Curriculum vitae

Clément Moreau

Born in Paris on June 15th, 1994

PhD in Applied mathematics

Contact

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Situation professionnelle

Invited Researcher at Kyoto University (Japan)

Affiliated to the Research Institute for Mathematical Sciences (RIMS)

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Academic career

2022– **JSPS (Japan Society for the Promotion of Science) Postdoctoral Fellow**, RIMS, Kyoto University. Supervision: Kenta Ishimoto. Project title : "Mathematical control theory for microrobot and cell locomotion".

2021–2022 **Invited researcher**, RIMS, Kyoto University.

2020–2021 **JSPS (Japan Society for the Promotion of Science) Postdoctoral Fellow**, RIMS, Kyoto University. Supervision: Kenta Ishimoto. Project title : "Applications of mathematical control theory to low-Reynolds number swimming".

Curriculum

2017–2020 **PhD in Applied mathematics** at Université Côte d'Azur

SUPERVISION:

Laetitia Giraldi, Inria Sophia-Antipolis
Pierre Lissy, Université Paris-Dauphine
Jean-Baptiste Pomet, Inria Sophia-Antipolis

TITLE:

Controllability in finite and infinite dimension and applications to life-inspired nonlinear systems

DEFENSE:

June 17$^{\text{th}}$, 2020 (online).

REVIEWERS:

Eamonn Gaffney, Oxford University
Emmanuel Trélat, Sorbonne Université

EXAMINERS:

Karine Beauchard, ENS Rennes
Jean-Baptiste Caillau, Université Côte d'Azur
Antonio DeSimone, SISSA

2013–2017 **Student at the École Normale Supérieure de Cachan**. "Diplôme de l'ENS Cachan" (awarded for outstanding completion of ENS 4-year course) obtained in September 2017.

2016–2017 **"Pre-doctoral Research year abroad" program (*Année de Recherche Prédoctorale à l'Etranger*)**, University of York (United Kingdom)
Project : "Numerical methods and simulations for elastohydrodynamics of microfilaments." Supervision: Hermes Gadêlha.

2015–2016 **Master's degree in Applied Mathematics, specialisation in "Mathematics for modelling"**, Université Pierre et Marie Curie (Paris 6), mention: bien (*magna cum laude*).
Thesis: "Partial controllability of magnetic micro-swimmers." Supervision: Laetitia Giraldi, Pierre Lissy and Jean-Baptiste Pomet.

2014-2015 **Master 1 (first year of graduate course) in "Pure Mathematics"**, ENS Cachan and Université Paris Diderot (Paris 7), mention: bien (*magna cum laude*).
Thesis: "Real-time suboptimal control of hybrid vehicles." Supervision: François Chaplais (CAS, Mines ParisTech).

2013–2014 **Bachelor's degree in Mathematics**, ENS Cachan and Université Paris Diderot (Paris 7), mention: bien (*magna cum laude*).
Thesis: "Numerical reconstruction of the Prokudin-Gorskii photographs." Supervision: Enric Meinhardt-Llopis and Jean-Michel Morel (CMLA, ENS Cachan).

2011–2013 **"Classe préparatoire" MPSI/MP**, (intensive two-year undergraduate course to prepare for the competitive entrance examination to French "Grandes Écoles"), Lycée Clemenceau, Nantes.

Research interests

- **Control theory and optimisation**: control-affine systems with and without drift, conditions of local controllability, geometric control, state-constrained control, control of parabolic PDEs and reaction-diffusion systems, shape optimisation.
- **Fluid mechanics**: Stokes equations, low-Reynolds number hydrodynamics, fluid-structure interactions, computational aspects, boundary integral method.
- **Control and modelling for microswimming**: hydrodynamics, modelling, elasticity and elastic filaments, controllability and optimal control and design of microrobots.

Publications

Publications in peer-reviewed journals

[11]† B. J. Walker, K. Ishimoto, C. Moreau, E. A. Gaffney, Emergent rheotaxis of shape-changing swimmers in Poiseuille flow, *Journal of Fluid Mechanics* 944, no. R2. DOI:10.1017/jfm.2022.474

[10]* K. Ishimoto, C. Moreau, K. Yasuda, "Self-organised swimming with odd elasticity", *Physical Review E* vol. 105, no. 060403, Jun 2022. DOI:10.1103/PhysRevE.105.064603

[9]† B. J. Walker, K. Ishimoto, E. A. Gaffney, C. Moreau, "The control of particles in the Stokes limit", *Journal of Fluid Mechanics* vol. 942, no. A1, May 2022. DOI:10.1017/jfm.2022.253

[8]† E. A. Gaffney, M. P. Dalwadi, C. Moreau, K. Ishimoto, B. J. Walker, "Canonical orbits for planar microswimmers in shear flow", *Physical Review Fluids* vol. 7, no. L022101, Feb 2022. DOI:10.1103/PhysRevFluids.7.L022101

[7]† B. J. Walker, K. Ishimoto, E. A. Gaffney, C. Moreau, M. P. Dalwadi, "Effects of rapid yawing on simple swimmer models and planar Jeffery's orbits",*Physical Review Fluids* vol. 7, no. 023101, Jan 2022. DOI:10.1103/PhysRevFluids.7.023101

[6]† C. Moreau, K. Ishimoto, "Driving a microswimmer with wall-induced flow", *Micromachines* vol. 12, no. 9:1025, Aug 2021. DOI:10.3390/mi12091025

[5]† C. Moreau, K. Ishimoto, E. A. Gaffney, B. J. Walker, "Control and controllability of microswimmers by a shearing flow", *Royal Society Open Science* 8: 211141, Aug 2021. DOI:10.1098/rsos.211141

[4]* P. Lissy, C. Moreau, "State-constrained controllability of linear reaction-diffusion systems", *ESAIM:COCV*, vol. 27, no. 70, Jul 2021. DOI:10.1051/cocv/2021057

[3] C. Moreau, "Local controllability of a magnetized Purcell's swimmer", *IEEE Control Systems Letters*, vol.3, no.3, pp. 637-642, May 2019. DOI:10.1109/LCSYS.2019.2915004

[2]† C. Moreau, L. Giraldi, H. Gadêlha, "The asymptotic coarse-graining formulation of slender-rods, bio-filaments and flagella", *Journal of the Royal Society Interface*, vol. 15, no. 144, Jul 2018. DOI:10.1098/rsif.2018.0235

[1]* L. Giraldi, P. Lissy, C. Moreau, J.-B. Pomet, "Addendum to "Local Controllability of the Two-Link Magneto-Elastic Micro-Swimmer" ", *IEEE Transactions on Automatic Control*, vol. 63, pp. 2303-2305, Jul 2018. DOI:10.1109/TAC.2017.2764422

Preprints

†Author order: by contribution
*Author order: alphabetical

[P2] C. Moreau, K. Ishimoto, Y. Privat, "Shapes optimising grand resistance tensor entries for a rigid body in a Stokes flow", submitted. arXiv:2207.06023

[P1]* L. Giraldi, P. Lissy, C. Moreau, J.-B. Pomet, "A necessary condition for local controllability of systems with two scalar controls", submitted. hal:02178973v2

Conference proceedings

[C2] C. Moreau, "Local Controllability of Magnetized Purcell's Swimmers", 21st IFAC World Congress (online), IFAC-PapersOnLine, vol. 53, no. 2, 2020.

[C1] (Joint publication CDC and L-CSS [3]) C. Moreau, "Local controllability of a magnetized Purcell's swimmer", 58th Conference on Decision and Control (CDC), 2019.

Communications

Oral presentations at national and international conferences

Jul 2022	World Congress of Biomechanics, Taipei, Taiwan (online participation)
Jun 2022	CANUM 2020+2, Evian-les-Bains, France
Jun 2022	ECCOMAS Congress 2022, Oslo, Norway
Mar 2022	Odd viscoelasticity workshop, Dutch Institute for Emergent Phenomena, Amsterdam, Netherlands
Jan 2022	Active Matter Workshop 2022, Meiji University, Japan
Jun 2021	Biofluids Symposium, Kyoto University (online)
Jan 2021	Active Matter Workshop 2021, Meiji University (online)
Dec 2020	Congrès d'Analyse Numérique (online)
Jul 2020	21st IFAC World Congress (online)
Dec 2019	58th Conference on Decision and Control (CDC), Nice, France
Jul 2019	Equadiff Conference, Leiden, Netherlands
May 2019	Colloque Inter'Actions, Bordeaux, France
May 2019	SMAI Congress, Guidel, France
Dec 2018	13th International Young Researchers Workshop on Geometry, Mechanics and Control, Coimbra, Portugal
Jan 2018	12th International Young Researchers Workshop on Geometry, Mechanics and Control, Padoue, Italie
Nov 2017	PGMO Days, EDF Lab, Saclay, France

Presentations at lab seminars and working groups

Jun 2022	Groupe de travail contrôle de l'IECL, Nancy, France
Mar 2022	RIMS Fluid Dynamics Group seminar, Kyoto, Japan
Feb 2022	RIMS Fluid Dynamics Group seminar, Kyoto, Japan
Dec 2021	Applied Maths Seminar, Kyoto University, Japan
Dec 2021	CRAN Seminar, Nancy, France (en ligne)
Nov 2021	RIMS Fluid Dynamics Group seminar, Kyoto, Japan

Sep 2021	IRMA PDE Seminar, Strasbourg, France.
Mar 2021	Yamamoto Group (Theoretical Modeling of Soft Matter and Living Systems) Seminar, Transport Phenomena Laboratory, Kyoto University (online)
Feb 2021	Seminar of the LMBA "Analyse, Phénomènes Stochastiques et Applications" team, Brest, France (online)
Feb 2021	Seminar of the I2M "Analyse Appliquée" team, Marseille, France (online)
May 2020	PhD seminar of the LJLL, Paris, France (online)
Apr 2018	PhD seminar of the PDE and Numerical Analysis team of the LJAD, Nice, France

Poster presentations

Feb 2020	Research Workshop of the Israel Science Foundation on Micro-Swimmers and Soft Robotics, Haifa, Israël
Jun 2018	Congrès National d'Analyse Numérique (CANUM), Cap d'Agde, France

Short-term research visits

Sep 2021	Université de Lorraine (France), with J. Lohéac (1 week)
May 2021	Sorbonne Université (France), with M. Bonnivard (1 week)
May 2022	Université de Strasbourg (France), with Y. Privat (2 weeks)
Sep 2021	Université de Strasbourg (France), with Y. Privat (2 weeks)
Jan 2020	Bristol University (United Kingdom), with H. Gadêlha (2 weeks)
Jun 2018	York University (United Kingdom), with H. Gadêlha (1 week)

Teaching

Université Paris-Dauphine (2019-2020)

Subject	Level	Type	Students	Hours
Analysis	Undergrad in Math/Economics	Tutorials	30	64

Université Côte d'Azur (2017-2019)

Subject	Level	Type	Students	Hours
Analysis	Undergrad in Economics	Tutorials	25-30	64
Statistics	Undergrad in Economics	Tutorials	25-30	36
Statistics	Undergrad in Math/Comp. Science	Tutorials/Practice	25-30	28

Other teaching experiences

2020 (Jan) **Mini-course** "An easy-to-use fluid-structure simulator for active/passive rods/filaments" dispensed to graduate and postgraduate students of the Engineering Mathematics department at Bristol Unviersity (UK). – 10h

2015–2016 **"Colles" in mathematics** (individual oral examinations, part of the French "Classe préparatoires" intensive training for competitive engineering school entrance examinations), Lycée Janson-de-Sailly, Paris – 60h

Supervision

2021 Co-supervision, with V. De Bortoli and A. Doucet, of B. Archer, graduate student at Oxford University. Dissertation title: "The application of genetic reinforcement learning techniques for the control of microscopic robots"

Administration

2019–2020 **Elected representative of the PhD students** at the CEREMADE (Univ. Paris- Dauphine) lab council

2019–2020 **member of the CEREMADE's committee for gender equality.**

Outreach

Contributor for the Images des Mathématiques website

Since 2018, I am a writer for the monthly press review of the "Images des mathématiques" website. This review offers an exhaustive summary of the articles that deal with topics related to mathematics (research, applications, outreach, teaching politics, history, art, *etc.*), in French-speaking, general-public media. The press review is read by around 2,500 people each month.

Scientific activities in school sector

- Presentation in front of Japanese high-school students in February 2021, within the JSPS Science Dialogue program.
- Organisation of a workshop on randomness with French junior high school students in October 2019.

Scientific activities for the general public

- Organisation of a workshop "Maths and Games" at the French festival"Belle Epine" in August 2020.
- "Open Days" at Inria Sophia-Antipolis (2018): research presentation to the public.
- Participation to the French "My PhD in 180 seconds" contest in 2018.
- Short live presentation for "La méthode scientifique" program on national French radio.

Miscellaneous skills

Computer science

Computational and programming software	Matlab/Scilab Maple, Mathematica Notions of Python and Fortran
Miscellaneous	LaTeX, html, Adobe Illustrator

Languages

French: mothertongue

English: fluent (C2)

German: intermediate (B2)

Japanese: elementary (A2)