# Wavelet Methods For Pointwise Regularity And Local Oscillations Of Functions

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**Wavelet Methods for Pointwise Regularity and Local Oscillations of Functions Share this page St( ’ )ephane Jaffard; Yves Meyer. Currently, new trends in mathematics are emerging from the fruitful interaction between signal processing, image processing, and classical analysis.**

**~~Wavelet Methods for Pointwise Regularity and Local ...~~**

**The idea is based on a wavelet characterization of pointwise Hölder regularity. Characterizations of other types of local regularity can be used to capture different local behavior [25, 26]. As ...**

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**Keywords Pointwise Ho ¨ lder regularity, Wavelets, Spectrum of singularities, Multifractal formalism. Mathematics Subject Classification 26A16, 42C40. 1 Introduction The concept of Ho ¨ lderian regularity has been introduced to study nowhere dif-ferentiable functions (several examples are given in [33, 44]). An archetype of**

**~~Wavelets techniques for pointwise anti-Holderian irregularity~~**

**So that if 0 < a < 1 and \b — xq\ > 1, these functions vanish in a neighborhood of 63 Wavelet Methods for Pointwise Regularity Xq when, for instance, e — 1/2; (4.12) is thus a consequence of f (x) — /o .Too W (^ b) ha,b) (x) % (/ * <Pa) (x). But W (a,b)^ {a)b) (x)db = (f*Oa) (x) = -a — (f*ipa) (x).**

**~~Wavelet Methods for Pointwise Regularity and Local ...~~**

**Wavelet methods for pointwise regularity and local oscillations of functions. [Stéphane Jaffard; Yves Meyer] -- We investigate several topics related to the local behavior of functions: pointwise Hölder regularity, local scaling invariance and very oscillatory "chirp-like" behaviors.**

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**Wavelet Methods for Pointwise Regularity and Local Oscillations of Functions . Ondersteuning. Adobe DRM. Currently, new trends in mathematics are emerging from the fruitful interaction between signal processing, image processing, and classical analysis. One example is given by "wavelets", which incorporate both the know-how of the Calderon ...**

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**To our knowledge, the natural definition of pointwise anisotropic regularity which allows for an anisotropic wavelet characterization was first introduced by Ben Slimane [7] in order to ...**

**~~Pointwise and directional regularity of nonharmonic ...~~**

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**Hölder regularity is the most widely used notion of pointwise regularity , . We give a review of the definition: Let $\alpha \geq 0$ and $x_0 \in R$ and a locally bounded function $f : R^d \to R$ . We say that $f \in C^{\alpha}(x_0)$ if there exists a constant C > 0 and a polynomial P with degree $deg(P) < \alpha$ such as: $|f(x) - P(x - x_0)| \leq C|x - x_0|^{\alpha}$ in the neighbourhood of the point $x_0$ .**

**~~Wavelet Leaders: A new method to estimate the multifractal ...~~**

**We study different characterizations of the pointwise Hölder spacesC s (x 0), including rate of approximation by smooth functions and iterated differences.As an application of our results we study the class of functions that are Hölder exponents and prove that the Hölder**

exponent of a continuous function is the limit inferior of a sequence of continuous functions, thereby improving a ...

~~Characterization of Pointwise Hölder Regularity ...~~
Multivariate processes with long-range memory properties can be encountered in many applications fields. Two fundamentals characteristics in such frameworks are the long-memory pa

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Scaling, Fractals and Wavelets Edited by Patrice Abry Paulo Gonçalves Jacques Lévy Véhel

~~Scaling, Fractals and Wavelets~~
The Fourier transform analyses the global regularity of a function. The wavelet transform makes it possible to analyze the pointwise regularity of a function. A signal is regular if it can be locally approximated by a polynomial.

~~Regularity Analysis~~
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S. Jaffard, Y. Meyer, Wavelet Methods for Pointwise Regularity and Local Oscillations of Functions, Memoirs of the A.M.S. Vol. 123 N. 587 (1996) [11] Applications of multifractal analysis in physics P. Abry, S. G. Roux, S. Jaffard, Detecting oscillating singularities in multifractal analysis: application to hydrodynamic turbulence, preprint ...

~~Stéphane Jaffard | publications~~
Lahdelma, S., Kotila, V.: Real order derivatives—new signal processing method. Kunnossapito, 17, No. 8, 39–42 (2003) (Finnish). Google Scholar

~~Wavelet-Based Hölder Regularity Analysis in Condition ...~~
The main goal of our article is to show that this is not the case: the latter Hölder exponents can also be expressed as lower limits of sequences of continuous functions. Our proof mainly relies on a ``wavelet-leader'' reformulation of a nice characterization of pointwise Hölder regularity due to P. Anderson.

~~Ayache , Jaffard : Hölder exponents of arbitrary functions~~
Wavelet Methods for Multifractal Analysis of Functions 99 3.2. General points regarding multifractal functions 3.2.1. Important definitions Multifractal functions help in modeling signals whose regularity varies from one point to another. Thus, the first problem is to mathematicallydefineafunction ’ s regularity at every point.

~~Wavelet MethodsforMultifractal AnalysisofFunctions~~
Spectral methods such as the continuous wavelet transform (CWT; frequently named wavelet analysis) and the fast Fourier transform have a special appeal for climate and paleoclimate research because they can be used to detect periodicities in time series.

~~Artificial Detection of Lower-Frequency Periodicity in ...~~
Our method, which we term the iterated amplitude adjusted wavelet transform can be used to generate bootstrapped versions of multifractal data, and because it preserves the pointwise Hölder regularity but not the local Hölder regularity, it can be used to test hypotheses concerning the presence of oscillating singularities in a time series, an important feature of turbulence and econophysics data.

Currently, new trends in mathematics are emerging from the fruitful interaction between signal processing, image processing, and classical analysis. One example is given by ``wavelets'', which incorporate both the know-how of the Calderon-Zygmund school and the efficiency of some fast algorithms developed in signal processing (quadrature mirror filters and pyramidal algorithms.) A second example is ``multi-fractal analysis''. The initial motivation was the study of fully developed turbulence and the introduction by Frisch and Parisi of the multi-fractal spectrum. Multi-fractal analysis provides a deeper insight into many classical functions in mathematics. A third example--``chirps''--is studied in this book. Chirps are used in modern radar or sonar technology. Once given a precise mathematical definition, chirps constitute a powerful tool in classical analysis. In this book, wavelet analysis is related to the 2-microlocal spaces discovered by J. M. Bony. The authors then prove that a wavelet based multi-fractal analysis leads to a remarkable improvement of Sobolev embedding theorem. In addition, they show that chirps were hidden in a celebrated Riemann series. Features: Provides the reader with some basic training in new lines of research. Clarifies the relationship between pointwise behavior and size properties of wavelet coefficents.

This book gives a comprehensive overview of both the fundamentals of wavelet analysis and related tools, and of the most active recent developments towards applications. It offers a state-of-the-art in several active areas of research where wavelet ideas, or more generally multiresolution ideas have proved particularly effective. The main applications covered are in the numerical analysis of PDEs, and signal and image processing. Recently introduced techniques such as Empirical Mode Decomposition (EMD) and new trends in the recovery of missing data, such as compressed sensing, are also presented. Applications range for the reconstruction of noisy or blurred images, pattern and face recognition, to nonlinear approximation in strongly anisotropic contexts, and to the classification tools based on multifractal analysis.

The contributions appearing in this volume are a snapshot of the different topics that were discussed during the Second Conference "Mathematics and Image Processing ” held at the University of Orléans in 2010. They mainly concern, image reconstruction, texture extraction and image classification and involve a variety of different methods and applications. Therefore it was impossible to split the papers into generic groups which is why they are presented in alphabetic order. However they mainly concern: texture analysis (5 papers) with different techniques (variational analysis, wavelet and morphological component analysis, fractional Brownian fields), geometrical methods (2 papers ) for restoration and invariant feature detection, classification (with multifractal analysis), neurosciences imaging and analysis of Multi-Valued Images.

This volume reflects the latest developments in the area of wavelet analysis and its applications. Since the cornerstone lecture of Yves Meyer presented at the ICM 1990 in Kyoto, to some extent, wavelet analysis has often been said to be mainly an applied area. However, a significant percentage of contributions now are connected to theoretical mathematical areas, and the concept of wavelets continuously stretches across various disciplines of mathematics. Key topics: Approximation and Fourier Analysis Construction of Wavelets and Frame Theory Fractal and Multifractal Theory Wavelets in Numerical Analysis Time-Frequency Analysis Adaptive Representation of Nonlinear and Non-stationary Signals Applications, particularly in image processing Through the broad spectrum, ranging from pure and applied mathematics to real applications, the book will be most useful for researchers, engineers and developers alike.

After centuries of research, turbulence in fluids is still an unsolved problem. The graduate-level lectures in this volume cover the state of the art of numerical methods for fluid mechanics. The research in this collection covers wavelet-based methods, the semi-Lagrangian method, the Lagrangian multi-pole method, continuous adaptation of curvilinear grids, finite volume methods, shock-capturing methods, and ENO schemes. The most recent research on large eddy simulations and Reynolds stress modeling is presented in a way that is accessible to engineers, postdoctoral researchers, and graduate students. Applications cover industrial flows, aerodynamics, two-phase flows, astrophysical flows, and meteorology. This volume would be suitable as a textbook for graduate students with a background in fluid mechanics.

This book collects significant contributions from the fifth conference on Fractal Geometry and Stochastics held in Tabarz, Germany, in March 2014. The book is divided into five topical sections: geometric measure theory, self-similar fractals and recurrent structures, analysis and algebra on fractals, multifractal theory, and random constructions. Each part starts with a state-of-the-art survey followed by papers covering a specific aspect of the topic. The authors are leading world experts and present their topics comprehensibly and attractively. Both newcomers and specialists in the field will benefit from this book.

Image compression, the Navier-Stokes equations, and detection of gravitational waves are three seemingly unrelated scientific problems that, remarkably, can be studied from one perspective. The notion that unifies the three problems is that of ``oscillating patterns'', which are present in many natural images, help to explain nonlinear equations, and are pivotal in studying chirps and frequency-modulated signals. The first chapter of this book considers image processing, more precisely algorithms of image compression and denoising. This research is motivated in particular by the new standard for compression of still images known as JPEG-2000. The second chapter has new results on the Navier-Stokes and other nonlinear evolution equations. Frequency-modulated signals and their use in the detection of gravitational waves are covered in the final chapter. In the book, the author describes both what the oscillating patterns are and the mathematics necessary for their analysis. It turns out that this mathematics involves new properties of various Besov-type function spaces and leads to many deep results, including new generalizations of famous Gagliardo-Nirenberg and Poincare inequalities. This book is based on the ``Dean Jacqueline B. Lewis Memorial Lectures'' given by the author at Rutgers University. It can be used either as a textbook in studying applications of wavelets to image processing or as a supplementary resource for studying nonlinear evolution equations or frequency-modulated signals. Most of the material in the book did not appear previously in monograph literature.