

Pierre Monmarché

Assistant professor

Laboratoire Jacques-Louis Lions, UPMC,
office n° 15-16.308
4 place Jussieu 75005 Paris, France
✉ pierre.monmarche@sorbonne-universite.fr
webpage : <https://www.ljll.math.upmc.fr/~monmarche/>



(updated in march 2021)

Education and Employment

- 01/2021 **HDR** : *Degenerated Markov processes for sampling, optimization and modelling.*
- 2017– ... **Assistant professor** at LJLL and LCT, Sorbonne Université.
- 2016–2017 **Postdoc researcher** at CERMICS and INRIA (Materials team)
working with Virginie Ehrlacher and Tony Lelièvre.
- 2015–2016 **Postdoc researcher** at Neuchâtel University working with Michel Benaim.
- 2012–2015 **Phd student** at Paul Sabatier University (PSU), Toulouse :
Hypocoercivity : alternative approach and applications to stochastic algorithms,
supervised by Laurent Miclo (defended the 10/12/2014).
- 2011–2012 **Master's Degree** in Probability at PSU, Toulouse.
- 2011 **Agrégation** (French competitive exam for teaching tenure) in Mathematics,
Probability section. National rank : 18/288.
- 2008–2011 **École Normale Supérieure of Rennes**

Main research interests

key-words : MCMC methods, stochastic optimization, molecular dynamics, hypocoercivity, kinetic processes, PDMP, functional inequalities, interacting particles, metastability, long-time convergence.

Stochastic algorithms (like MCMC or simulated annealing), in statistics or molecular dynamics for instance, are based on the efficient exploration of a high-dimensional state space with complex geometry. My work is concerned with the use in such context of dynamics that are in some sense degenerated (kinetic processes, PDMP, adaptive methods...), their long-time or small temperature behaviour. More generally, at the intersection of probability theory (Markov processes, couplings) and analysis (PDE, functional inequalities), I develop tools to study these so-called hypocoercive processes.

All my publications and preprint are available on my webpage or on arXiv.

Preprints

- [1] T. Lelièvre, L. Maurin, and P. Monmarché. The Adaptive Biasing Force algorithm with non-conservative forces and related topics. *arXiv e-prints*, page arXiv :2102.09957, February 2021.
- [2] P. Monmarché. Almost sure contraction for diffusions on \mathbb{R}^d . Application to generalised Langevin diffusions. *arXiv e-prints*, page arXiv :2009.10828, September 2020.
- [3] P. Monmarché, M. Rousset, and P.-A. Zitt. Exact targeting of Gibbs distributions using velocity-jump processes. *arXiv e-prints*, page arXiv :2008.09360, August 2020.
- [4] P. Monmarché. High-dimensional MCMC with a standard splitting scheme for the underdamped Langevin diffusion. *arXiv e-prints*, page arXiv :2007.05455, July 2020.
- [5] A. Guillin and P. Monmarché. Uniform long-time and propagation of chaos estimates for mean field kinetic particles in non-convex landscapes. *arXiv e-prints*, page arXiv :2003.00735, March 2020.
- [6] V. Ehrlacher, T. Lelièvre, and P. Monmarché. Adaptive force biasing algorithms : new convergence results and tensor approximations of the bias. Hal preprint, December 2019.
- [7] L. Journal and P. Monmarché. Convergence of the Fleming-Viot algorithm : uniform in time estimates in a compact soft case. *arXiv e-prints*, page arXiv :1910.05060, October 2019.
- [8] P. Monmarché. Elementary coupling approach for non-linear perturbation of Markov processes with mean-field jump mechanisms and related problems. *arXiv e-prints*, page arXiv :1809.10953, Sep 2018.

Articles

- [1] E. Löcherbach and P. Monmarché. Metastability for systems of interacting neurons. *to appear in Ann. IHP*, 2021.
- [2] T. Jaffreot Inizan, F. Célerse, O. Adjoua, D. El Ahdab, L.-H. Jolly, C. Liu, P. Ren, M. Montes, N. Lagarde, L. Lagardère, P. Monmarché, and J.-P. Piquemal. High-resolution mining of the sars-cov-2 main protease conformational space : supercomputer-driven unsupervised adaptive sampling. *Chem. Sci.*, 2021.
- [3] P. Monmarché, J. Weisman, L. Lagardère, and J.-P. Piquemal. Velocity jump processes : An alternative to multi-timestep methods for faster and accurate molecular dynamics simulations. *The Journal of Chemical Physics*, 153(2) :024101, 2020.
- [4] P. Monmarché. Hypocoercivité L^2 , inégalité de concentration, temps d’atteinte et fonctions de Lyapunov. *to appear in Annales Mathématiques Blaise Pascal*, 2020.
- [5] M. Benaïm, C.-E. Bréhier, and P. Monmarché. Analysis of an adaptive biasing force method based on self-interacting dynamics. *Electron. J. Probab.*, 25 :28 pp., 2020.
- [6] N. Fournier, P. Monmarché, and C. Tardif. Simulated annealing in \mathbb{R}^d with slowly growing potentials. *Stochastic Processes and their Applications*, 131 :276 – 291, 2021.
- [7] P. Monmarché. Kinetic walks for sampling. *ALEA Lat. Am. J. Probab. Math. Stat.*, 17 :491., 2020.
- [8] P. Cattiaux, A. Guillin, P. Monmarché, and C. Zhang. Entropic multipliers method for langevin diffusion and weighted log sobolev inequalities. *Journal of Functional Analysis*, 277(11) :108288, 2019.
- [9] A. Durmus, A. Guillin, and P. Monmarché. Piecewise Deterministic Markov Processes and their invariant measure. *to appear in Ann. IHP*, 2021.

- [10] A. Durmus, A. Guillin, and P. Monmarché. Geometric ergodicity of the bouncy particle sampler. *Ann. Appl. Probab.*, 30(5) :2069–2098, 10 2020.
- [11] P. Monmarché. A note on Fisher Information hypocoercive decay for the linear Boltzmann equation. *Analysis and Mathematical Physics*, 2021.
- [12] C.-E. Gauthier and P. Monmarché. Strongly self-interacting processes on the circle. *Stochastics*, 91(8) :1249–1271, 2019.
- [13] P. Monmarché. Generalized Γ calculus and application to interacting particles on a graph. *Potential Analysis*, 50 :439–466, 2019.
- [14] P. Monmarché. Hypocoercivity in metastable settings and kinetic simulated annealing. *Probability Theory and Related Fields*, Jan 2018.
- [15] P. Monmarché. Weakly self-interacting piecewise deterministic bacterial chemotaxis. *Markov Process. Related Fields*, 23(4) :609–659, 2017.
- [16] P. Monmarché. Long-time behaviour and propagation of chaos for mean field kinetic particles. *Stochastic Process. Appl.*, 127(6) :1721–1737, 2017.
- [17] A. Guillin and P. Monmarché. Optimal linear drift for an hypoelliptic diffusion. *Electronic Communication of Probability*, 21, 2016.
- [18] P. Monmarché. Piecewise deterministic simulated annealing. *ALEA Lat. Am. J. Probab. Math. Stat.*, 13(1) :357–398, 2016.
- [19] P. Monmarché. On \mathcal{H}^1 and entropic convergence for contractive PDMP. *Electronic Journal of Probability*, 20, December 2015.
- [20] P. Monmarché. Hypocoercive relaxation to equilibrium for some kinetic models. *Kinet. Relat. Models*, 7(2) :341–360, 2014.
- [21] L. Miclo and P. Monmarché. Étude spectrale minutieuse de processus moins indécis que les autres. *Séminaire de Probabilités*, 2078 :459–481, 2013.

Book

- participation to *5 jeunes chercheurs d’avenir 2015*, éditions Le Pommier.

Proceedings

- A short introduction to Piecewise Deterministic Markov samplers, dans *Stochastic dynamics out of equilibrium*, *Springer Proc. Math. Stat.* 82, Springer, Cham, 2019.

Supervision

2020	Pierre Le Bris (Master thesis then Phd, with Arnaud Guillin)
2020 – ...	Hadrien Vroylandt (postdoc, within the MAESTRO team)
2019 – 2020	Ludovic Cesbron (postdoc)
2019	Jeremy Weisman (Master thesis ENSTA engineering school)
2019 – ...	Lucas Journal (Master thesis and then Phd)
2018 – ...	Lise Maurin (Phd, with Tony Lelièvre and Jean-Philip Piquemal)
2018	Hayet Ankoud and Basma Naili (3 month Erasmus stay, Phd students from Tunisia)
2018	Guillaume Chenetier (first year Master internship)

Fundings and awards

- 2020 – 2024 PI of ANR project SWIDIMS
2020 grant *Tremplins nouveaux entrants* of FSI, Sorbonne Université
2020 – 2022 member of ISCD team MAESTRO, Sorbonne Université (PI Marco Saitta)
2019 – 2023 member of ANR project METANOLIN (PI Julian Tugaut)
2018 – 2024 member of ERC project EMC2 (PI E. Cancès, L. Grigori, Y. Maday, J.-P. Piquemal)
2018 – 2021 member of ANR project EFI (PI Jean Dolbeault and Arnaud Guillin)
2018 PEPS grant of INSMI
2015 award of Academic Research of Le Monde
2014 – 2019 member of ERC project MSMATH (PI Tony Lelièvre)
2013 – 2017 member of ANR project PIECE (PI Florent Malrieu)

Teaching activities

- 08/2018 **Mathematics-Chemistry-HP Computing summer school**, Roscoff.
C++ and scilab practice for molecular dynamics and MCMC.
- 2017– ... **Assistant teacher**, Sorbonne Université.
4th year courses on computational probabilities and statistics ; on ODE and stability
5th year (mechanical engineering students, Polytech' Paris) courses on prob. and stat.,
1st year courses on general mathematics ; supervised research activities,
2nd year courses on sequences and series of functions ; professional integration.
- 07/2017 **Dynamical systems summer school**, Marseille.
MCMC algorithms for pre-Phd chinese students.
- 2011–2015 **Teacher assistant**, INSA, Toulouse.
3rd year math course for civil engineering students,
projects supervision for 2nd and 3rd year math students.
- 01/2014 **Doctoral course**, Kwame Nkrumah University, Kumasi (Ghana).
Differential equations for Ghanean Phd students.
- 2007–2010 **Miscellaneous**
one month high school teaching internship in Rennes 2010, one month voluntary
teaching in a secondary school in Auroville (India) 2009, regular voluntary
educational support in high schools in Tours and Rennes from 2007 to 2009.

Other professional activities

- 2018 Examiner for ENS competitive exam
2019– ... Co-organizer of *Mathematic Park* monthly seminar
2019– ... Member of the LCT council
2018– ... Organizer of LJLL/LCT math and chemistry EMC2 seminar
2018 Co-organizer of *math./comp. chem. Franco-German Workshop*, Aachen (Germany)
2016–2018 Organizer of ERC MSMaths seminar
2013–2015 Phd students representative at IMT council
2012–2013 Co-organiser of the IMT junior seminar

Talks

- 2021 Optimal transport and Mean field games seminar, UCLA (USA)
- 2020 Probability and Statistics seminar, IECL, Nancy
Statistics and probabilities seminar at KTH Royal Institute of Technology, Stockholm (Suède)
MCQMC 2020
math/chemistry EMC2 seminar, Sorbonne Université
Lille University, probability and statistics seminar
- 2019 Grenoble-Alpes University, probability seminar of Fourier Institute
Sousse University (Tunisia), *New trends in analysis and probability* conference
ICIAM, Valencia (Spain)
HIM Bonn (Germany), *Qualitative behaviour of kinetic equations* workshop
SMAI congress, *functional inequality in probability and analysis* session
Paris Diderot University, mathematical finance, computational prob. and stat. seminar
Orléans University, Denis Poisson Institute seminar
- 2018 Paris Dauphine University, CEREMADE seminar
CIRM, Marseille, *Advances in Computational Statistical Physics* conference
Franco-German Workshop on mathematical aspects in computational chemistry, Aachen (Germany)
MAS days, University of Burgundy
MCQMC conference, Rennes
CANUM conference, Cap d'Agde
University of Cambridge (United Kingdom), Geom. Anal. and Part. Diff. Equ. seminar
Montpellier University, probability and statistics seminar
- 2017 Pierre and Marie Curie University, LJLL seminar
Delft University of Technology (Netherlands), seminar of Probabilities and Statistics
Paris Dauphine University, stochastic algorithms day
Pierre and Marie Curie University, probability seminar
Henri Poincaré Institute, Paris, *non-equilibrium dynamics* semester,
Paris Descartes University, probability seminar
Oxford University (United Kingdom), seminar of the Department of Statistics,
CIRM, Marseille, *PDE/Probability Interactions : Kinetic Equations* conference
ENPC, Marne-la-Vallée, *PDMP and sampling* workshop
Rouen University, probability and ergodic theory seminar
- 2016 Nancy University, probability and statistics seminar
ENS Lyon, probability and statistics seminar
INRIA Paris, junior Seminar
ETH Zurich (Switzerland), probability seminar
Neuchâtel University (Switzerland), probability seminar
EPFL (Switzerland), probability seminar
Bath University (United kingdom) School and Workshop on Random Interacting Systems
ENPC, Marne-la-Vallée, CERMICS seminar
Marseille University, probability and statistics seminar
Nantes University, applied mathematics seminar
Pierre and Marie Curie University, PIECE ANR working group
Rennes University, Gaussbusters students seminar
Rennes University, probability seminar
Blaise Pascal University, Clermont-Ferrand, probability seminar
- 2015 Neuchâtel University (Switzerland), probability seminar
Rabelais University, Tours, PIECE ANR workshop
AGH University, Cracow (Poland) CNRS-PAN Mathematics Summer Institute
SMAI congress, *Long-time for non-linear and degenerated PDE* session
Paul Sabatier University, Toulouse, math and physics meeting (LPT/IMT)
Paul Sabatier University, Toulouse, math and physics junior seminar
Lyon University, analysis seminar of Camille Jordan Institute
- 2014 Lyon University, STAB ANR workshop
Rennes University, Lebesgue student workshop
Toulouse University, junior seminar
Bordeaux University, Lambda student workshop
Young probabilist and statisticians colloquium, Forges-les-Eaux
- 2013 AGH University, Cracow (Poland) CNRS-PAN Mathematics Summer Institute
Rennes University, Lebesgue semester, PDMP workshop
Toulouse University, student seminar

Dissemination of scientific culture

- **Images des maths** : two articles (*le champ de vecteurs* 2017, *Une vie de couple* 2018), reviewer since 2010, participant and/or winner and/or judge Bulles au Carré (2011–2020).
- **Academic Research of Le Monde** : popularization of my Phd thesis in Le Monde newspaper, participation to a collective book, 2015.
- **Three minute thesis** : Midi-Pyrénées finals, 2015 (available on my webpage).
- **Math and music** : talks at SU 2017, IMT and twice for high school students 2014
- **Maths and comics** : comics available on my webpage. Talk at IMT 2015.
- **Events** : Salon Culture et Jeux Mathématiques 2020, Fête de la Science 2017, Matinales de l'ENPC 2016, two talks in high schools 2016, congrès Maths en Jean 2015, Exposcience 2014, Fête de la Science 2010.