

Curriculum-Vitæ of Stéphane Jaffard

Born: Mai 23d 1962 at Boulogne-Billancourt, France

Professional Address: Département de Mathématiques, UFR de Sciences et Technologie, UPEC (Université Paris Est Créteil), 61 Avenue du Général de Gaulle, 94010 Créteil Cedex, France

See [my webpage](#)

Career and recognition

Since September 1st 1995: Full professor at Université Paris Est Créteil

Fall 2023: Holder of the [Aisenstadt Chair](#) (CRM, University of Montreal)

2022: On leave at INSMI (Mathematics Institute of CNRS), in charge of the organization of the [Assises des Mathématiques](#), a major mediatic event which demonstrated the increasing importance of mathematics in sciences, industry and society. It took place at UNESCO, in Paris (Nov. 14–16).

November 2021: Laureate of the *Jacques-Louis Lions Prize* (“Grand Prix Thématique” of the French Academy of Sciences)

2011-2014: Head of the Bézout CNRS Federation (and of the corresponding Labex)

August 2010: Plenary speaker at CLAM IV (Latin-American Congress of Mathematics)

2007-2010: President of the French Mathematical Society (SMF)

2000-2005: Junior Member of the *Institut Universitaire de France*

1989-90: Member of the Institute for Advanced Study (Princeton)

1986-89: PhD Thesis at Ecole Polytechnique: *Construction and properties of wavelet bases, remarks on exact controllability* (Advisor: Yves Meyer)

1981-84: Student at Ecole Polytechnique, France

Member of the following editorial boards:

Journal of Fractal Geometry, Applied and Computational Harmonic Analysis, Journal of Fourier Analysis and Applications, Constructive Approximation, Lecture Notes in Applied and Numerical Harmonic Analysis

Recent scientific responsibilities

Research projects (P.I. or Co-P.I.):

2019-2023: *Multifractal analysis and modelling for cities* (ISITE FUTURE of COMUE Paris Est Sup);

2017-2021: *Multifractal theory and methods for large size multivariate systems and applications to scale free analysis of brain dynamics analysis* ANR project (Agence Nationale de la Recherche);

2012-2015: CNRS Groupe de Recherche (GDR) “Analyse multifractale”;

2012-2016: AMATIS *Analyse Multifractale pour l'Analyse et le Traitement de l'Image et du Signal*. ANR project

Membership in national and international hiring committees:

2017-2018: “Mathematics and Biology” committee of the ANR (member of the board),

2017: Bergen Research Foundation (Norway),

2014, 2016, 2017: Vienna Science and Technology Fund (Austria),

2011, 2012, 2014: Institut Universitaire de France,

2016: Head of the HCERES evaluation committee of the J.A. Dieudonné Laboratory (Côte d’Azur University, Nice, France).

Membership in research councils of academic institutions:

Ecole Universitaire de Recherche (EUR) Math & Computer Sciences of Université Paris Nord (2020-...); Doctoral school MSTIC of Paris Est Sup (2019- 2021); ISITE FUTURE of COMUE Paris Est Sup (2017- ...); French Mathematical Society (2016- 2018); Université Paris Est Créteil (2012-2016); Marne la Vallée University (2012-2015); ESIEE (2013-...); COFECUB (French-Brazil cooperation organism) 2012-2018.

Visits to foreign research centers (2005-2023)

Fall 2023: CRM of Montreal as holder of the “Aisenstadt Chair”
Fall 2017: Mittag-Leffler Institute (Stockholm) for the “Fractal geometry and dynamics” program
November 2015: Invited by J.-M. Lina at CRM in Montreal, Canada
October 2012: Schrödinger Institute in Vienna (Austria) during the ESI 2012 semester *Modern Methods of Time-Frequency Analysis*
November 2007: Invited by M. de Hoop at Purdue University
Mars 2006: Invited by F. Herrmann at UBC (University of British Columbia, Canada)
Avril 2006: Invited by M. Lapidus at UCR (University of California at Riverside)

Organisation of international conferences and schools (2005-2023)

July 3-15 2023: School “ Harmonic and Multifractal analyses: From Mathematics to Quantitative Neurosciences” (CRM, Montréal)
June 2019 : Wavelets and Beyond - A celebration for Alexandre Grossmann and Yves Meyer, Orsay University
June 2018: Image Processing for Art Investigation, Ghent, Belgique
August 2017 : CIMPA School “New trends in applied harmonic analysis: Sparse representations, compressed sensing and multifractal analysis”, Buenos Aires, Argentina
Juillet 2016: “Analysis and Probability” ,Conference in honour of Jean-Pierre Kahane (Orsay and Paris)
March 2014: Multifractal analysis: From theory to applications and back, at BIRS (Banff, Canada):
August 2013: CIMPA School: “New Trends in Applied Harmonic Analysis: Sparse Representations, Compressed Sensing and Multifractal analysis”, Mar del Plata, Argentina
March 2011: Conference in memory of Benoît Mandelbrot, Ecole Polytechnique, France
2008-09: Coorganiser of the IMI special year “Analysis and its applications” of the Indian Institute of Science.
June 2008: “Wavelets and Applications” : Two weeks conference in Singapore
August 2007: Summer School “Wavelets and applications to signal and image processing”, Zuhai, China

PhD and PostDoc level courses (outside France): 2005-2023

July 2023 : Summer school *Harmonique and multifractal analyses : From mathematics to neurosciences*, CRM, Université de Montréal. Course on the foundations of Multifractal Analysis .
June 2021: Summer school *Analyse Harmonique et Applications*, Félix Houphouët-Boigny University, Abidjan: Course on Multifractal Analysis
August 2017: Buenos Aires : CIMPA summer school *New trends in applied harmonic analysis: Sparse representations, compressed sensing and multifractal analysis*; course “Multifractal analysis based on wavelet bases : Mathematical foundations and p-leaders analysis”
June 2014: Trieste summer school *Coherent state transforms, time-frequency and time-scale analysis, applications* Course on Multifractal Analysis.
January 2012: Bangalore winter school (India) *Cocompact imbeddings; profile decompositions and their applications to PDE*. Course on Wavelet characterizations of function spaces.

May 2010: Paseky, Czech Republic, *Analysis summer school* Course: An Introduction to Davenport Series
 May 2009: Year on Analysis and applications of IFIM; Course: “Multifractal Analysis ” at IMI (Bengalore)
 March 2009: Course on Wavelet analysis at the graduate school of Monastir Faculty of Sciences (Tunisia)
 March 2005: Signal Processing UNESCO chair of “Mathématiques and developpement”), course on “Wavelet methods in Analysis” Tunis (Tunisia).

PhD Students : Quentin Rible (2022-...), Qian Zhang (2021-...), Wejdene Nasr Ben Hadj Amor (2019- ..) Guillaume Saes (2016- 2021), Xiaochuan Yang (2013- 2016), Dan Zhou (2005-2009), Marianne Clausel (2004-2008), Arnaud Durand (2003-2007), Aurelia Fraysse (2001-2005), Sophie Dispa (2002-2006), Francois Roueff (1997-2001), Clothilde Melot (1998-2002), Jean-Marie Aubry (1995-1998), Abdelhak Ezzine (1992-1997), Mourad Ben Slimane (1993-1996), Francis Ribaud (1993-1996).

Invitations to international conferences as plenary speaker (2011–2023)

May 11-12, 2023: Scientific days in honor of Ingrid Daubechies on the occasion of her nomination as Doctor Honoris Causa of Rome University *la Sapienza*.
 April 19-21, 2023: *Multiscale tour of harmonic analysis and machine learning*, Conference in honor of Stéphane Mallat, IHES, France
 March 24-26, 2023 : *Applied and Industrial mathematics*, Sharda University and the Indian Society of Industrial and Applied Mathematics
 September 3-9, 2022: *FARF IV (Fractals and related Fields)*, Porquerolles, France
 June 7-10, 2022 *Scale Invariance and Randomness*, Lille, France
 August 2-6, 2021: *13th ISAAC Congress*, Ghent, Belgium
 June 28-29, 2021: *11th International Conference on Image Processing, Wavelet and Applications*, Istanbul, Turkey
 July 2-3, 2019: *Rigueur: Musique, Philosophie, Mathématiques*”, EHESS, Paris
 September 19-21, 2019: *Jubilee of Fourier Analysis and Applications in honour of John Benedetto*, University of Maryland
 December 7-9, 2018: *Annual Conference of the Hellenistic Mathematical Society*, Athens, Greece
 June 25-27, 2018: *Time, frequency, and everything that follows: In celebration of the 64th birthday of Ingrid Daubechies*, Hasselt, Belgium
 February 5-7, 2018: *International Symposium on Computational Science and its Applications*, Sharda University, Delhi, India
 February 1-4, 2018: *14th Biennial Conference of ISIAM*, Amritsar, India
 October 2-6, 2017: *Harmonic analysis and geometric measure theory* CIRM, France
 July 3-7, 2017: *SAMPTA*, Tallin, Estonie
 September 19-25, 2015: *Fractals and Related Fields III*, Porquerolles, France
 March 16-20, 2015: *Annual Conference of the Tunisian Mathematical Society*, Hammamet, Tunisai
 June 10-13 2014: *Harmonic Analysis, Probability and Applications, Conference in honour of Aline Bonami*, Orléans, France
 May 19-23, 2014: *Fifth International Conference on Computational Harmonic Analysis and Applications*, Nashville, Tennessee
 March 24-28, 2014: *Fractal Geometry and Stochastics V*, Tabarz, Germany
 October 28-31, 2013: *Nord-Pas de Calais Belgium Congress of Mathematics*, Valenciennes and Mons

February 11-15, 2013: *Time-frequency analysis and uncertainty*, Oslo
 December 10-14, 2012: *Advances on fractals and related topics*, Hong-Kong
 September 17-21, 2012: *Turbulent cascades in the solar wind: anisotropy and dissipation*, Meudon, France
 August 6-10, 2012: *CLAM IV (4th Latin-American Congress of Mathematics)*, Córdoba, Argentina
 August 21-24, 2012: *Abel Symposium on Operator Related Function Theory and Time-Frequency Analysis*, Oslo
 June 25-28, 2012: *MNOTSI 2012 (Modelling and Numerical Simulation)*, Kenitra, Morocco
 March 22-3, 2012: *Nonlinear Evolution Equations and applications*, Hammamet, Tunisia
 December 5-9, 2011: *Mathematics: Muse, Maker, and Measure of the Arts*, BIRS, Banff, Canada
 June 13-17, 2011: *Fractals and Related Fields II*, Porquerolles, France
 June 6-10, 2011: *Selfsimilarity and related fields*, Le Touquet, France
 March 27-April 2, 2011: *Operator algebras and representation theory: Frames, Wavelets and Fractals*, Oberwolfach, Germany

Selected publications:

I. Daubechies, S. Jaffard, J.-L. Journé *A simple Wilson orthonormal basis with exponential decay*, **S.I.A.M. Journal of Mathematical Analysis** Vol. **22**, pp. **554–572**, **1991**

This article brings an answer to a conjecture of Physics Nobel Prize laureate K. Wilson concerning the existence of orthonormal bases with a uniform exponential localization around one position and two opposite frequencies. The simple algorithmic structure of this “time-frequency” basis offers a numerically efficient way to turn the “Balian-Low” impossibility statement, which was a major deadlock in signal processing (the Balian-Low theorem states that the elements of an orthonormal basis cannot be uniformly well localized in space and frequency). A spectacular use of this mathematical tool was recently put in light: This basis is a key ingredient in the gravitational waves detection procedure.

S. Jaffard, *The multifractal nature of Lévy processes*, **Probability Theory and Related Fields**, Vol. **114** N.2 pp.207–227, **1999**

This article shows that the sample paths of a class of stochastic processes which play a central role in probability are *multifractal*: Their pointwise regularity exponent is a very erratic random function, which takes a given value on everywhere dense fractal sets, whose Hausdorff dimension (referred to as the *multifractal spectrum*) is determined. Before this article, regularity results of random processes were mostly obtained at a fixed point, and thus led to deterministic pointwise results (as opposed to the regularity of a generic sample paths, which usually is random). This paper introduced a novel approach to study pointwise regularity of stochastic processes, and paved the way for similar results obtained for wide collections of stochastic processes.

S. Jaffard, *On the Frisch-Parisi conjecture*, **Journal de Mathématiques Pures et Appliquées**, Vol. **79** n. **6** pp. **525–552**, **2000**

This article shows that quasi-every function (in the sense of Baire categories) of most classical function spaces (e.g. Sobolev or Besov spaces) is multifractal. The role played by this article can be compared to the famous Banach-Mazurkiewicz result stating that quasi-every continuous function is nowhere differentiable: Functions which, before, were considered as “pathological” were actually shown to be generic. This article also had an impact on physicists working in turbulence: The fact that multifractality was proved to be generic showed that, contrary to a common belief, it needs not be the consequence of a cascade type construction (such as the *Richardson cascade*, a mechanism widely acknowledged to explain the energy dissipation of turbulent flows).

S. Jaffard, *Wavelet techniques in multifractal analysis*, **Fractal Geometry and Applications: A Jubilee of Benoît Mandelbrot**, M. Lapidus et M. van Frankenhuysen Eds., **Proceedings of Symposia in Pure Mathematics, A.M.S., Vol. 72 Part 2, pp. 91–151, 2004**

This article introduced *wavelet leaders*, a new multiresolution quantity on which the numerical determination of multifractal spectra can be based (through a procedure referred to as the *multifractal formalism*). This procedure is shown to enjoy better mathematical properties than previous ones (such as using the Kolmogorov scaling function, the Wavelet Transform Maxima Method, or the Detrended Fluctuation Analysis method): It supplies a general upper bound of the multifractal spectrum, and has robustness properties (invariance under smooth diffeomorphisms or smooth perturbations). An indication of its success is that the method proposed in this paper is now the one used in MatLab algorithms to perform the multifractal analysis of signals.

S. Jaffard, B. Martin *Multifractal analysis of the Brjuno function*, **Inventiones Mathematicae, Volume 212, pp 109-132, 2018**

The Brjuno function quantifies how small the iterates of the Gauss map can be at a given point. It was introduced by J.-C. Yoccoz in order to encapsulate information concerning analytic small divisor problems in dimension 1, and it plays a key role in the theory of holomorphic dynamical systems. Several conjectures by Yoccoz, Marmi and Moussa concern the regularity of this function or its variants. In this article the regularity of this function (using the p -exponent of Calderón and Zygmund) at every point is determined, thus showing that it is another example of multifractal function.

S. Jaffard, S. Seuret, H. Wendt, R. Leonarduzzi, P. Abry, *Multifractal formalisms for multivariate analysis*, **Proceedings of the Royal Society A, Vol. 475, N. 2229, 2019**

The prevalence of big data in sciences has led to new demands in signal and image processing: Instead of one signal, a collection of correlated signals is available, thus requiring for the development of new mathematical tools to perform a multivariate analysis, i.e. a joint analysis of these collections of data: the main scientific challenge is to go beyond the classical statistical tools which allow to measure correlations in order to understand how the singularity sets of the different signals are related. In this article the mathematical properties and limitations of such a multifractal analysis are investigated and the first results concerning mathematical models are derived.