

# 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

## Career and recognition

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

2022: On leave at INSMI (Mathematics Institute of CNRS), in charge of the organisation of the “*Assises des Mathématiques*” (fall 2022), a major media event which will demonstrate the increasing importance of mathematics in sciences, industry and society.

November 2021: Laureate of the *Jacques-Louis Lions Prize* (thematic “grand prix” of the French Academy of Sciences)

2019- 2022: Vice-Director of the LAMA CNRS laboratory (Laboratoire d’Analyse et de Mathématiques Appliquées)

2011-2014: Director of the Bézout Labex and CNRS Federation

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

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

2000-2005: 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)

1984-87: Student at Ecole Nationale des Ponts et Chaussées

1981-84: Student at Ecole Polytechnique, France

## Editorial boards

Journal of Fractal Geometry (since 2014)

Panoramas et Synthèses, SMF book series (2004-07)

Applied and Computational Harmonic Analysis (since 1993)

Journal of Fourier Analysis and Applications (since 1994)

Constructive Approximation (since 1998)

Applied and Numerical Harmonic Analysis, Springer book series (since 2011)

## Scientific Responsibilities

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

2019-2022: *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 (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

### **Membership in national and international hiring committees:**

2017-2018: Board of the “Mathematics and Biology” committee of the ANR;  
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- ...); 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.

### **Membership in administration boards of academic institutions:**

COMUE Paris Est Sup (2018- ...), Société Mathématique de France (2006-2012), Société de Mathématiques Appliquées et Industrielles (2004-2007), Université Paris Est Créteil (1997-2005).

## **Stays in foreign research centers**

October 2017: Mittag-Leffler Institute (Stockholm) during the term “Fractal geometry and dynamics”  
November 2015: Invited by J.-M. Lina at CRM (Centre de Recherches Mathématiques) 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)  
1st Term 1999: Newton Institute in Cambridge (GB) for the term “Applications of Fractals”.  
Spring 1996 : CRM Semester on Wavelets (Montreal, Canada).

## **Organisation of international conferences and schools**

Spring 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  
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)  
Mars 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” conference in Singapore

August 2007: Summer School “Wavelets and applications to signal and image processing”, Zuhai, China

October 2004: “Wavelets and fractals” conference in Monastir (Tunisie)

July 2004: Summer school “Wavelets and Multifractals” in Cargese (France)

June 2003: Conference in honour of Ronald Coifman and Yves Meyer” at Orsay, France

May 2001: “Wavelets and fractals” Conference in Monastir (Tunisia)

May 1998: “International wavelet Conference” in Tangiers (Morocco)

Juin 1992: Summer school “wavelets” in Wuhan (China).

## Master and PhD courses

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*; minicourse “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.

March 2014: Cergy-Pontoise University: *AUF Séminar in Mathematics* Mini-course : “L’analyse multifractale: de nouveaux outils issus de l’analyse pour la classification de signaux et d’images”

January 2012: Bangalore winter school (India) *Cocompact imbeddings; profile decompositions and their applications to PDE*. Minicourse on Wavelet characterizations of function spaces.

June 2010: *Analyse on Fractals* school in Grenoble, France; Minicourse on Wavelet techniques in Multifractal analysis

May 2010: Paseky, Czech Republic, *Analysis summer school* Course: An Introduction to Davenport Series

May 2009: Year on Analysis and applications of IFIM; Mini-course “Multifractal Analysis ” at IMI (Bengalure)

March 2009: Course on Wavelet analysis at the doctoral school of the Monastir Faculty of Sciences (Tunisia)

2001-2017 : Course “Multifractal Analysis ” Master 2 level at Marne-La-Vallée University.

March 2005: Signal Processing UNESCO trimester chair of “Mathématiques and developpement”), course on “Wavelet methods in Analysis” Tunis (Tunisia).

March 2004: School on *Power laws in Probability and Statistics* : Minicourse “Introduction to multifractal analysis” (CIRM, Marseille).

February 2004 : Winter school *Recent Trends in Nonlinear Analysis*, (Palma de Majorque, Spain), Minicourse “Wavelet techniques for the local regularity of signals”

February 2001: Doctoral course on “Wavelet analysis” at University Paul Sabatier (Toulouse, France)

1995-2001: Course “Wavelets and Applications” Master 2 of Analysis and Random Systems, Marne-La-Vallée University.

1990-1995: Course “Wavelets and Numerical Analysis”, Master 2 of Numerical Analysis (Orsay, France)

August 1994: Doctoral minicourse on “Wavelet Methods in Mathematical Physics” organised by CITMA (Madera).

March 1992: Minicourse on “ Wavelets and Opérateurs” at the Doctoral school of de Bordeaux University (France) .

May 1990: Minicourse on “Wavelet methods for the resolution of PDEs” at E.N.S. Cachan (France).

## PhD Students

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

August 2-6, 2021: *13th ISAAC Congress*, Ghent, Belgium

June 28-29, 2021: *11th International Conference on Image Processing, Wavelet and Applications*, Istanbul, Turkey

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 Indian Society of Industrial and Applied Mathematics (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, Tunisia

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

September 2009: *Dictionary of atoms: new trends in advanced brain signal processing*, Montreal, Canada

June 2009: *Complexity in Physics, Conference in honour of Bernard Castaing and Alain Arneodo*, ENS Lyon, France.

March 2009: *Franco-Tunisian Conference of Mathematics*, Djerba, Tunisia

December 2008: *Indo-French Conference in Mathematics*, Chennai, India

October 2008: *Conference in memory of Jean-Morlet*, CIRM, France

July-August 2008: *NATO Advanced Study Institute on Unexploded Ordnance Detection and Mitigation*, Il Ciocco, Italy

June 2008: *Annual Conference of the Portuguese Mathematical Society*, Coimbra, Portugal

May 2008: *Symposium in honour of Ingrid Daubechies*, Hasselt, Netherlands

Mach 2008: *Annual Conference of the Tunisian Mathematical Society*, Hammamet, Tunisia

March 2008: *PDE Conference*, Hammamet, Tunisia

February 2008: *Franco-Corean Conference in Analysis*, Paris, France

March 2007: *Harmonic Analysis and its Applications*, Tokyo, Japan

July-August 2008: *NATO Advanced Study Institute: Imaging for Detection and Identification*, Il Ciocco, Italy

November 2005: *International Conference on Wavelet Analysis and its Applications*, University of Macao, China

October 2005: *Interface between Harmonic Analysis and Number Theory*, CIRM, France

July 2-9, 2005: *Conference on operator theory, function spaces and applications*, Aveiro, Portugal

November 15-19, 2004: *Mathematical Analysis and Multiscale Geometric Analysis*, IPAM, UCLA, USA

September 20-24, 2004: *Approximation and Probability, Conference on the occasion of the 70th anniversary of Professor Zbigniew Ciesielski*, Bedlewo, Poland

June 2004: *Functional Analysis and PDE Conference*, Han sur Lesse (Belgium)

May 2004: *Second International Conference on Computational Harmonic Analysis*, Nashville, Tennessee

May 2003: *NBFAS Conference*, Edinbrough, Scotland

June 2002: *Functional Analysis and PDE Conference*, Han sur Lesse (Belgium)

May 2001: *SAMPTA (Sampling Theory and Applications)*, Orlando, USA

July 2000: *2000 years of Harmonic Analysis* NATO-ASI Conference, Il Ciocco, Italy)

October 1999: *Conference in honour of John Benedetto*, College Park, USA

March 1999: *Annual Conference of the Tunisian Mathematical Society*, Tabarka, Tunisia

January 1999: *Lévy Processes*, Aarhus, Denmark

July 1998: *NATO-ASI Conference on multimedia*, Il Ciocco, Italy

April 1998: *Wavelets and applications*, Tangiers, Morocco

February-March 1998: *Order, Chance and Risk, Les Houches winter school on Wavelets*, Les Houches, France

July 1997: *Signal Analysis, Simulation and Probabilistic Models*, Marseille, France

June 1997: *Control and PDEs*, CIRM, Marseille, France

September 1996: *Numerical methods in PDEs*, Trieste, Italy

August 1996: *Summer school Wavelets and Applications*, Zakopane, Poland

August 1995: *Wavelets and signal analysis*, Oberwolfach, Germany

March 1995: *Multiscale methods in numerical analysis*, Berlin, Germany

February 1995: *Recent advances in numerical methods for PDE's*, Turin, Italy

May 1994: *Conference in honour of Misha Cotlar*, Caracas, Venezuela

June 1993: *International Conference on Wavelets*, Taormina, Italy

July 1992: *Nato-ASI Conference on Wavelets and applications*, (Il Ciocco, Italy)

May 1992: *Wavelets and signal analysis*, Oberwolfach, Germany

July 1991: *Nato-ASI Conference on Probabilistic and Stochastic Methods in Analysis and Applications*, Il Ciocco, Italy

October 1990: *Wavelets, Fractals and Fourier transforms*, Cambridge, G.B.

June 1990: Annual Conference of the European Consortium for Mathematics in Industry, *Lahti, Finland*

June 1989: Conference in memory of Jose-Luis Rubio de Francia, El Escorial, Spain

June 1989: *Real and Harmonic Analysis*, Oberwolfach, Germany

June 1987: *International Workshop in Analysis and Applications*, Dubrovnik, Yougoslavia

May 1987: *Workshop in Computational Vision DIKU*, Copenhagen, Denmark

**A short description (in french) of my scientific contributions can be found on the web page of Université Paris Est Créteil announcing the attribution of the Jacques-Louis Lions prize:**

<https://www.u-pec.fr/fr/enseignant-e-chercheur-e/actualites/stephane-jaffard-laureat-dun-prix-de-lacademie-des-sciences>

## **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 offered 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). This basis is now used as 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 have *multifractal sample paths*: 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 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.

**S. Jaffard**, *Wavelet techniques in multifractal analysis*, **Fractal Geometry and Applications: A Jubilee of Benoît Mandelbrot**, M. Lapidus et M. van Frankenhuijsen 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 better mathematical properties than previous methods (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 pointwise regularity of this function (using the  $p$ -exponent of Calderón and Zygmund) 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. In this article the mathematical properties and limitations of such a multifractal analysis are investigated and the first results concerning concerning mathematical models (such as couples of binomial cascades) are derived.