CURICULUM VITÆ DE FRANÇOISE PÈNE

Surname : Pène

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Born the : 13/08/1974 **at** Rennes, France

Position : University Professor in Mathematics at the Université de Brest

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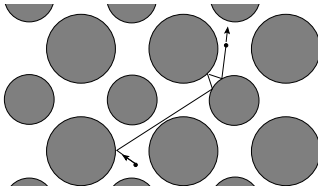
Research subjects : probabilistic limit theorems, stationary sequences of random variables, dynamical systems, quantitative recurrence and ergodicity and mixing in finite and infinite measure, Sinai billiards and periodic Lorentz gas in finite and infinite horizon, Bunimovich stadium billiard, billards with cusps, partially hyperbolic systems, Markov chains, random walks, random sceneries, random orientations, collisions of random walks in random environments, Lévy-Lorentz process, etc.

Cursus

- depuis 01/09/2015 : University Professor at the Université de Brest (1st class in 2017, exceptional class in 2022)
- 2014-2019 : Junior member of the prestigious Institut Universitaire de France
- 2001-2015 : Maîtresse de conférences at the Université de Brest
- 2009 : Habilitation à diriger des recherches defended on the 4th of December 2009 at the Université de Brest
- Bonus for research or scientific excellence (PES/PEDR) : 2003-2007 (no other application between 2001 and 2008), 2010-2014, 2014-2019 (IUF), 2019-2023
- Present principal responsabilities : nominated at the National University committee (CNU) (2019-2023), elected at the social administration committee (CSA) of the university (12/2022-), member of the scientific committee of the French Mathematical Society (SMF) (2020-), of the council of the Teaching and Research Unit (UFR) and of its Continuum and Research commissions (2021-), co-main editor for the SMF of a special volume about scientific popularization(2022-)
- Past responsabilities : in charge of the biggest team of the laboratory (5 years : 2017-2022, 25-30 permanents on 2 sites UBO-UBS distant from 200km, only organizer of 7 team seminar-days d'équipe including invitation of outside speakers, laboratory evaluation (Hcéres) 2020-2021, etc.), in charge of equality between men and womenfor the university (4 years: 2016-2020); university councils: member of the research council and of its bureau+Academic council+restricted academic council (4 years: 2016-2020); teaching (7 years: university diploma of interactive media technician 2003-2005, preparation at the internal competition for the Agrégation 2002-2003 et 2005-2006, preparation at the competition for the CAPES+first Master model in 2008-2009, M2 Agrégation 2016-2018); laboratory deputy director (2009-2011); co-organization of the team seminar (2003-2011); (co-)organization of 18 research conferences or meetings
- 2 PhD-students (+ their Master 2 thesis): defenses in 2018 (with a co-director) and 2022 (alone)

- Many popularization activities (4 talks, scientific animation at the science festival : 17 years, redaction of a booklet, 4 popularization articles, etc.)
- 1998-2001 : Allocataire Monitrice Agrégée at the l'Université de Rennes 1
  Doctorat (Ph-D) of Mathematics and applications (supervisor : Jean-Pierre Conze) defended on the 20th of December 2000 at the Université de Rennes 1.
- 1998 : external competitions of Agrégation de Mathématiques (rank: 66th) and CAPES de Mathématiques (rank: 6th)
- 1992-1997 : studies at the Université de Rennes 1 ended by the D.E.A. (old version of Master 2 Research) of Fundamental Mathematics and applications (with honours) and of the Magistère of mathematical Modelling and Computer methods (with honours)
- Research teams :
  member of **6 projects of the french research national agency (ANR)** (5 national : JCJC TEMI 2006-2009, JCJC RANDYMECA 2009-2011, GEODE 2010-2015, PERTURBATIONS 2011/2014, MEMEMO2 2011-2014 et 1 France-Switzerland (MALIN 2017-2021)), to **5 GDR of the CNRS** (2569 Systèmes Dynamiques 2003-2006; 2250 GRIP Interactions de Particules 2003-2006; Platon [member of the scientific committee 2018-2021]; AMA [correspondant for the Bretagne team 2021-], Branching [2023, member of the scientific committee]), to **1 european GDR** (224 GREFI-MEFI), **many national and international collaborations** (15 abroad: Allemagne, Angleterre, Autriche, Brésil, Canada, Corée du Sud, États-Unis d'Amérique, Italie, Pays-Bas).
- My research work deals essentially with the study of dependent random variables variables, random walks, dynamical systems preserving a finite or infinite measure and Markov chains. The picture below represents a trajectory of $\mathbb{Z}^2$-periodic Lorentz gas, which is one of the models whose statistical properties I have studied extensively.



I have studied in particular the chaotic behaviour of deterministic dynamical systems derived from statistical physics models (Sinai's billiards represented on the figure in finite or infinite horizon, Bunimovich billiards in the stadium, chaotic billiards in planar domains with corners and/or cusps) or algebraic (automorphisms of the torus) as well as non-Harris recurrent Markov chains. In addition to the classical limit theorems in probability (central limit theory standard or not, speed of convergence,...), I have studied properties of quantitative recurrence (return time in a small domain, asymptotic behaviour when the domain diameter goes to 0), growth rates for branching processes.

The study of the stochastic properties of dynamical systems in infinite measure knows an impressive development. Few results exist, many questions are open. I have been particularly involved in the study of the stochastic properties of the periodic Lorentz gas (Sinai billiard Z^2-periodic) which is an important example of a chaotic dynamical system preserving an infinite measure (study of mixing for the transformation but also for the flow, in the finite or infinite horizon case, behaviour of Birkhoff sums, etc.). In a general framework, I have studied the unprecedented question of invariance by induction of the asymptotic variance and of the analogous quantity of order 3 (for dynamical systems preserving a finite or infinite measure).

I have also been interested in purely probabilistic models that can model the displacement of liquid in non-homogeneous stratified media (random walk in random scenery and related models). For these models (with a long memory). In particular I studied the phenomena of recurrence (when the particle returns infinitely often to its departure point), of persistence (the time to wait before the particle crosses a border), the number of visits (local time). I have also worked on questions of collisions of random walks in random environments.

In the field of algebraic enumerative geometry, I have studied the caustic surfaces on which the sun's light and heat (or sound) are concentrated after reflection. In particular,

I have established formulae for the degree of these surfaces when the mirror is given by an algebraic surface.

I have also contributed to the field of statistics, studying non-homogeneous Markovian regime change models with the aim of providing realistic generators of temporal wind sequences.

I worked a lot on my own at the beginning of my career. The interest of colleagues for my first works naturally led me to work in collaboration. My collaborative work then intensified and became more international.

- 117 talks (73 in conferences or abroad)

Expertise

- president of an evaluation committee for the CNRS in 2019, member of 2 laboratory evaluation committees for the Hceres in 2017
- Regional evaluation for PhD grant (4 years : 2019, 2020, 2021, 2022)
- 3 reports on PhD-theses (2 abroad) and 10 other PhD-thesis defense committee (only 2 in my university)
- 1 report on an Research Direction Habilitation (HDR) and another HDR committee
- 21 teacher-researcher recruiting committees
- Report for a tenure (2021)
- 34 detailed reports for international journals

Publication and preprint of my PhD-students' work

- Nasab Yassine, **Quantitative recurrence of some dynamical systems with an infinite measure in dimension one**, Discrete and Continuous Dynamical Systems-A 2018, 38 (1): 343–361.
- Maxence Phalempin, **Limit theorems for self-intersecting trajectories in $\mathbb{Z}$-extensions**, submitted preprint, 37 pages. accessible on Hal: hal-03504799

Two other manuscripts (one by Nasab and one by Maxence, in continuation of their PhD-theses) are in end of redaction.

Book

- F. Pène, **Stochastic properties of dynamical systems**, Cours Spécialisés de la SMF, Tome 30 (2022), 276 p.

Articles

[1] F. Pène, **Applications des propriétés stochastiques de billards dispersifs**
Comptes Rendus de l'Académie des Sciences 330, série I (2000), 1103–1106

[2] F. Pène, **Rates of convergence in the CLT for two-dimensional dispersive billiards**
Communications in Mathematical Physics 225, No 1 (2002), 91–119

[3] F. Pène, **Averaging method for differential equations perturbed by dynamical systems**
ESAIM Probability and statistics 6 (2002), 33–88

[4] F. Pène, **Multiple decorrelation and rate of convergence in multidimensional limit theorems for the Prokhorov metric**
Annals of Probability 32, No 3B (2004), 2477–2525

[5] Stéphane Le Borgne et F. Pène **Vitesse dans le théorème limite central pour certains systèmes dynamiques quasi-hyperboliques**
Bulletin de la Société mathématique de France 133, No 3 (2005), 395–417

[6] F. Pène, **Rate of convergence in the multidimensional CLT for stationary processes. Application to the Knudsen gas and to the Sinai billiard**
Annals of Applied Probability 15 (2005), 2331–2392

[7] F. Pène, **Transient random walk in $\mathbb{Z}^2$ with stationary orientations**
ESAIM Probability and Statistics 13 (2009), 417–436

[8] F. Pène, **Asymptotic of the number of obstacles visited by the planar Lorentz process**
Discrete and Continuous Dynamical Systems, series A, 24, No 2 (2009), 567–588

[9] F. Pène, **Planar Lorentz process in a random scenery**
Annales de l'Institut Henri Poincaré, Probabilités et Statistiques 45, No 3 (2009), 818–839

[10] F. Pène, Benoît Saussol, **Quantitative recurrence in two-dimensional extended processes**
Annales de l'Institut Henri Poincaré, Probabilités et Statistiques 45, No 4 (2009), 1065–1084

[11] F. Pène, Benoît Saussol, **Back to balls in billiards**
Communications in Mathematical Physics 293 (2010), 837–866

[12] Loïc Hervé, F. Pène, **The Nagaev method via the Keller-Liverani theorem**
Bulletin de la Société Mathématique de France 138 (2010), 415–489

[13] Fabienne Castell, Nadine Guillotin-Plantard, F. Pène et Bruno Schapira, **A local limit theorem for random walks in random scenery and on randomly oriented lattices**
Annals of Probability 39, No 6 (2011), 2079–2118

[14] Nadine Guillotin-Plantard, F. Pène, **Renewal theorems for random walks in random scenery**
Electronic Journal of Probability 17, No 78 (2012), 1–22

[15] F. Pène, Benoît Saussol, Roland Zweimüller, **Recurrence rates and hitting-time distributions for random walks on the line**
Annals of Probability 41, No 2 (2013), 619–635

[16] Fabienne Castell, Nadine Guillotin-Plantard, F. Pène, **Limit theorems for one and two-dimensional random walks in random scenery**
Annales de l'Institut Henri Poincaré, Probabilités et Statistiques 49, No 2 (2013), 506–528

[17] Loïc Hervé, F. Pène, **Study of the recurrent set for planar Markov random walks**
Journal of Theoretical Probability 26, No 1 (2013), 169–197

[18] Jérôme Dedecker, Florence Merlevède, F. Pène, **Rates of convergence in the strong invariance principle for non adapted sequences. Application to ergodic automorphisms of the torus**
Proceedings of the sixth International Conference on High Dimensional Probability, Progress in Probability 66 (2013), 113–138

[19] Alexis Devulder, F. Pène, **Random walk in random environment in a two-dimensional stratified medium with orientations**
Electronic Journal of Probability 18, No 88 (2013), 1–23

[20] Fabienne Castell, Nadine Guillotin-Plantard, F. Pène, Bruno Schapira, **On the one-sided exit problem for stable processes in random scenery**
Electronic Communications in Probability 18, No 33 (2013), 1–7

[21] Alfrederic Josse, F. Pène, **Degree and class of caustics by reflection for a generic source**
Comptes Rendus de l'Académie des Sciences - Mathématique 351 (2013), 295–297

[22] Jérôme Dedecker, Florence Merlevède, F. Pène, **Empirical central limit theorems for ergodic automorphisms of the torus**
ALEA Lat. Am. J. Probab. Math. Stat. 10, No 2 (2013), 731–766

[23] Fabienne Castell, Nadine Guillotin-Plantard, F. Pène, Bruno Schapira, **On the local time of random processes in random scenery**

Annals of Probability 42 (2014), No. 6, 2417–2453

[24] Alfrederic Josse, F. Pène, **On the degree of caustics by reflection**
Communications in Algebra 42, No 6 (2014), 2442–2475

[25] Jérôme Dedecker, Florence Merlevède, F. Pène, **Rates in the strong invariance principle for ergodic automorphisms of the torus**
Stochastics and Dynamics Vol. 14, No. 2 (2014) 1350021 (30 pages)

[26] F. Pène, **Self-intersections of trajectories of Lorentz process**
Discrete and Continuous Dynamical Systems-A 34, No 11 (2014), 4781–4806

[27] Nina Gantert, Michael Kochler, F. Pène, **On the recurrence of some random walks in random environment**
ALEA 11 (2014), 483–502

[28] Alfrederic Josse, F. Pène, **On the class of caustics by reflection of planar curves**
Annali della Scuola Normale Superiore di Pisa, Classe di Scienze XIV, No 3 (2015), 881–906.

[29] Pierre Ailliot, F. Pène, **Consistency of the maximum likelihood estimate for Non-homogeneous Markov-switching models**
ESAIM PS 19 (2015), 268-292.

[30] Pierre Ailliot, Julie Bessac, Valérie Monbet, F. Pène, **Non-homogeneous hidden Markov-switching models for wind time series**
Journal of Statistical Planning and Inference, Elsevier, (2015), 160, 75-88. doi:10.1016/j.jspi.2014.12.

[31] F. Pène, Benoît Saussol, **Poisson law for some nonuniformly hyperbolic dynamical systems with polynomial rate of mixing**
Ergodic Theory and Dynamical Systems 36, No 8 (2016), 2602–2626. doi:10.1017/etds.2015.28..

[32] Alfrederic Josse, F. Pène, **On caustics by reflection of algebraic surfaces**
Advances in Geometry 16, No 4 (2016), 437–464.

[33] F. Pène, Benoît Saussol, Roland Zweimüller, **Return- and hitting-times limits for rare events of null-recurrent Markov maps**
Ergodic Theory and Dynamical Systems 37, No 1 (2017), 244–276. doi:10.1017/etds.2015.38.

[34] Brice Franke, F. Pène, Martin Wendler, **Convergence of U-statistics indexed by a random walk to stochastic integrals of a Levy sheet**
Bernoulli 23, No 1 (2017), 329–378.

[35] Alfrederic Josse, F. Pène, **On the Halphen transform of algebraic space curves**
Communications in Algebra 45, No 2 (2017), 606–620.

[36] Brice Franke, F. Pène, Martin Wendler **Stable Limit Theorem for U-Statistic Processes Indexed by a Random Walk**
Electronic Communications in Probability 22 (2017), No. 9, 1–12.

[37] Frank Aurzada, Alexis Devulder, Nadine Guillotin-Plantard, F. Pène, **Random walks and branching processes in correlated Gaussian environment**
Journal of Statistical Physics 166 (2017), No 1, 1–23

[38] Frank Aurzada, Nadine Guillotin-Plantard, F. Pène, **Persistence probabilities for stationary increment processes**
Stochastic Processes and Applications, 128 (2018), no. 5, 1750–1771.

[39] F. Pène, **Mixing in infinite measure for $\mathbb{Z}^d$-extensions, application to the periodic Sinai billiard**
Chaos, Solitons and Fractals, special issue "Probabilistic Dynamics", 106 (2018), 44–48.

[40] F. Pène, **Mixing and decorrelation in infinite measure: the case of the periodic sinai billiard**
Annales de l'Institut Henri Poincaré, Probabilités et Statistiques, 55 (2019), No. 1, 378–411

[41] Alexis Devulder, Nina Gantert, F. Pène, **Collisions of several walkers in reccurrent random environments**
Electronic Journal of Probability, 23 (2018), paper no. 90, 1-34.

[42] F. Pène, Damien Thomine, **Potential kernel, hitting probabilities and distributional asymptotics**
Ergodic Theory and Dynamical Systems, Volume 40, Issue 7 (07/2020, en ligne: 26/01/2019), 1894-1967. doi:10.1017/etds.2018.136

[43] Loïc Hervé, Sana Louhichi, F. Pène, **Exponential growth of branching processes in a general context of lifetimes and birthtimes dependence**
ESAIM Probability Statistics 23 (2019), 584–606.

[44] Loïc Hervé, Sana Louhichi, F. Pène, **Multiplicative ergodicity of Laplace transforms for additive functional of Markov chains**
ESAIM Probability Statistics 23 (2019), 607–637.

[45] Alessandra Bianchi, Marco Lenci, F. Pène, **Continuous-time random walk between Lévy-spaced targets in the real line**
Stochastic Processes and their Applications, 130 (2020), No 2, 708–732.

[46] F. Pène, Benoît Saussol, **Spatio-temporal Poisson processes for visits to small sets**
Israel Journal of Mathematics 240 (2020) 625–665.

[47] Alexis Devulder, Nina Gantert, F. Pène, **Arbitrary many walkers meet infinitely often in a subballistic random environment**
Electronic Journal of Probability, 24 (2019), paper no. 100, 25 pp.

[48] Paul Jung, F. Pène, Hong-Kun Zhang, **Convergence to α-stable Lévy motion for chaotic billiards with cusps at flat points**
Nonlinearity, 33 (2019), No 2, 807–839

[49] Mark Demers, F. Pène, Hong-Kun Zhang, **Local limit theorem for randomly deforming billiards**
Communications in Mathematical Physics, 375 (2020) 2281-2334.

[50] Nadine Guillotin-Plantard, F. Pène, Martin Wendler, **Empirical processes for recurrent and transient random walks in random scenery**
ESAIM PS 24 (2020) 127–137

[51] F. Pène, D. Thomine, **Central limit theorems for the $\mathbb{Z}^2$-periodic Lorentz gas**
Israel Journal of Mathematics, 241 (2021), 539–582

[52] Paul Jung, Ian Melbourne, F. Pène, Paulo Varandas, Hong-Kun Zhang, **Necessary and sufficient condition for $\mathcal{M}_2$-convergence to a Lévy process for billiards with cusps at flat points**
Stochastics and Dynamics, Vol. 21, No. 5 (2021) 2150024 (8 pages)

[53] F. Pène, Benoît Saussol, **Application of the convergence of the spatio-temporal processes for visits to small sets**, Chapitre d'ouvrage, Pollicott M., Vaienti S. eds, Thermodynamic Formalism. Lecture Notes in Mathematics (Morlet Chair), vol 2290. Springer, Cham. (2021), 263–288.

[54] F. Pène, Damien Thomine, **Probabilistic potential theory and induction of dynamical systems**
Annales de l'Institut Henri Poincaré, Probabilités et Statistiques, Vol. 57 (2021), No. 3, 1736–1767.

[55] F. Pène, Dalia Terhesiu, **Sharp error term in local limit theorems and mixing for Lorentz gases with infinite horizon**
Communications in Mathematical Physics, volume 382 (2021), 1625–1689.

[56] Dmitry Dolgopyat, Péter Nándori, F. Pène, **Asymptotic expansion of correlation functions for $\mathbb{Z}^d$-covers of hyperbolic flows**
Annales de l'Institut Henri Poincaré, Probabilités et Statistiques, Vol. 58, Issue 2, (May 2022) , 1244–1283

[57] F. Pène, **Limit theorems for additive functionals of random walks in random scenery**
Electronic Journal of Probability, Vol. 26 (2021), paper no. 128, 1–46.

[58] Kasun Fernando, F. Pène, **Expansions in the local and the central limit theorems for dynamical systems**
Communication in Mathematical Physics, Vol. 389 (2022), 273–347.

[59] F. Pène, **Probabilistic limit theorems via the operator perturbation method, under optimal moment assumptions**
Accepté pour publication dans Annales de l'Institut Henri Poincaré
hal-03241597, 39 pages.

[60] I. Melbourne, F. Pène, D. Terhesiu, **Local large deviations for periodic infinite horizon Lorentz gases**

Accepté pour publication dans Journal d'Analyse Mathématique
arXiv:2108.13748 , 30 pages.

Conference Proceeding

[A1] F. Pène, **Random walks in random sceneries and related models**, ESAIM: Proceedings and surveys, (Journées MAS 2018) 68, 35-51 (2020).

Other publications

[A] F. Pène, **Approximation d'une diffusion induite sur une équation cinétique par un système dynamique**, fascicule de Probabilités de l'IRMAR, 49 p. (1998)
[B] Stéphane Le Borgne, F. Pène, **Vitesse dans le théorème limite central pour certains processus stationnaires fortement décorrélés**, arXiv:0306083 (2003), complementary document to [5].

Submitted preprint

[a] F. Pène, D. Terhesiu, **Strong mixing for the periodic Lorentz gas flow with infinite horizon**. hal-03979660. 71 pages.

Popularization articles

[1] F. Pène, **Marches aléatoires et modèle de Lorentz : une approche de la théorie du chaos**, Images des Mathématiques, CNRS (2011).
[2] Nadine Guillotin-Plantard, F. Pène, **Les PAPAs**, Images des Mathématiques, CNRS (2012).
[3] F. Pène, paragraphe sur les systèmes chaotiques, book of mathematics 1ère S, collection Barbazo, Hachette, p. 150 (2015).
[4] F. Pène, **Des flippers de taille infinie**, INSMI web page, CNRS, Scientific actualities (04/2017).
[5] Alfredéric Josse, F. Pène, **Codes correcteurs d'erreurs et jeu de cartes (avec ou sans mensonge)**, Example of activity accompanying the announcement of a special volume dedicated to popularization activities, Gazette de la SMF, Avril 2022
- Long version hal-03527313, 14 p.
- Material : https://kits.math.cnrs.fr/spip.php?activite27