obstructions to small time local controllability in finite dimension**, by introducing a new definition, giving importance to the regularity of the control. The main result of **[5]** is a quadratic alternative:

- when $\mathcal{S}_2 \not\subset \mathcal{S}_1$, then the solution drifts along the direction of an explicit "bad" Lie bracket,
- when $\mathcal{S}_2 = \mathcal{S}_1$, the quadratic term does not increase the dimension of the reachable set.

The key idea is to measure controls with an appropriate functional norm, determined by the scalings of Gagliardo-Nirenberg-Sobolev inequalities. In conclusion, $\mathcal{S}_2 \subset \mathcal{S}_1$ is a necessary condition for the smooth small-time local controllability. **The double view point introduced in [5] geometry (Lie brackets) and analysis (functional norm that measures the control), opens new perspectives in the control of ODEs,** to tackle problems that could not be solved with only geometrical arguments.

In **[A34]**, we expose **unexpected quadratic behaviors for PDEs**, because impossible for ODEs: drifts quantified by essentially arbitrary norms (fractional Sobolev, log-Sobolev), and the possibility to **recover directions at the quadratic order** in small time. We also prove that the quadratic term may **recover an infinite number of directions**, by constructing a subtle illustrative system. To simplify, the analysis is done on a nonlinear 1D heat equation (but it can be adapted to different equations). The proofs rely on the study of an asymptotic (in small time) quadratic kernel, coupled with Paley-Wiener type arguments and Amrein-Berthier uncertainty principle. The construction of the system allows to isolate the important phenomenons, like the need of oscillation of the kernel, up to infinity, to recover directions in small time.

2 Career

2.1 Permanent positions

2018-	**Head of the mathematics department** of ENS Rennes.
2014-	**Professor at ENS Rennes**, full professor (PR1) since sept 2018.
2010-2014	Part-time teacher ('Professeur chargée de cours') at the mathematics department of École Polytechnique.
2006-2014	**Researcher at CNRS** in CMLA (ENS Cachan) 2006-2011 then CMLS (École Polytechnique) 2011-2014.
2005-2006	Teacher ('Agrégée préparatrice') at the mathematics department of ENS Cachan.

2.2 Distinctions

2018-2022	**Junior Member of IUF** (Institut Universitaire de France)
2017	**Michel Monpetit Prize, French Sciences Academy**
2011-2020	**Scientific excellence bonus** (PES, PEDR)
2008	**Peccot Course at Collège de France**, 'Control of the Schrödinger equation'

2.3 Education

2010	**Habilitation thesis** at ENS Cachan *Title:* Analysis and control of some PDEs *Reports:* Nicolas Burq, Piermarco Cannarsa, Jean-Pierre Puel.
2002-2005	**PhD** at Orsay University *Title:* Controllability and stabilization of the Schrödinger equation *Superviser:* **Jean-Michel Coron** *Reports:* Gilles Lebeau, Enrique Zuazua.
1999-2003	Student at **ENS Cachan** rank 6 at the French national competitive exam for teachers ('agrégation') 2002 Master in numerical analysis at Paris 6 University

3 Scientific activity

3.1 Publications

My publications are downloadable on my webpage
http://w3.bretagne.ens-cachan.fr/math/people/karine.beauchard/

Articles in international journals:

- **[A1]** K. Beauchard,
  Local controllability of a 1D Schrödinger equation,
  Journal de Mathématiques Pures et Appliquées, vol. 84, p. 851-956, July 2005.
- **[A2]** K. Beauchard and J.-M. Coron,
  Controllability of a quantum particle in a moving potential well,
  Journal of Functional Analysis, vol. 232, p. 328-389, 2006.
- **[A3]** K. Beauchard, J.-M. Coron, M. Mirrahimi and P. Rouchon,
  Implicit Lyapunov control of finite dimensional Schrödinger equations,
  Systems and Control Letters, vol. 56, p. 388-395, May 2007.
- **[A4]** K. Beauchard,
  Controllability of a quantum particule in a 1D variable domain,
  ESAIM: Control, Optimisation and Calculus of Variations, vol. 14, n. 1, p. 105-147, 2008.
- **[A5]** K. Beauchard,
  Local controllability of a 1D beam equation,
  SIAM Journal on Control and Optimization, vol. 47, n. 3, p. 1219-1273, 2008.
- **[A6]** K. Beauchard and M. Mirrahimi,
  Practical stabilization of a quantum particle in a one-dimensional infinite square potential well,
  SIAM Journal on Control and Optimization, vol. 48, n. 2, p. 1179-1205, 2009.
- **[A7]** F. Alouges and K. Beauchard,
  Magnetization switching on small ferromagnetic ellipsoidal samples,
  ESAIM: Control, Optimisation and Calculus of Variations, vol. 15, p. 676-711, 2009.
- **[A8]** K. Beauchard and E. Zuazua,
  Some controllability results for the Kolmogorov equation,
  Annales de l'Institut Henri Poincaré - Analyse Nonlinéaire, vol. 26, p. 1793-1815, 2009.

- **[A9]** K. Beauchard, Y. Chitour, D. Kateb and R. Long,
Spectral controllability for 2D and 3D linear Schrödinger equations,
Journal of Functional Analysis, vol. 256, p. 3916-3976, June 2009.
- **[A10]** K. Beauchard, J.-M. Coron and P. Rouchon,
Controllability issues for continuous-spectrum systems and ensemble controllability of Bloch equations,
Communications in Mathematical Physics, vol. 296, n. 2, p.525-557, June 2010.
- **[A11]** K. Beauchard and C. Laurent,
Local controllability of linear and nonlinear Schrödinger equations with bilinear control,
Journal de Mathématiques Pures et Appliquées, vol. 94, n. 5, pages 520-554, November 2010.
- **[A12]** K. Beauchard and V. Nersesyan,
Semi-global weak stabilization of bilinear Schrödinger equations,
Note aux CRAS, vol. 348, n. 19-20, p. 1073-1078, October 2010.
- **[A13]** K. Beauchard,
Local controllability and non controllability of a 1D wave equation,
Journal of Differential Equations, vol. 250, p. 2064-2098, 2011.
- **[A14]** K. Beauchard and E. Zuazua,
Large time asymptotics for partially dissipative hyperbolic systems,
Archive for Rational Mechanics and Analysis, vol. 199, pp. 177-227, 2011.
- **[A15]** K. Beauchard, P. Pereira da Silva and P. Rouchon,
Stabilization and motion planning for an ensemble of half spin system,
Automatica, vol. 48, pp. 68-76, 2012.
- **[A16]** K. Beauchard, P. Pereira da Silva and P. Rouchon,
Stabilization of an arbitrary profile for an ensemble of half spin system,
Automatica, vol. 49, p. 2133-2137, 2013.
- **[A17]** K. Beauchard, P. Cannarsa and R. Guglielmi,
Some controllability results for the 2D Grushin equations,
Journal of the European Mathematical Society, vol. 16, no. 1, p. 67-101, 2014.
- **[A18]** K. Beauchard and M. Morancey,
Local controllability of 1D Schrödinger equations with bilinear control and minimal time,
Mathematical Control and Related Fields, vol. 4, n. 2, June 2014.
- **[A19]** K. Beauchard.
Null controllability of Kolmogorov-type equations,
Mathematics of Control, Signals, and Systems, vol. 26, n. 1, p. 145-176, March 2014.
- **[A20]** K. Beauchard, P. Cannarsa and M. Yamamoto,
Inverse source problem and null controllability for multi-D Grushin-type parabolic operators,
Inverse Problems, vol. 30, n. 2, February 2014.
- **[A21]** K. Beauchard, N. Zarrouati-Vissière and P. Rouchon,
Rotational and translational bias estimation based on depth and image measurements,
Siam J. Control Optim. Vol. 52, No. 6, 2014, pp. 3463-3495, 2014.
- **[A22]** K. Beauchard, J.-M. Coron and H. Teismann,
Minimal time for the bilinear control of Schrödinger equations,
Systems and Control Letters, 71, p. 1-6, 2014

- **[A23]** K. Beauchard, B. Helffer, R. Henry and L. Robbiano,
  Degenerate parabolic operators of Kolmogorov type with a geometric control condition
  ESAIM Control Optim. Calc. Var. 21, no. 2, p. 487–512, 2015

- **[A24]** K. Beauchard, H. Lange and H. Teismann,
  Local Exact Controllability of a One-Dimensional Nonlinear Schrödinger Equation,
  SIAM Journal on Control and Optimization, Vol. 53, No. 5, pp. 2781-2818, 2015

- **[A25]** K. Beauchard, L. Miller and M. Morancey,
  2D Grushin-type equations: minimal time and null controllable data,
  Journal of Differential Equations 259, pp.5813-5845, 2015

- **[A26]** K. Beauchard, P. Cannarsa,
  Heat equation on the Heisenberg group: observability and applications,
  Journal of Differential Equations, Volume 262, Issue 8, p. 4475-4521, April 2017.

- **[A27]** K. Beauchard, C. Laurent
  Local exact controllability of the 2D-Schrödinger-Poisson system,
  Journal de l'École polytechnique - Mathématiques, 4, p. 287-336, 2017

- **[A28]** K. Beauchard, C. Laurent
  Bilinear control of high frequencies for a 1D Schrödinger equation,
  Mathematics of Control Signals and Systems, Volume 17, Issue 2, June 2017.

- **[A29]** K. Beauchard, K. Pravda-Starov
  Null-controllability of non-autonomous Ornstein-Uhlenbeck equations,
  J. Math. Anal. Appl. 456, no. 1, 496-524, 2017

- **[A30]** K. Beauchard, K. Pravda-Starov,
  Null-controllability of hypoelliptic quadratic differential equations,
  Journal de l'École Polytechnique, Math. 5, p.1-43, 2018

- **[A31]** K. Beauchard, F. Marbach,
  Quadratic obstructions to small time local controllability for scalar-input systems,
  J. Differential Equations, 264(5):3704-3774, 2018.

- **[A32]** K. Beauchard, J.-M. Coron, H. Teismann
  Minimal time for the approximate bilinear control of Schrödinger equations,
  Mathematical Methods in the Applied Sciences 41(4), January 2018

- **[A33]** K. Beauchard, S. Ervedoza, J. Darde
  Minimal time issues for the observability of Grushin-type equations
  Annales de l'Institut Fourier, in press, hal-01677037v1

- **[A34]** K. Beauchard, F. Marbach
  Unexpected quadratic behaviors for the small-time local null controllability of scalar-input parabolic equations,
  Journal de Mathématiques Pures et Appliquées, to appear, arXiv 1712.09790

- **[A35]** Karine Beauchard, Armand Koenig, Kévin Le Balc'h,
  Null-controllability of linear parabolic-transport systems
  Journal de l'École polytechnique - Mathématiques, Tome 7 (2020) p. 743-802

- **[A36]** K. Beauchard, M. Egidi, K. Pravda-Starov
  Geometric conditions for the null-controllability of hypoelliptic quadratic parabolic equations with moving control supports
  Comptes Rendus de Mathématiques, to apear, arXiv:1804.04895

Preprints:

- **[P1]** K. Beauchard, P. Jaming, K. Pravda-Starov
  Spectral inequality for Hermite functions and null controllability for hypoelliptic quadratic equations from thick sets
  arXiv:1804.04895

Patent:

I am one of the 5 inventors of a patent registered in November 2013, by the start-up SYSNAV. The other inventors are Pierre Rouchon (Professor at the engineer school Mines de Paris), Nadège Zarrouati-Vissière (PhD student of Pierre Rouchon), David Caruso (worker at SYSNAV) and Mathieu Hilion (engineer at SYSNAV). This patent presents a new process to estimate the motion of an object in a static environment, from a dense depth image, produced, for instance, by a kinect sensor.

Proceedings et other texts:

- **[Proc1]** F. Alouges, K. Beauchard and M. Sigalotti,
  Magnetization switching in small ferromagnetic ellipsoidal samples,
  Proceedings of the 48th IEEE Conference on Decision and Control, Shanghai, China, 2009.
- **[Proc2]** S. Dudret, K. Beauchard, F. Ammouri and P. Rouchon,
  Stability and asymptotic observers of binary distillation processes described by nonlinear convection/diffusion models,
  Proceedings of the American Control Conference, p. 3352-3358, 2012.
- **[Proc3]** K. Beauchard, N. Zarrouati-Vissière and P. Rouchon,
  Rotational and translational bias estimation based on depth and image measurements,
  Procedding for CDC 2012.
- **[Proc4]** K. Beauchard,
  Null controllability of degenerate parabolic equations of Grushin and Kolmogorov type,
  Texte du séminaire Laurent Schwarz, Mars 2012.
- **[O1]** K. Beauchard and Pierre Rouchon,
  Bilinear control of Schrödinger PDEs,
  Encyclopedia of Systems and Control, edited by Tariq Samad and John Baillieul (tutorial article submitted in 2013)
- **[O2]** K. Beauchard, J.-M. Coron and P. Rouchon,
  Garder le contrôle... à l'aide des mathématiques,
  Brochure 'explosion des mathématiques' de la SMAI, 2013.
- **[Proc5]** K. Beauchard and P. Cannarsa,
  Inverse coefficient problem for Grushin-type parabolic operators,
  Procedding of the conference 'ODEs, Inverse problems and Control' [Cortona, Italie], 2013. arXiv:1312.2184.

3.2 Supervision

I supervised **4 PhD** (3 defended, 1 in progress), **1 post-doc** and 12 internships

Thesis 1: Morgan Morancey, Sept 2010-Dec 2013
Origin: Morgan is a former student of ENS Cachan and Numerical Analysis Master of Paris 6 (http://mmorancey.perso.math.cnrs.fr/)
Current situation: Morgan is Associate Professor at Université Aix-Marseille since 2014
My contribution in PhD supervision: 100%.
Title: Control of Schrödinger and singular degenerate parabolic equations.
Content of the PhD:

1. M. Morancey,
Explicit approximate controllability of the Schrödinger equation with a polarizability term,
Mathematics of Control, Signals, and Systems, vol. 25, n.3, 2013.
2. K. Beauchard and M. Morancey,
Local controllability of 1D Schrödinger equations with bilinear control and minimal time,
Mathematical Control and Related Fields, vol. 4, n. 2, June 2014.
3. M. Morancey,
Simultaneous local exact controllability of 1D bilinear Schrödinger equations,
Ann. Inst. H. Poincaré Anal. Non Linéaire. 31 (3), 2014
4. M. Morancey and V. Nersesyan,
Global exact controllability of 1D Schrödinger equations with a polarizability term,
C.R. Math. Acad. Sci. Paris. 352 (5), 2014
5. M. Morancey and V. Nersesyan,
Simultaneous global exact controllability of an arbitrary number of 1D bilinear Schrödinger equations,
J. Math. Pures Appl. (9). 103 (1), 2015.
6. M. Morancey,
Approximate controllability for a 2D Grushin equation with potential having an internal singularity,
Ann. Inst. Fourier. 65 (4), 2015

Thesis 2: Ivan Moyano, Sept 2013-Sept 2016
Origin: Ivan is a former student of Universidad Complutense de Madrid and Numerical Analysis Master of Université Paris 6 (http://ivan.moyano.perso.math.cnrs.fr)
Current situation: Ivan Moyano is Associate Professor at Université de Nice since 2018
My contribution in PhD supervision: 50% co-supervision with Daniel Han Kwan (50%)
Title: Controllability of some kinetic equations, parabolic degenerate equations and of the Schrödinger equation.
Content:

1. J. Le Rousseau and I. Moyano
Null-controllability of the Kolmogorov equation in the whole phase space.
Journal of Differential Equations, 260 (2016), p. 3193-3233.
2. I. Moyano
Flatness for a strongly degenerate 1D-parabolic equation.
Mathematics of Control, Signals, and Systems, to appear, 19 pages, hal-01178510.

3. I. Moyano
   On the controllability of the 2-D Vlasov-Stokes system.
   Communications in Mathematical Sciences, to appear, 37 pages, hal-01220050.

4. I. Moyano
   Local null-controllability of the 2-D Vlasov-Navier-Stokes system
   Submitted 2016, 43 pages, hal-01346787.

5. I. Moyano
   Local exact controllability of a quantum particle in a time-varying 2D disc with radial data
   Journal of Mathematical Analysis and Applications (to appear), hal-01405624

Thesis 3: Kevin Le Balc'h, Sept 2016-July 2019
Origin: Kevin is a former student of ENS Rennes. (https://sites.google.com/view/kevinlebalch/accueil)
Current situation: Kevin is in post-doc with Marius Tucsnak and Meiji Azaiev, in Bordeaux University.
My contribution in PhD supervision: 60% co-supervision with Michel Pierre (40%).
Title: Control of reaction-diffusion systems.
Content:

1. K. Le Balc'h
   Controllability of a 4×4 quadratic reaction-diffusion system
   Journal of Differential Equations, to appear, DOI 10.1016/j.jde.2018.08.046,
   arXiv:1711.08892,

2. K. Le Balc'h
   Null-controllability of two species reaction-diffusion system with nonlinear coupling: a new duality method
   SIAM Journal on Control and Optimization, to appear, DOI 10.1137/18M1173010 2018,
   arXiv:1802.09187

3. K. Le Balc'h
   Local controllability of reaction-diffusion systems around nonnegative stationary states
   ESAIM:COCV, to appear, https://doi.org/10.1051/cocv/2019033,
   arXiv:1809.05303

4. K. Le Balc'h
   Global null-controllability and nonnegative-controllability of slightly superlinear heat equations
   JMPA, to appear, https://doi.org/10.1016/j.matpur.2019.10.009
   arXiv:1810.12232

5. Karine Beauchard, Armand Koenig, Kévin Le Balc'h,
   Null-controllability of linear parabolic-transport systems
   Journal de l'École polytechnique - Mathématiques, Tome 7 (2020) p. 743-802

Post-doc: Frédéric Marbach, Sept 2017-Sept 2018
Origin: Former student at ENS Ulm, Frédéric wrote my PhD thesis under the supervision of Jean-Michel Coron on control in fluid mechanics, defended in September 2016. He was then a post-doc student of Anne-Laure Dalibard (2016-2017) on the analysis of boundary layer models.
(https://frederic.marbach.fr).
Current situation: Frédéric is a CNRS junior research scientist in mathematics, working at IRMAR

laboratory, in Rennes.
My contribution in post-doc supervision: 100%.
Title: Quadratic obstructions to controllability.
Content:

1. K. Beauchard, F. Marbach,
   Quadratic obstructions to small time local controllability for scalar-input systems,
   J. Differential Equations, 264(5):3704-3774, 2018.

2. K. Beauchard, F. Marbach
   Unexpected quadratic behaviors for the small-time local null controllability of scalar-input parabolic equations,
   Journal de Mathématiques Pures et Appliquées, to appear, arXiv 1712.09790

Thesis 4: Mégane Bournissou, Sept 2019-
Origin: Mégane is a former student of ENS Rennes
My contribution to PhD supervision: 50% co-supervision with Frédéric Marbach (50%).
Title: Control of nonlinear PDEs.

Internships:

- 5 graduate students (M2) : Ruixing Long (2007), Morgan Morancey (2010), Ivan Moyano (2013), Kevin Le Balch (2016), Megane Bournissou (2019).
- 7 undergraduate students (M1) : C. Mifsud, B. Moubèche, A. Pauthier et P.-D. Thizy (ENS Cachan, 2010), A. Millot (X, 2013), Juliette Legrand (ENS Rennes, 2017), Emilien Manent (ENS Rennes, 2018)

3.3 Editorial activities

- I am member of the following 4 editorial boards
  - since 2011 : **MCRF** (Mathematical Control and Related Fields)
  - since 2013 : **ESAIM:COCV** (Control, Optimisation and Calculus of Variations)
  - since 2015 : **NWEJM** (North-Western European Journal of Mathematics)
  - since 2018 : **JEE** (Journal of Evolution Equations)
- I was Editor-in-chief, in 2006, with Emmanuel Trelat, of a special issue of ESAIM:COCV in honor of Jean-Michel Coron, for his 60th birthday. This volume contains 20 original research articles.

3.4 Head of 3 scientific funded projects

- 2012/2016 : ANR funded project EMAQS (Evaluation and Manipulation at Quantum Scale). The members of this project are : Andrea Grigoriu, Camille Laurent, Claude Le Bris, Yvon Maday, Vahagn Nersesyan, Jean- Pierre Puel, Pierre Rouchon, Julien Salomon, Gabriel Turinici. The budget was 180kE.
- 2014/2018 : CNRS research group (GDR) about control of partial differential equations. This project gathers about 200 researchers in France. The budget was about 80kE (20kE/year).
- 2017-2019: Scientific project founded by Rennes city ('Allocation d'Installation Scientifique'). The budget was 10kE.

3.5 Organisation of 3 international conferences and 4 workshops

- 3 international conferences:
  - 2016: Conference in honor of Jean-Michel Coron, for his 60th birthday, organized with his former PhD students, Paris.
  - 2014: Conference 'Control of PDEs', organized with Jean-Michel Coron, Thierry Horsin and Marco Caponigro, Paris.
  - 2012: CNRS thematic school 'Control theory: interactions and applications', organized with Fatiha Alabau, Emmanuel Trélat and Judith Vancostenoble, CIRM.
- 4 workshops:
  - 2019: Journées jeune EDPistes, oranized with Rémi Carles, Olivier Ley, Karel Pravda-Starov and Miguel Rodrigues, Rennes.
  - 2016: Analysis of parabolic control with hyperbolic effects, organized with Frank Boyer, Toulouse.
  - 2015: Minisymposium 'Analysis and Control of Hypoelliptic Diffusion', organized with Piermarco Cannarsa, SIAM Conference on control and its applications.
  - 2014: Workshop 'Hypoelliptic diffusion: analysis and control', organized with Piermarco Cannarsa, à l'IHP.

3.6 Courses, conferences, talks

- 4 courses at research level:
  - 2008 : Cours Peccot at Collège de France, 'Bilinear control of Schrödinger equation' (8H),
  - 2009 : CIMPA School in Marrakech 'Bilinear control of Schrödinger equation' (12H)
  - 2013 : 'Seville University' Bilinear control of Schrödinger equation' (8H)
  - 2018 : CIMPA School in Hammamet, ?Control of ordinary differential equations?
- 44 conferences in international congress
- 49 talks in laboratory seminars

3.7 Expert assessment

- **12 PhD jury, 1 as reviewer:**
  - 2020 : Lydia Ouailli, supervisor: Assia Benabdallah (Marseille), reviewer
  - 2019 : Armand Koenig, supervisor: Gilles Lebeau (Nice)
  - 2019: Mona Ben Said, supervisor: Francis Nier (Paris 13)
  - 2019: Shengquan Xiang, supervisor: Jean-Michel Coron (Paris 6)
  - 2019: Amauray Hayat, supervisor: Jean-Michel Coron (Paris 6)
  - 2018: Guillaume Klein, supervisor: Nalini Anantharaman (Strasbourg)
  - 2018: Damien Allonsius, supervisor: Franck Boyer et Morgan Morancey (Marseille)
  - 2017: Rémi Buffe, supervisors: Jérôme Le Rousseau et Luc Robbiano (Orléans)
  - 2013: Nadège Zarrouati-Vissière, supervisor: Pierre Rouchon (Centre Automatiques et Systèmes, Mines de Paris)

- 2013: Guillaume Olive, supervisors: Assia Benabdallah et Franck Boyer (Aix Marseille Université)
- 2013: Laetitia Giraldi, supervisor: François Alouges (CMAP, Ecole Polytechnique)
- 2011: Florent Di Meglio, supervisor: Nicolas Petit (Centre Automatiques et Systèmes, Mines de Paris)

• **2 habilitation jury, 1 as reviewer:**
  - 2019: Emmanuelle Crépeau (Versailles)
  - 2017: Marco Caponigro (CNAM), reviewer

• **17 recruitment committees, 2 as president:**
  - 7 PR : ENS Rennes (2020, presidence), Nancy (2019), Lyon (2018), P6 (2017), Strasbourg (2016), Tours et Rennes (2015)
  - 5 MC : Besancon (2016), Lille (2013), Paris 6 et 7 (2012), Versailles (2009)
  - 1 PCC : X (2012)
  - 3 agrégés préparateurs: ENS Rennes (2018), ENS Cachan (2006, 2*)
  - 1 ATER, ENS Rennes (2019, presidence).

• **Report on 2 ANR projects** (2014, 2015)

• **HCERES committee** for evaluation of the Laboratory of Applied Mathematics in Compiègne (LMAC) in 2017.