

# AVVISO DI SEMINARIO

**Martedì 4 giugno 2013**

**ore 11.00, Aula Riunioni**

***Dipartimento di Ingegneria dell'Informazione***

**Via G. Caruso 16, Pisa**

**Prof. Michael Unser**

**Biomedical Imaging Group**

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## **SPARSE STOCHASTIC PROCESSES: A STATISTICAL FRAMEWORK FOR COMPRESSED SENSING AND RELATED TECHNIQUES**

### **ABSTRACT**

We introduce an extended family of continuous-domain sparse processes that are specified by a generic (non-Gaussian) innovation model or, equivalently, as solutions of linear stochastic differential equations driven by white Lévy noise. We present the mathematical tools for their characterization.

The two leading threads of the exposition are:

- (1) the statistical property of infinite divisibility, which induces two distinct types of behavior—Gaussian vs. sparse—at the exclusion of any other;
- (2) the structural link between linear stochastic processes and spline functions which is exploited to simplify the mathematical analysis.

This allows us to prove that these processes admit a parsimonious representation in some matched wavelet-like basis. Finally, we show that these models have predictive power for image compression and that they are applicable to the derivation of statistical algorithms for solving ill-posed inverse problems, including compressed sensing.

## Short Bio of the speaker

Michael Unser is Professor and Director of EPFL's [Biomedical Imaging Group](#). His main research area is biomedical image processing. He has a strong interest in sampling theories, multiresolution algorithms, wavelets, and the use of splines for image processing. He is the author of over 150 published [journal papers](#) in these areas, and is one of [ISI's Highly Cited](#) authors in Engineering.

He was born in Zug, Switzerland, on April 9, 1958. He received the M.S. (*summa cum laude*) and Ph.D. degrees in Electrical Engineering in 1981 and 1984, respectively, from the Swiss Federal Institute of Technology ([EPFL](#)) in Lausanne, Switzerland. From 1985 to 1997, he was with the Biomedical Engineering and Instrumentation Program, [National Institutes of Health](#), Bethesda USA, conducting research on bioimaging and heading the Image Processing Group.

Michael Unser received the Dommer prize for excellence in 1981 (1st rank among all EPFL graduates) and the research prize of the Brown-Boveri Corporation (Switzerland) for his Ph.D. thesis in 1984. He is recipient of the [IEEE Signal Processing Society's 1995 Best Paper Award](#) (with A. Aldroubi and M. Eden), the [IEEE Signal Processing Society's 2000 Magazine Award](#), and the [IEEE Signal Processing Society's 2003 Best Paper Award](#) (with T. Blu).

He is the Editor-in-Chief of the [Wavelet Digest](#), the electronic newsletter of the wavelet community. He has held the position of associate Editor-in-Chief (2003-2005) for the [IEEE Transactions on Medical Imaging](#). He is (or was) member of the editorial boards of [Foundations and Trends in Signal Processing](#), the [SIAM Journal of Imaging Sciences](#), the [Journal of Mathematical Imaging and Vision](#), [Sampling Theory in Signal and Image Processing](#), [Signal Processing](#) (1997-2000), [Pattern Recognition](#) (2000-2006), the [Journal of Visual Communication and Image Representation](#) (1997-2006), and the [IEEE Signal Processing Magazine](#) (2003-2006). He also served as Associate Editor for the [IEEE Transactions on Medical Imaging](#) (1999-2002; 2006-present) including Guest Editor for its special issue on [Wavelets in Medical Imaging](#), the [IEEE Transactions on Image Processing](#) (1992-1995), and the [IEEE Signal Processing Letters](#) (1994-1998).

Dr. Unser co-organized the 1994 IEEE-EMBS Workshop on Wavelets in Medicine and Biology, and served as regular chair for SPIE's annual conference on [Wavelets](#) from 1993 to 2003. He was general co-chair (with Z.P. Liang) for the first [IEEE International Symposium on Biomedical Imaging](#) (ISBI'2002), which was held in Washington, DC, July 7-10, 2002. He is a long standing member of the Image and Multidimensional Signal Processing Committee (1993-2000; 2003-present) of the IEEE Signal Processing Society (SPS). He was chairman of the IEEE-SPS technical committee on Bio Imaging and Signal Processing ([BISP](#)) (2004-2006), as well as the ISBI steering committee (2006-2008).

He was [plenary speaker](#) at the IEEE Intl. Conf. on Image Processing ([ICIP'05](#)), the IEEE Medical Imaging Conference (MIC'04), SPIE's conference on Medical Imaging (MedIm 2002), as well as a number of other conferences and workshops.

Prof. Unser is a [Fellow of the IEEE](#) (1999), an elected member of the [Swiss Academy of Engineering Sciences](#) (2007), and an [EURASIP Fellow](#) (2009). He is the recipient of the 2008 [Technical Achievement Award](#) of the IEEE Signal Processing Society "for the contributions to the theory and practice of splines and their applications in signal and image processing."