H.M.de Oliveira: Collected Abstracts

Here are the abstracts of some publications of mine (journal and conference papers), which I compiled to provide a view of my interests and previous work. I hope this may have some usefulness for other people.

Full-papers versions can be found at the URL: http://www2.ee.ufpe.br/codec/publicacoes.html

I tried to supply a wide-view about the contributions and fields I have tackled.

- Signal processing and analysis (SP)
- Communication systems (CS)
- Applied Information theory (IT)
- Biomedical Engineering papers (BE)
- Pharmacy and Chemistry (PhCh)

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Signal processing and analysis (SP)

Converting EEG, ECG and other paper legated biomedical maps into digital signals (SP&BE)

A naïve and straightforward digital signal-processing tool developed using Matlab is offered as a very low-cost and quite effective strategy for analog-to-digital conversion of signals without requiring dedicated hardware. This software-based approach is particularly helpful for digitalizing biomedical signals acquired from analog apparatus equipped with a plotter. Albeit signals used in biomedical diagnosis are the primarily concern, this imaging processing tool can be suitable and economically feasible for modernizing facilities in a non-expensive way. As an appealing feature, old ECG and EEG charts can be fast and efficiently digitalized in order to be added in existing up-to-date medical data banks of cardiologists and neurologists to improve the follow-up of patients.

Applications of Non-Orthogonal Filter Banks to Signal and Image Analysis (SP)

A non-orthogonal wavelet-based multi-resolution analysis was already provided by scaling and wavelet filters derived from Gegenbauer polynomials. Allowing for odd n (the polynomial order) and a value (a polynomial parameter) within the orthogonality range of such polynomials, scaling and wavelet functions are generated by frequency selective FIR filters. These filters have compact support and generalized linear phase. Special cases of such filter banks include Haar, Legendre, and Chebyshev wavelets. As an improvement, it has been achieved that for specific a values it is possible to reach a filter with flat magnitude frequency response. We obtain a unique closed expression for values for every n odd value. The main advantages in favor of Gegenbauer filters are their smaller computational effort and a constant group delay, as they are symmetric filters. Potential applications of such wavelets include fault analysis in transmission lines of power systems and image processing.

Wavelet Decomposition over Finite Fields (SP)

This paper introduces some foundations of wavelets over Galois fields. Standard orthogonal finite-field wavelets, the so-called FF Wavelets, including FF Haar and FF Daubechies are derived. Non-orthogonal FF-wavelets such as B splines over GF of p are also considered. A few examples of multiresolution analysis over finite fields as well as conditions for the coefficients of the smoothing filter to achieve vanishing moments are presented. A new fast algorithm to compute FF-wavelets, based on two-phase decomposition is introduced. Wavelet-packed transforms over finite fields are also considered. An application of FF-wavelets to design multiplex schemes with spread-spectrum sequences is presented.

Signal Analysis Using Fourier-like Wavelets (SP)

In continuous-time wavelet analysis, most wavelet presents some kind of symmetry.

Based on the Fourier and Hartley transform kernels, a new wavelet multiresolution analysis has been proposed. This approach is based on a pair of orthogonal wavelet functions and can be named as the Fourier-like and Hartley-like wavelet analysis. In this paper we carry a preliminary investigation about potentials applications for the Fourier-like wavelet analysis on signals derived from power systems to illustrate the behavior of such wavelets.

A Fast Algorithm for Computing the Hartley/Fourier Spectrum (SP)

Discrete transforms have been playing a relevant role in several areas, especially in Engineering. An interesting example is the Discrete Fourier Transform or DFT. Another very rich transform related to the DFT is the Discrete Hartley Transform or DHT, the discrete version of the symmetrical, Fourier-like, integral transform introduced by Ralph V.L. Hartley. Besides its numerical side appropriateness, the DHT has proven over the years to be a powerful tool. A decisive factor for applications of the DFT has been the existence of the so-called fast transforms for computing it. Fast Hartley transforms also exist and are deeply connected to the DHT applications. Recent promising applications of discrete transforms concern the use of finite field Hartley transforms to design digital multiplex systems, efficient multiple access systems and multilevel spread spectrum sequences. Besides being a real transform, the DHT is also involutionary, i.e.; the kernel of the inverse transform is exactly the same as the one of the direct transform (self-inverse transform). Since the DHT is a more symmetrical version of a discrete transform, this symmetry is exploited so as to derive a new FT that requires the minimal number of real floating point multiplications. A FT algorithm for the DHT is also a FT for the DFT and vice versa. Discrete transforms presenting a low multiplicative complexity have been an object of interest for a long time. The minimal multiplicative complexity of the one-dimensional DFT for all possible sequence lengths can be computed by converting the DFT into a set of multi-dimensional cyclic convolutions. In this work a fast algorithm is derived, which meet the lower bound on the multiplicative complexity of a DFT/DHT for short blocklengths. It is based on a multilayer decomposition of the DHT using Hadamard-Walsh transforms. These new schemes are attractive and easy to implement using a Digital Signal Processor and the regularity of the structure allows the design of low-cost high-speed dedicated Integrated Circuits.

A Short Survey on Arithmetic Transforms and the Arithmetic Hartley Transform (SP)

Arithmetic complexity has a main role in the performance of algorithms for spectrum evaluation. Arithmetic transform theory offers a method for computing trigonometrical transforms with minimal number of multiplications. In this paper, the proposed algorithms for the arithmetic Fourier transform are surveyed. A new arithmetic transform for computing the discrete Hartley transform is introduced: the Arithmetic Hartley transform. The interpolation process as the key to the arithmetic transform theory is also examined.

Elliptic-Cylindrical Wavelets: The Mathieu Wavelets (SP)

This note introduces a new family of wavelets and a multiresolution analysis that exploits the relationship between analyzing filters and the Floquet solution of Mathieu differential equations. The transfer function of both the detail and the smoothing filter is related to the solution of a Mathieu equation of the odd characteristic exponent. The number of notches of these filters can be easily designed. Wavelets derived by this method have potential application in the fields of optics and electromagnetism.

The Discrete Cosine Transform over Finite Prime Fields (SP)

This paper examines finite field trigonometry as a tool to construct digital trigonometric transforms. In particular, by using properties of k-cosine function over a Galois field, the finite field discrete cosine transform is introduced. The finite field DCT pair in GF(p) is defined, having blocklengths that are divisors of p plus one over two. A special case is the Mersenne finite field DCT, defined when p is Mersenne prime. In this instance block lengths that are power of two are possible and radix-two fast algorithms can be used to compute the transform.

Taylor Series as Wide-sense Biorthogonal Wavelet Decomposition (SP)

Pointwise-supported generalized wavelets are introduced, based on Dirac, doublet and further derivatives of δ. A generalized biorthogonal analysis leads to standard Taylor series and new Dual-Taylor series that may be interpreted as Laurent Schwartz distributions. A Parseval-like identity is also derived for Taylor series, showing that Taylor series support an energy theorem. New representations for signals called derivagrams are introduced, which are similar to spectrograms. This approach corroborates the impact of wavelets in modern signal analysis.

A Tool for Music Analysis: The Quantized Fourier Series (SP)

This work investigates a novel approach for harmonic content estimation, which is based on quantized Fourier series. This algorithm is a suitable candidate for real time applications involving a massive computation of harmonic content of signals, especially due to its low computational complexity. In particular, this new tool can be useful for analysing musical sounds.

Compactly Supported One-cyclic Wavelets Derived from Beta Distributions (SP)

New continuous wavelets of compact support are introduced, which are related to beta distribution. Wavelets can be related to probability distributions using "blur" derivatives. These new wavelets have just one cyclic, so they are termed unicycle wavelets. They can be viewed as a soft variety of Haar wavelets. Their relevance is due to the central limit theory applied for supported compact signals.

The Fourier-like and Hartley-like Wavelet Analysis Based on Hilbert Transforms (SP)

In continuous-time wavelet analysis, most wavelet presents some kind of symmetry.
Based on the Fourier and Hartley transform kernels, a new wavelet multiresolution analysis is proposed. This approach is based on a pair of orthogonal wavelet functions and is named as the Fourier-Like and Hartley-Like wavelet analysis. A Hilbert transform analysis on the wavelet theory is also included.

Infinite Sequences, Series Convergence and the Discrete Time Fourier Transform over Finite Fields (SP)

Digital Transforms have important applications on subjects such as channel coding, cryptography and digital signal processing. In this paper, two Fourier Transforms are considered, the discrete time Fourier transform (DTFT) and the finite field Fourier transform (FFFT). A finite field version of the DTFT is introduced and the FFFT is redefined with a complex kernel, which makes it a more appropriate finite field version of the Discrete Fourier Transform. These transforms can handle FIR and IIR filters defined over finite algebraic structures.

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The Discrete Sine Transform over a Finite Field (SP)

A new transform, the discrete sine transform over a finite field is introduced. The kernel of this DST is the sinus function defined over a finite field. The block lengths of the transform are the divisors of $(p+1)/2$. A special case is the Mersenne DST, which is defined when p is a Mersenne prime. This class of transforms supports blocklengths that are power of two, thereby allowing their computation by radix-two fast algorithm.

Fault Analysis Using Gegenbauer Multiresolution Analysis (SP)

This paper exploits the multiresolution analysis in the fault analysis on transmission lines. Faults were simulated using the ATP (Alternative Transient Program), considering signals at 128/cycle. A nonorthogonal multiresolution analysis was provided by Gegenbauer scaling and wavelet filters. In the cases where the signal reconstruction is not required, orthogonality may be immaterial. Gegenbauer filter banks are thereby offered in this paper as a tool for analyzing fault signals on transmission lines. Results are compared to those ones derived from a 4-coefficient Daubechies filter. The main advantages in favor of Gegenbauer filters are their smaller computational effort and their constant group delay, as they are symmetric filters.

Infinite Sequences over Finite Fields and New Digital Transforms (SP)

Digital Transforms have important applications on subjects such as channel coding, cryptography and digital signal processing. In this paper, two Fourier Transforms are considered, the discrete time Fourier transform (DTFT) and the finite field Fourier transform (FFFT). A finite field version of the DTFT is introduced and the FFFT is redefined with a complex kernel, which makes it a more appropriate finite field version of the Discrete Fourier Transform. These transforms can handle FIR and IIR filters defined over finite algebraic structures.

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New Compactly Supported Scaling and Wavelet Functions Derived from Gegenbauer Polynomials (SP)

A new family of scaling and wavelet functions is introduced, which is derived from Gegenbauer polynomials. The association of ordinary second order differential equations to multiresolution filters is employed to construct these new functions. These functions, termed ultraspherical harmonic or Gegenbauer scaling and wavelet functions, possess compact support and generalized linear phase. This is an interesting property since, from the computational point of view; only half the number of filter coefficients is required to be computed. By using an alpha factor that is within the orthogonality range of such polynomials, there are generated scaling and wavelet that are frequency selective FIR filters. Potential application of such wavelets includes fault detection in transmission lines of power systems.

Fourier Eigenfunctions, Uncertainty Gabor Principle and Isoresolution Wavelets (SP)

Shape-invariant signals under Fourier transform are investigated leading to a class of eigenfunctions for the Fourier operator. The uncertainty Gabor-Heisenberg principle is revisited. The concept of isoresolution in joint time-frequency analysis is introduced showing that any Fourier eigenfunction achieve isoresolution. Isoresolution wavelets can be derived from each wavelet family by a suitable scaling.

Chebyshev Wavelets (SP)

In this note we introduce a new family of wavelets, named Chebyshev wavelets, which are derived from conventional Chebyshev polynomials. Properties of Chebyshev filter banks are investigated, including orthogonality and perfect reconstruction conditions. Chebyshev wavelets of 2^{nd}-kind have compact support, their filters possess good selectivity, but they are not orthogonal. The convergence into 2^{nd}-kind Chebyshev wavelets via the cascade algorithm is proved by Markov chains theorems. Computational implementation of these wavelets and some clear-cut applications are presented. These wavelets are offered as a choice in wavelet analysis.

The Finite Field Discrete cosine Transform (SP)

A new digital transform, the discrete cosine transform in a finite field (FFDCT) is introduced. The kernel of the FFDCT is the trigonometric function cosine defined over a finite field. A new property of such functions is established, through which an inversion formula for the FFDCT is derived.

Compactly Supported Wavelets Derived from Legendre Polynomials: Spherical Harmonic Wavelets (SP)

A new family of wavelets is introduced, which is associated with Legendre polynomials. These wavelets, termed spherical harmonic or Legendre wavelets, possess compact support. The method for the wavelet construction is derived from the association of ordinary second order differential equations with multiresolution filters. The low-pass filter associated with Legendre multiresolution analysis is a linear phase finite impulse response filter (FIR).

On Filter Banks and Wavelets Based on Chebyshev Polynomials (SP)

In this note we introduce a new family of wavelets, named Chebyshev wavelets, which are derived from conventional Chebyshev, polynomials. Properties of Chebyshev filter banks are investigated, including orthogonality and perfect reconstruction conditions. Chebyshev wavelets of 2^{nd}-kind have compact support, their filters possess good selectivity, but they are not orthogonal. Using properties of Markov chains proves the convergence of the cascade algorithm of 2^{nd}-kind Chebyshev wavelets. Computational implementation of these wavelets and some clear-cut applications are presented. These wavelets are offered as a choice in wavelet analysis.

Wavelets In Fault Detection and Fault Classification for Transmission Lines (SP)

This paper presents a wavelet-aided algorithm for fault detecting in transmission lines, which estimates the fault localisation and can be implemented in a central station or a monitoring instrument used to evaluate the quality of the electrical signal. In order to do so, fault simulations on a 500 kV transmission line were performed assuming one-sided monitored phase voltage and current signals, at 128 samples/cycle.

Arithmetica Probabilitas (generalised-SP)

This study presents a sketch on the "arithmetization" of the probability theory. The proposal is to take benefit of the relationship between Riemann Zeta function and a measure on set of integers. It is shown that any subset of the natural set is measurable. Interpretations to the introduced measure are presented as well as some its properties.

Fault Detection and Classification by wavelet transforms (SP)

This paper presents preliminary results concerning the application of wavelet theory to detection and fault classification in a 500 kV transmission line. Acquisition of signals is single-end performed at 128 samples per cycle. A new approach is presented by taking into account the decomposing of fault voltage signals in a single scale of the subband codification, where Daubechies 4 is used as mother wavelet, and assessing the energy content associated with the wavelet coefficients at the first scale.

Compression of Disturbance Signal in Power Transmission Systems by wavelets (SP)

At the time of a new Brazilian regulation of the electric sector, continuous monitoring for energy quality turns into an actual requirement. Such an uninterrupted monitoring associated with the high sample rates required by digital disturbance recorders has been demanding a large amount of storage at the data collect station. This paper offers and describes an implementation of a wavelet-based (lossy) compression algorithm, which takes into account the error energy and coefficient threshold limits as fundamental parameters, in the sense of preserving the main features of the original recorded signal. The potential of this approach is supported by a sizeable reduction in the compressed file (typically 82%) obtained in a wide-ranging variety of disturbances.

Wavelets for Elliptical Waveguide Problems (SP)

New elliptic cylindrical wavelets are introduced, which exploit the relationship between analysing filters and Floquet's solution of Mathieu differential equations. It is shown that the transfer function of both multiresolution filters is related to the solution of a Mathieu equation of odd characteristic exponent. The number of notches of these analyzing filters can be easily designed. Wavelets derived by this method have potential application in the fields of optics, microwaves and electromagnetism.

Fault Localization In Transmission Lines by Means of the Wavelet Multiresolution Representation (SP)

This paper presents a preliminary investigation on the use of the wavelet theory for fault location in transmission lines. Faults were simulated in a 500 kV transmission line, with the acquisition of the single phases of voltages and currents signals in only one-ended terminal of the line, with 128 points/cycle monitoring instrument. A new methodology is showed considering three-level decomposition of fault signals by sub-band coding and the apparent impedance technique.

A Numerical Hartley Transform and Gaussian Integer Groups (SP)

Finite field transforms are attractive since they do not introduce round off errors and, in many cases, can be implemented with a low computational complexity. In this paper, the Hartley Number-Theoretic Transform is introduced. In particular, the Mersenne HNTT is defined and some multiplication free transforms are given. Some algebraic structures that are related to the HNTT are introduced and, in particular, the group of modules and the group of phases of a finite field are defined, which allows the construction of a polar representation for the elements of the Galois field GF(p^2). A few applications involving the TNH are discussed.

Rounded Hartley Transform: A quasi-involution (SP)

A new multiplicative-free transform derived from discrete Hartley transform (DHT) is introduced: The Rounded Hartley Transform RHT. Investigations on the properties of the RHT lead us to the concept of matrix weak-inversion. Using new constructs, we show that RHT is not exactly involutionary like the DHT, but exhibits a quasi-involutionary property, a definition derived from periodicity of matrices. Thus, instead of the actual inverse transform, the RHT can be roughly viewed as an involutionary transform, allowing the use of direct (multiplication-free) to evaluate the inverse transform. A fast algorithm to compute the RHT is presented. This algorithm held embedded properties. We also extended RHT to the two-dimensional case. This allows us to perform a preliminary analysis on the effects of RHT on images. Despite some signal to noise ratio loss, the RHT can be very interesting for applications involving image monitoring associated with decision making, such as military applications or medical imaging.

The Z-Transform over Finite Fields (SP)

Finite field transforms have many applications and, in many cases, can be implemented with a low computational complexity. In this paper, the Z-Transform over a finite field is introduced and some of its properties are presented.

Interpolating in Arithmetic Transform Algorithms (SP)

In this paper, we propose a unified theory for arithmetic transform of a variety of discrete trigonometric transforms. The main contribution of this work is the elucidation of the interpolation process required in arithmetic transforms. We show that the interpolation method determines the transform to be computed. Several kernels were examined and asymptotic interpolation formulae were derived. Using the arithmetic transform theory, we also introduce a new algorithm for computing the discrete Hartley transform.

A Factorization Scheme for Discrete Hartley Transform Matrices (SP)

Discrete transforms such as the Discrete Fourier Transform or the Discrete Hartley Transform furnish an indispensable tool in Signal Processing. The successful application of transform techniques relies on the existence of the so-called fast transforms. In this paper some fast algorithms are derived which meet the lower bound on the multiplicative complexity of a DFT/DHT. The approach is based on the factorization of DHT matrices. New algorithms for short block lengths such as $N = 3$, 5, 6, 12 and 24 are presented.

Fourier series coefficients estimation by the sequential mean square method (SP)

A new algorithm is introduced and implemented using Matlab so as to efficiently guesstimate coefficients of a Fourier trigonometric series, which is based on the sequential mean square approach. Simulations are presented as well as Fourier series assessment for experimental non-stationary data.

Fast Finite Field Hartley Transforms based on Hadamard Decomposition (SP)

A new transform over finite fields, the Finite Field Hartley Transform FFHT was recently introduced and a number of promising applications on the design of efficient multiple access systems and multilevel spread spectrum sequences were proposed. The FFHT exhibits interesting symmetries, which are exploited to derive new Fast Transform algorithms (FT). These FTs are based on successive decompositions of the FFHT by means of Hadamard-Walsh transforms. This new approach meets the lower bound on the multiplicative complexity for all the cases investigated so far. The complexity of these new FTs is compared with that of some classical algorithms.

On Fast Finite Field Hartley Transform Algorithms (SP)

New fast algorithms over finite fields are investigated, which compute the Hartley Transform. These algorithms are derived from properties finite field trigonometry. Additive and multiplicative are calculated in each case.

On Wavelet Decomposition over Finite Fields (SP)

This paper introduces some foundations of wavelets over Galois fields. Standard orthogonal finite-field wavelets (FF Wavelets) including FF-Haar and FF-Daubechies are derived. Non-orthogonal FF-wavelets such as B-spline over GF(p) are also considered. A few examples of multiresolution analysis over Finite fields are presented showing how to perform Laplacian pyramid filtering of finite block lengths sequences. An application of FF-wavelets to design spread-spectrum sequences is presented.

Radix-2 Fast Hartley Transform Revisited (SP)

A Fast algorithm for the Discrete Hartley Transform (DHT) is presented, which resembles radix-2 fast Fourier Transform. Although fast DHTs are already known, this new approach bring some light about the deep relationship between fast DHT algorithms and a multiplication-free fast algorithm for the Hadamard Transform.

Finite Field Transforms and the Gaussian Integer Field (SP)

Discrete transforms have been playing a significant role in countless electrical engineering applications. Specifically, discrete transforms defined over finite fields are attractive because they do not present round off errors and allow low-complexity implementation. In this paper, a number of algebraic structures related to the Hartley transform over a finite field are introduced. In particular, modulus and phase fields of a finite field are introduced engendering a polar representation for elements of the finite field GF(p^2). Applications concerning Hartley number transform are presented.

A Bifunctional Algorithm for Evaluating Hadamard and Hartley Spectra (SP)

In this paper, a new algorithm for computing the discrete Hartley and Hadamard transforms is introduced, joining ideas by Hsu-Wu and Guo. A hardware implementation with parallel sums is shown.

Fast Algorithm for Computing Finite Field Wavelet Transform (SP)

A new version of wavelet transform was recently introduced, named the finite field wavelet transform. Such a transform has cyclic structure and can be defined in the frequency domain through finite field Fourier transform. The potential of this tool is promising since innovative application for discrete wavelet transform appears in several branches of electrical engineering. A decisive factor for the efficient use of this tool is the existence of fast algorithms for computing it. In this work a new fast algorithm is introduced, which is based on finite field Fourier transform.

Multilevel Hadamard Decomposition of Discrete Hartley Transforms (SP)

Discrete transforms such as the Discrete Fourier Transform or the Discrete Hartley Transform furnish an indispensable tool in Signal Processing. The successful application of transform techniques relies on the existence of the so-called fast transforms. In this paper some fast algorithms are derived which meet the lower bound on the multiplicative complexity of a DFT/DHT. The approach is based on a decomposition of the DHT into layers of Hadamard-Walsh transforms. In particular, schemes named Turbo Fourier Transforms for short block lengths such as N=4, 8, 12 and 24 are presented.

Number Theoretical Hartley Transforms (SP)

Discrete transforms play a significant role in engineering and their applications are primarily due to the existence of the fast transforms. Specifically, discrete transforms over finite field are attractive because they do not introduce rounding as well as they held low-arithmetic complexity. In this paper the number theoretical Hartley transform NTHT is introduced. In particular, the Hartley-Mersenne number theoretical transform is defined and a number of multiplication-free transforms. A fast algorithm for computing the NTHT is suggested.

Complex Hartley Transform over a Finite Field (SP)

Discrete transforms, defined over finite or infinite fields, play a very important role in Engineering. In either case, the successful application of transform techniques is mainly due to the existence of the so-called fast transform algorithms. In this paper, the complex finite field Hartley transform is introduced and a fast algorithm for computing it is suggested.

Introducing An Analysis in Finite Fields (SP)

Looking forward to introducing an analysis in Galois Fields, discrete functions are considered (such as transcendental ones) and MacLaurin series are derived by Lagrange's Interpolation. A new derivative over finite fields is defined which is based on the Hasse Derivative and is referred to as negacyclic Hasse derivative. Finite field Taylor series and α-adic expansions over GF(p), p prime, are then considered. Applications to exponential and trigonometric functions are presented. Theses tools can be useful in areas such as coding theory and digital signal processing.

The Complex Hartley Transform over a Finite Field (SP)

Discrete transforms, defined over finite or infinite fields, play a very important role in Engineering. In either case, the successful application of transform techniques is mainly due to the existence of the so-called fast transform algorithms. In this paper, the complex finite field Hartley transform is introduced and a fast algorithm for computing it is suggested.

The Adaptive Mean-Linkage Algorithm: A Bottom-up Hierarchical Cluster Technique (SP)

In this paper a variant of the classical hierarchical cluster analysis is reported. This agglomerative cluster technique is referred to as the Adaptive Mean-Linkage Algorithm. It can be interpreted as a linkage algorithm where the value of the threshold is conveniently up-dated at each interaction. The superiority of the adaptive clustering with respect to the average-linkage algorithm

follows because it achieves a good compromise on threshold values: Thresholds based on the cut-off distance are sufficiently small to assure the homogeneity and also large enough to guarantee at least a pair of merging sets. This approach is applied to a set of possible substituents in a chemical series.

The Hartley Transform over a Finite Field (SP)

In this paper, the *k*-trigonometric functions over the Galois Field are introduced and their main properties derived. This leads to the definition of the cosine and sine function over GF(q), which in turn leads to a finite field Hartley Transform. The main properties of this new discrete transform are presented and areas for possible applications are mentioned.

Signal Spectral Analysis: A view from an Engineer (SP)

The fact the introductory classes of electrical and further engineering courses (such as signal and systems) have no laboratory lessons and often have lectures given by mathematicians is not inspiring for undergraduates. As a result, students do not grasp the foundations of mathematics (e.g. Fourier analysis), and develop a refusal of applying such useful tools. The drawback is essentially concerned with the focus and examples presented. An attempt to play down these inconvenient consists of using educational software so as to motivate and increasing the attention of students as well as a way to help learning key concepts. The software FOURIER/UFPE was built assembling Turbo Pascal 7.0 routines assisted by resources in object-oriented language (turbo vision). Graphic animations are presented, which illustrate certain aspects of spectral analysis, for instance, going to Fourier series to Fourier transform, compression-expansion effects in both domains etc. Some alternative proofs are given relate to time-frequency and stability of linear networks, trying to cope them with the undergraduate level. In order to present the spectrum analyzer, a comparison is made with an optical prism. Finally, it is stated the imperative requisite to modernize classes of signal and systems by introducing modern spectral techniques suitable for non-stationary signals. How to deal with more advanced tools than Fourier techniques? It is suggested here a primary foreword on Gabor transform and wavelets (*ondelettes*), allowing to realize the potential of such tools.

New Processing Tools for Finite Field Signals (SP)

In this paper, the concept of Galoisian ring is introduced aiming at the development of new tools for the processing of signals defined over finite fields. The notions of *k*-trigonometric functions over the finite field GF(p^m) are defined, and a few of its properties investigated. Some applications of the new tools are suggested.

Communication systems (CS)

Shaping probability distribution over the integers (CS)

This work investigates the ability of finite field transforms in formatting the probability distribution of an information source, by converting it into uniform distribution. Theoretical aspects of this tool are discussed and simulation presented. Some application scenarios of that property are suggested.

Fourier Codes and Hartley Codes (CS&SP)

Real-valued block codes are introduced, which are derived from Discrete Fourier Transforms (DFT) and Discrete Hartley Transforms (DHT). These algebraic structures are built from the eigensequences of the transforms. Generator and parity check matrices were computed for codes up to block length N=24. They can be viewed as lattices codes so the main parameters (dimension, minimal norm, area of the Voronoi region, density, and centre density) are computed. Particularly, Hamming-Hartley and Golay-Hartley block codes are presented.

Linear block codes based upon filter banks and cyclic wavelets over finite fields (CS&SP)

This paper presents a new approach to linear block codes using cyclic filter banks and wavelets. Tree structures for encoding and decoding, based on synthesis and analysis cyclic filter banks, are presented. In some

particular cases, the construction of the generator and parity-check matrices of the codes is shown. Known codes are generated from these structures, such as Hamming, Reed-Solomon and repetition codes. New types of codes are found through the design technique based on the finite field short time Fourier transforms.

Faster DTMF Decoding (CS&SP)

In this paper, a new method for the decoding of DTMF signals is proposed. The approach, which applies the arithmetic Fourier transform, is more efficient, in terms of computational complexity, than existing techniques. Theoretical aspects and features that determine the accuracy and complexity of the proposed method are discussed.

A New Wavelet-based Multiplex System Multiresolution Division Multiplex (CS)

An original multiplex scheme is introduced, which is based on Mallat's multiresolution formulation of wavelet systems. This system is adaptable and its implementation is well matched to digital signal processors and computers. The approach termed multiresolution division multiplex (MRDM) is intensive in signal processing (SP) tools, extremely flexible and can combine a variety of tributaries at different bit rates. A broad variety of orthogonal wavelet systems can endow with MRDM and the channel waveforms, and consequently the spectral shape and system performance depend upon the selected wavelets. Demultiplex can be done efficiently, since the number of floating multiplications and additions increase only linearly with the length of signals. A Haar-based MRDM scheme is presented to illustrate the versatility of this new multiplex approach.

Eigensequences for Multiuser Communication over the Real Adder Channel (CS&SP)

Shape-invariant signals under the Discrete Fourier Transform are investigated, leading to a class of eigenfunctions for the unitary discrete Fourier operator. Such invariant sequences (eigensequences) are suggested as user signatures over the real adder channel (t-RAC) and a multiuser communication system over the t-RAC is presented.

DTMF Decoding via Arithmetic Fourier Transform (CS&SP)

In this paper, a new method for the decoding of DTMF signals is proposed. The approach, which applies the Arithmetic Fourier Transform, is more efficient, in terms of computational complexity, than existing techniques. Theoretical aspects and features that determine the accuracy and the complexity of the proposed method are discussed.

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Wavelet Shift-Keying: A New Digital Modulation (CS&SP)

This note introduces the preliminary ideas of a new digital modulation scheme termed Wavelet Shift Keying (WSK), which is based on discrete wavelet transforms. The source bit stream is translated into a sequence of scales indicating which version of the mother wavelet should be transmitted in each symbol slot. The modulated signal therefore consists in a sequence of overlapping (or non-overlapping) scaled-translated versions of a wavelet. Such schemes can be viewed as a generalisation of "wavelet-based OFDM systems". Simple examples of deO-modulation and Mexican hat modulation are presented.

A Family of Wavelets and a new Orthogonal Multiresolution Analysis Based on the Nyquist Criterion (CS&SP)

A generalisation of the Shannon complex wavelet is introduced, which is related to raised cosine filters. This approach is used to derive a new family of orthogonal complex wavelets based on the Nyquist criterion for Intersymbolic Interference elimination. An orthogonal Multiresolution Analysis is presented, showing that the roll-off parameter should be kept below 1/3. The pass-band behaviour of the Wavelet Fourier spectrum is examined. The left and right roll-

off regions are asymmetric; nevertheless the Q-constant analysis philosophy is maintained. Finally, a generalisation of the square root raised cosine wavelets is proposed.

On Galois-Division Multiple Access Systems: Figures of Merit and Performance Evaluation (CS)

A new approach to multiple-access based on finite field transforms is investigated. These schemes, termed Galois-Division Multiple Access (GDMA), offer compact bandwidth requirements. A new digital transform, the Finite Field Hartley Transform (FFHT) requires dealing with fields of characteristic p ($p \neq 2$). A binary-to-p-ary mapping based on the opportunistic secondary channel is introduced. This allows the use of GDMA in conjunction with available digital systems. The performance of GDMA is also evaluated.

Performance of Lattice Codes over the Gaussian Channel (CS&IT)

We derive an upper bound on the error probability of lattice codes combined with quadrature amplitude modulation over the additive Gaussian noise channel. This bound depends on a lattice figure of merit and it is readily put in exponential form by using Chernoff bound. An interesting lower bound is derived by a similar reasoning. We also examine the estimation of the average information rate based upon the continuous approximation of the average power normalized to two dimensions, and suggest improving it by using the sphere packing idea. Examples of performance evaluation are given for a few lattices. Finally, we present upper and lower bounds on the best fundamental coding gains per dimension due to both density and thickness for an arbitrary large number of dimensions. It is shown in the appendix that, as the Ungerboeck codes, the lattice codes do not shape the signal power spectrum.

Some Properties of Orthogonal Galois-Field Spreading Sequences (CS)

Orthogonal Galois-field spreading sequences are a new tool to perform multilevel direct sequence spread spectrum communication (DS-SS). By defining a generalised finite field correlation, main properties of these digital sequences are derived. Besides, it is shown that good correlation properties of these 'carriers' allow anti-jamming and multiple access capabilities. Systems that employ Galois-field spreading sequences are the so-called Galois-Division Multiple Access (GDMA). An attempt to classify GDMA signals as spread spectrum signals, by means of a more elegant treatment, is also supplied.

Spread-Spectrum Based on Finite Field Fourier Transforms (CS)

Spread-spectrum systems are presented, which are based on finite field Fourier transforms. Orthogonal spreading sequences defined over a finite field are derived. New digital multiplex schemes based on such spread-spectrum systems are also introduced, which are Multilevel Coding Division Multiplex. These schemes termed Galois-field Division multiplex GDM offer compact bandwidth requirements because only leaders of cyclotomic cosets are needed to be transmitted.

Efficient Multiplex for Band-Limited Channels: Galois-Field Multiple Access (CS)

A new efficient-bandwidth code-divison multiple access CDMA for bandlimited channels is introduced, which is based on finite field transforms. A multilevel code division multiplex exploits orthogonality properties of non-binary sequences defined over a complex finite field. Galois-Fourier transforms contain some redundancy and only cyclotomic coefficients are needed to be transmitted yielding compact spectrum requirements. The primary advantage of such schemes regarding classical multiplex is their better spectral efficiency. This paper estimates the bandwidth compactness factor relatively to time division multiplex access TDMA showing that it strongly depends on the alphabet extension. These multiplex schemes termed Galois-field division multiplex GDM are based on transforms for which there exists fast algorithms. They are also convenient from the hardware viewpoint since they can be implemented by a digital signal processor.

Orthogonal Multilevel Spreading Sequence Design (CS)

Finite field transforms are offered as a new tool of spreading sequence design. This approach exploits orthogonality properties of

synchronous non-binary sequences defined over a complex finite field. It is promising for channels supporting a high signal-to-noise ratio. New digital multiplex schemes based on such sequences have also been introduced, which are multilevel Code Division Multiplex. These schemes termed Galois-field Division Multiplex (GDM) are based on transforms for which there exist fast algorithms. They are also convenient from the hardware viewpoint since a Digital Signal Processor can implement them. A new Efficient-bandwidth code-division-multiple-access CDMA is introduced, which is based on multilevel spread spectrum sequences over a Galois field. The primary advantage of such schemes regarding classical multiple access digital schemes is their better spectral efficiency. Galois-Fourier transforms contain some redundancy and only cyclotomic coefficients are needed to be transmitted yielding compact spectrum requirements.

On generalized two-dimensional cross constellations and the opportunistic secondary channel (CS)

An optimum bits-to-symbol mapping for square constellation is introduced, which allows a simple detection in narrow sense quadrature amplitude modulation systems. Then, a family of two-dimensional generalized cross constellations is presented as well as upper and lower bounds on the symbol error probability over an ideal band-limited channel, which generalize those previously known for conventional QAM. The application of this scheme to the opportunistic secondary channel is analysed and it is shown how fractional rates can be supported on 2D generalized QAM systems. These signaling schemes are compared with multi dimensional generalized constellations recently proposed by Forney and Wei.

On Lattice Implementation: A Combined Decoding-Demapping Algorithm (CS&IT)

Lattices are efficient Coded Modulation schemes. The practical implementation of bounded lattices deals with a mapping of binary strings into lattice points, decoding noisy vectors into a lattice point and demapping it into binary sequences. We introduce a combined demapping-decoding algorithm for lattices obtained from any generalized code formula. The process is simplified by decoding a noisy vector directly into a binary stream. The aim is to exploit attractive configurations from the practical point of view. The algorithm performance is evaluated by simulation: It is maximum likelihood for lattices from construction A, and it is bounded distance in any other case.

Probabilité d'erreur du codage aléatoire avec décodage optimal sur le canal à bruit gaussien additif (CS&IT)

We took up again Shannon computations about the error probability of random coding in the presence of additive Gaussian noise, with no other constraint than the use of constant energy signals, and assuming optimum decoding. The means nowadays available enable to go farther in the literal computations and to numerically compute the exact expressions instead of having to rely on bounds. The results thus obtained are intended to predict those which may be expected from a system combining maximum distance separable coding with a mapping of the alphabet symbols into the points of a two dimensional constellation, especially of a constant-amplitude one. We also consider the case where receiving takes place in the place in the presence of Rayleigh distribution amplitude fluctuations.

On lattice coding for the Gaussian channel (CS&IT)

The definition and basic properties of lattice codes for the Gaussian channel are first recalled. Then, an estimation of the code rate and bounds on the error probability are presented. Lattice codes are shown to exit, which reach the channel capacity. Separate coding and shape gains are introduced. Finally, the asymptotic behaviour of lattice codes is examined and we are led to conjecture that achieving capacity is a covering-rather than packing-problem.

Notes on data transmission teaching: MODEMs - Of History to the State of the Art (CS)

At the time of computers and information highways, data transmission take for granted an ever-increasing significance. One of relevant aspects of digital transmission refers to modems and codecs. Even thought fresh references on the subject exists, several of good quality, there have been difficulties in

teaching the subject, which is partially a result of the complexity of currently techniques. This often makes hard the knowledge diffusion, because many students do not grasp why using specific technical issues without enough knowledge of the revolutions that took place since the Bell's 300 bps first modems. The present distillation is intended to supply extra information for data transmission courses. The aim of this text is helping understanding and furnishing an appreciation of the modern techniques. From the beginnings to the state-of-art of modems, the main ideas are gradually revealed (scramblers, channel coders, sophisticated digital modulation techniques, adaptive equalization, echo cancel etc.) The focus is the current requirements of channel coding for high transmission rates. Many recognized instructors lack the actual closeness between current achieved rates and the channel capacity. An attempt to elucidate the rate constraints in private and commuted telephone lines is made, expressing results in terms of the spectral efficiency. The presentation is split into two lines: low speed modems (without channel coding) and high and ultra-high speed modems (including channel coding).

A new Hybrid ARQ-FEC strategy for data network protocols: The Monte Carlo Decoding for Block Codes (CS)

A new class of probabilistic decoding algorithms suitable for data network protocols is introduced, which intrinsically combines FEC and ARQ techniques. The main algorithm is all-purpose, straightforward, quite flexible, and has parallel architecture. The tradeoffs between space/time complexity and performance are evaluated by simulation using importance sampling. A few results for block codes such as BCH (31,15) and quadratic residues code QR (47,23) are presented.

Performance of Lattice Codes over the Gaussian Channel (CS)

We derive an upper bound on the error probability of lattice codes combined with quadrature amplitude modulation over the additive Gaussian noise channel. This bound depends on a lattice figure of merit and it is readily put in exponential form by using Chernoff bound. An interesting lower bound is derived by a similar reasoning. We also examine the estimation of the average information rate based upon the continuous approximation of the average power normalized to two dimensions, and suggest improving it by using the sphere packing idea. Examples of performance evaluation are given for a few lattices. Finally, we present upper and lower bounds on the best fundamental coding gains per dimension due to both density and thickness for an arbitrary large number of dimensions. It is shown in the appendix that, as the Ungerboeck codes, the lattice codes do not shape the signal power spectrum.

Codage déterministe imitant le codage aléatoire pour le canal à bruit gaussien additif (CS&IT)

We show that the Euclidean distance distribution of a system that combines maximum distance separable coding and a modulation, which performs a deterministic one-to-one mapping of the alphabet symbols onto a two-dimensional constellation is close to that which results in the average from random coding, provided that the code length and the dimensionality of the code are large enough. Thus, deterministic means enable in principle to approach as closely as desired the capacity of the additive white gaussian noise channel. We then briefly review over some problems related to the implementation of such a system.

Coding and Modulation for the Gaussian Channel in the Absence or in the Presence of Fluctuations (CS&IT)

Looking for systems that combine coding and multilevel modulation whose Euclidean distance is close to that which results in the average from random coding, we consider the combination of MDS codes over a large size alphabet a one-to-one mapping of the alphabet into a symmetric constellation, e.g., phase modulation. Its performance in the presence of additive Gaussian noise can be predicted from that of the random coding, provided that the signal to noise ratio is small enough. The results exhibit the sphere-hardening phenomenon whether or not amplitude fluctuations are present. Weighted demodulator output and soft decoding should be affected in order to achieve this performance. Such a decoding can be done in principle according to previous work by Fang

and Battail. A prohibitive complexity can be avoided only at the expense of strict optimality.

Empirical Bayes Adaptive Decoding for Sources with Unknown Distribution (CS)

A decoding algorithm for sources with unknown distributions is presented, which uses adaptive decision thresholds. The method is based upon a decision-direct receiver and in results derived from the empirical Bayes unsupervised learning technique, being appropriate for channels with low signal to noise ratio. The algorithm's convergence is analyzed and it is shown that the decoding error probability almost surely converges to the value that would be obtained if the source prior distribution were known. An application for binary transmission with digital modulation is discussed and the association of the technique with linear block codes is considered, which results in an adaptive MAP decoding procedure for such codes.

Applied Information theory (IT)

Wavelet Analysis as an Information Processing (IT&SP)

A new interpretation or the wavelet analysis is reported, which can is viewed as an information processing technique. It was recently proposed that every basic wavelet could be associated with a proper probability density, allowing defining the entropy of a wavelet. Introducing now the concept o wavelet mutual information between a signal and an analysing wavelet fulfils the foundations of a wavelet information theory (WIT). Both continuous and discrete time signals are considered. Finally, we showed how to compute the information provided by a multiresolution analysis by means of the inhomogeneous wavelet expansion. Highlighting ideas behind the WIT are presented.

Shannon and Renyi Entropy of Wavelets (SP&IT)

This paper reports a new reading for wavelets, which is based on the classical De Broglie principle. The waveparticle duality principle is adapted to wavelets. Every continuous basic wavelet is associated with a proper probability density, allowing defining the Shannon entropy of a wavelet. Further entropy definitions are considered, such as Jumarie or Renyi entropy of wavelets. We proved that any wavelet of the same family has the same Shannon entropy of its mother wavelet. Finally, the Shannon entropy for a few standard wavelet families is determined.

Towards a Wavelet Information Theory (IT)

This note reports a new reading for wavelets, which is based on the classical De Broglie principle. Some kind of duality "wave-particle" behaviour can be adapted to wavelets. The continuous basic wavelet is associated to a probability density on both time and frequency domain, allowing to define the Shannon entropy of a wavelet. It is shown that any wavelet of the same family has the same entropy of the mother wavelet. The entropy for a few standard wavelet families is determined. Introducing the concept of wavelet mutual information between a signal and an analyzing wavelet completes the foundations of a wavelet information theory.

The Entropy of a Code with Probabilities (IT)

The entropy of a code with probabilities is defined and as a consequence the concept of conservation of entropy in lossless coding emerges in a natural manner. For any given probability distribution $(p_1,p_2,\ldots p_T)$ all the distinct decompositions of the associated entropy function $h(p_1,p_2,\ldots,p_T)$, as a function of entropies of lower orders, are obtained from the terminal uncertainty of the distinct rooted trees with leaf probabilities $(p_1,p_2,\ldots p_T)$.

Homophonic Sequence Substitution (IT)

Homophonic sequence substitution is the name given in this paper to the technique, which consists of substituting one-to-one a given finite or semi-infinite sequence of symbols by another finite or semi-infinite sequence over the same alphabet, but having a higher entropy rate. The output sequence of a given discrete stationary and ergodic source is encoded a binary lossless source code C. A concatenation of codewords of C is then conveniently parsed and reencoded with

a binary lossless source code. By iterating the latter step a number of times, it is proved that the entropy rate of the binary sequence at the output of the last encoder approaches the value one asymptotically, therefore performing optimum homophonic sequence substitution. The remaining redundancy, after k consecutive encodings, is $1-H_k(S)$ bits per binary digits, where H_k is the entropy rate of the binary sequence resulting after the k^{th} encoding. A Markov source model is presented to describe the binary encoded sequences and to compute their entropy rate.

A Capacity Theorem for Lattice Codes on Gaussian Channels (IT&CS)

A capacity theorem for lattice codes signaling is presented, which is based on an upper bound on the error probability introduced by R. de Buda. It is shown that lattice codes can be used to achieve the channel capacity for any signal-to-noise ratio (positive statement) and the negative statement of the capacity theorem is also proved. The sphere hardening is shown to result from the weak law of large numbers. The proof allows a better understanding of the application of dense lattice as an efficient signaling alphabet. An expression of the reliability function $E(R,C)$ for lattices in AWGN channels is also presented.

The Random Coded-modulation (IT)

We apply the random coding argument to coded modulation. The well-known union bound on the error probability of general signaling schemes is revisited. The random coding modulation idea is introduced and a simple bound on the average performance of coded constellations is presented. A relationship between the union bound and the cut off rate is exhibited by introducing the concept of N-dimensional partial cut off rate. We define finite theta series for bounded finite dimensional constellations and their related transfer functions. Bounds on the block and symbol error probability based on the transfer function are derived. The discussion is then focused on the square Euclidean distance distribution. The evaluation of such parameters as its first two moments, that is, average square distance and square distance variance, is consider by either finite theta series or transfer function of the bounded signal set. The Euclidean distance spectra of a few multidimensional coded modulation schemes based on square or cross constituent two dimensional constellations are presented. Their respective partial cutoff rates are computed. We discuss the asymptotical behaviour and we show that almost all very long coded constellations are good. Actually, they tend to become quasi identical in a certain sense. Finally, we examine how to extend the initial union bound to Gallagher-type bounds.

Biomedical engineering papers (BE)

Converting EEG, ECG and other paper legated biomedical maps into digital signals (BE&SP)

A naïve and straightforward digital signal-processing tool developed using Matlab is offered as a very low-cost and quite effective strategy for analog-to-digital conversion of signals without requiring dedicated hardware. This software-based approach is particularly helpful for digitalizing biomedical signals acquired from analog apparatus equipped with a plotter. Albeit signals used in biomedical diagnosis are the primarily concern, this imaging processing tool can be suitable and economically feasible for modernizing facilities in a non-expensive way. As an appealing feature, old ECG and EEG charts can be fast and efficiently digitalized in order to be added in existing up-to-date medical data banks of cardiologists and neurologists to improve the follow-up of patients.

Of Protein Size and Genomes (BE)

An approach for approximately calculating the number of genes in a genome is presented, which takes into account the average protein length expected for the species. A number of viruses, bacterial and eukaryotic genomes are scrutinized. Genome figures are presented, which support the average protein size of a species as a criterion for assessing life complexity. The human gene distribution in the twenty-three chromosomes is investigated emphasizing the genomic rate, the mean exon length, and the mean exons per gene. It is shown that storing all genes of a single human definitely requires less than twelve Mbyte.

Virus Genome Imaging via a²grams (BE&SP)

Much of genomic signal analysis approaches for feature extraction and functional cataloguing have been focused on oligonucleotide patterns in the linear primary sequences of genomes. New DNA-imaging tools for genomic signal processing namely codongrams and a²grams had recently been offered for extracting meaningful genomic features embedded in DNA. A Matlab toolbox was implemented for allowing the image analysis of viruses and bacteriophages. Twenty different a²grams are defined for a genome, one for each amino acid (valgram is an a²gram for valine; alagram is an a²gram for alanine, etc.) They furnish information about the distribution and occurrence of the investigated amino acid. The codongram describes the distribution of a specific codon through the genome. The a²gram for a particular amino acid provides information about the sections of the DNA strand, which potentially leads to the synthesis of such an amino acid. DNA ×grams are among powerful visual tools for GSA like spectrograms, which can be applied when searching for particular nucleotide patterns. Among such patterns, the software includes built-in options the following: metgram to find out potential start position of genes, Shine-Dalgarno sequence localizer (translation mRNA to protein), TATA Box (replication DNA to mRNA), Enter a sequence (DNA particular sequence finder). A few genomes of viruses and bacteriophage were made available in the DEMO version: Bacteriophage ΦX174, phage MS2, Tomato Bushy Stunt Virus (TBSV), Tobacco Mosaic Virus (TMV), Phage M13, and Simian virus SV40 (genome lengths ranging from 3,569 to 6,400 bp). This tool is particularly helpful for comparing viruses, and it is also particularly valuable for educational purposes.

Genomic Imaging Based on Codongrams and a²grams (BE&SP)

This paper introduces new tools for genomic signal processing, which can assist for genomic attribute extracting or describing biologically meaningful features embedded in a DNA. The codongrams and a²grams are offered as an alternative to spectrograms and scalograms. Twenty different a²grams are defined for a genome, one for each amino acid. valgram is an a²gram for valine; alagram is an a²gram for alanine and so on. They provide information about the distribution and occurrence of the investigated amino acid. In particular, the metgram can be used to find out potential start position of genes within a genome. This approach can help implementing a new diagnosis test for genetic diseases by providing a type of DNA-medical imaging.

The Genetic Code revisited (BE)

How to represent the genetic code? Despite the fact that it is extensively known, the DNA mapping into proteins remains as one of the relevant discoveries of genetics. However, modern genomic signal processing usually requires converting symbolic-DNA strings into complex-valued signals in order to take full advantage of a broad variety of DSP techniques. The genetic code is revisited in this paper, addressing alternative representations for it, which can be worthy for genomic signal processing. Three original representations are discussed. The inner-to-out map builds on the unbalanced role of nucleotides of a codon, and it seems to be suitable for handling information-theory-based matter. The two-dimensional Gray map representation is offered as a mathematically structured map that can help interpreting spectrograms and scalograms. Finally, the world-map representation for the genetic code is investigated, which can particularly be valuable for educational purposes, besides furnishing plenty of room for application of distance-based algorithms.

How to Represent the Genetic Code? (BE)

The advent of molecular genetic comprises a true revolution of far-reaching consequences for humankind, which evolved into a specialized branch of the modern-day Biochemistry. The analysis of specific genomic information is gaining wide-ranging interest because of their significance to the early diagnosis of disease, and the discovery of modern drugs. In order to take advantage of a wide assortment of signal processing (SP) algorithms, the primary step of modern genomic SP involves converting symbolic DNA sequences into complex-valued signals. How to represent the genetic code? Despite being extensively known, the DNA mapping into proteins is one of the relevant discoveries of genetics. The genetic code (GC) is revisited in this work, addressing other descriptions for it, which can be worthy

for genomic SP. Three original representations are discussed. The inner-to-outer map builds on the unbalanced role of nucleotides of a codon. A two-dimensional-Gray genetic representation is offered as a structured map that can help interpreting DNA spectrograms or scalograms. These are among the powerful visual tools for genome analysis, which depends on the choice of the genetic mapping. Finally, the world-chart for the GC is investigated. Evoking the cyclic structure of the genetic mapping, it can be folded joining the left-right borders, and the top-bottom frontiers. As a result, the GC can be drawn on the surface of a sphere resembling a world-map. Eight parallels of latitude are required (four in each hemisphere) as well as four meridians of longitude associated to four corresponding anti-meridians. The tropic circles have 11.25 degrees, 33.75°, 56.25°, and 78.5° (North and south). Starting from an arbitrary Greenwich meridian, the meridians of longitude can be plotted at 22.5°, 67.5°, 112.5°, and 157.5° (East and West). Each triplet is assigned to a single point on the surface that we named Nirenberg-Kohama's Earth. Despite being valuable, usual representations for the GC can be replaced by the handy descriptions offered in this work. These alternative maps are also particularly useful for educational purposes, giving a much rich interpretation and visualization than a simple look-up table.

Pharmacy and chemistry (PhCh)

Desenvolvimento do Algoritmo de Classificação Hierárquica e Aplicação à Série de Derivados indol-2-carboxilato (PhCh)

The hierarchical clustering is a pattern recognition technique, which can be applied to drug design. In this work, an agglomerative cluster analysis approach is presented so as to perform a chemical substituent clustering based on the similarities among their physicochemical parameters. Once grouped, the relationship between the hierarchical cluster groups and the biological activities of compounds is addressed through the quantitative structure-activity relationship Q S A R. The software named Winclus, conceived for, implements the approach. An application for a series of indol-2-carboxilate described in the literature as an anticonvulsive agent is described, besides discussing software implementation issues. Substituents of synthesized compounds were particularly considered with the purpose of deriving the relationship between activity and cluster groups. In order to do so, a dendrogram was assembled, illustrating that this software is a handy tool for the drug design of new active compounds.

Release Kinetic Models of Penicillin G Benzatine for Nanocapsules and Liposomes: A New Look Based on Linear Systems (PhCh)

A new approach is introduced to examine the release kinetic of a drug carrier, which is based on the linear systems. A few examples of Penicillin G Benzatine (PenGB) release models from nano particulated systems are considered. Methods and Results: The PenGB release from nanocapsules and charged liposomes is examined by the inverse bulk dialysis method. The Penicillin release from nanocapsules furnishes a typical kinetic profile from nanoparticulated carriers. In contrast, when liposomes are used as a carrier for the PenGB, the kinetic profile presents an "oscillatory" behavior and the released drug often exceeds the steady state response (100%). The filter impulse response corresponds to a "channel" model of the drug delivering system. The time that is required to release almost all the content entrapped into nanoparticles could be evaluated by calculating the response time of the filter. A naive model corresponds to a 0.0628 rd/min (1/6 mHz) cut-off frequency ideal low-pass yielding a rise time of 45-60 min. A new interpretation of the drug release kinetics is presented which exploits the signal and system characterization. It is shown that the release rate model corresponds to the unit step response of a time-invariant linear low-pass filter. The rather uncommon Penicillin release profile from charged liposomes exhibits an overshoot and underdamped oscillations (a non-Fickian diffusion). The tools here introduced can help understanding such an unusual behavior of drug delivery from charged liposomes. Information is given to avoid erroneous or misinterpreted conclusions from anyone insufficiently familiarized with such kinetic profiles.

Bioequivalence of two Lamividine Tablet Formulations (PhCh)

The present study describes the determination of the bioavailability of a new commercial tablet formulation of Lamivudine

compared with a reference formulation. The comparative bioequivalence of the test and a reference formulation (each 3 × 150 mg) was assayed in 24 health volunteers by means of a randomized two-way crossover design. Prior to the study both the test and the reference formulations were examined for conformation to chromatography purity and drug content. Each volunteer received the test T and the reference formulation R with a one-weak drug-free interval between administrations. The plasma concentrations of T were monitored over a period of 12 hs after administration using a sensitive HPLC method. Pharmacokinetic parameters for T were determined from plasma concentration-time data. Statistical tests were carried out at 95% confidence intervals using a parametric method (three-way ANOVA) for AUC and C_{max}, and nonparametric method for T_{max}. The present study showed that both formulations were bioequivalent for the geometric mean of $AUC_{(0,12)}$, $AUC_{(0,\infty)}$, C_{max} and T_{max} at the 95% confidence interval. The bioavailability of the test (%) was 96.7, 93.3, 99.7, 100.3, respectively. The T:R ratio was, in each case, well within the acceptable rage of 100±20%.

Automated search for potentially active compounds by using cluster trees (PhCh)

A new bottom up hierarchical cluster technique, referred to as the adaptive mean linkage algorithm, is derived. Cluster algorithms are also offered as a tool to explore the descriptor space knowing the quantitative structure-activity relationship (QSAR). The substituents are clustered building a dendrogram per site. Choosing appropriate pathways on such cluster trees according to the QSAR equation, an automated search for potentially active substituted compounds can be performed. Applications to a series of substituted phenylguanidines with anticancer activity are focused illustrating this approach.

On Preparing a List of Random treatment assigns (PhCh)

This paper presents the foundations of a computer-oriented approach for preparing a list of random treatment assignments to be adopted in randomised controlled trials. Software is presented which can be applied in the earliest stage of clinical trials and bioequivalence assays. This allocation of patients to treatment in clinical trials ensures exactly equal treatment numbers. The investigation of the randomness properties of an assignment leads to the concept of a "strong randomised list". The new approach introduced in this note is based on thresholds and produces a strong randomised list of treatment assignments.

Motomura's Modified Equation for Surfactant Penetration into Spread Monolayers (PhCh)

The extent of surfactant penetration into monolayers is often evaluated by thermodynamic approaches. The most formal treatment of the penetration phenomenon is due to Motomura et al. However, this model seems to be inadequate to determine adsorption into films in the condensed state. It is also in contradiction with Hall's work, which demonstrated that it is impossible to calculate penetration quantities without extra thermodynamic assumptions. We present here a modified equation for determination of thermodynamic quantities of penetration and calculate the adsorption of poly oxyethyylene poly oxypropylene block copolymers into soya phospholipid films using our previously obtained experimental data. The proposed modified Motomura equation may yield penetration quantities more reasonable than those obtained with the use of the Alexander and Barnes or classical Motomura equations. It also indicated why the known penetration models give such different adsorption values. Moreover, these contributions allow one to clarify the relationship between different approaches aimed at quantifying surfactant penetration into insoluble films.

Corrélation entre la structure et l'activité de Guanylhydrazones par le Modèle de Free& Wilson modifié (PhCh)

Des guanylhydrazones dérivés de phenylthioacétaldhéydes et phenyltio-propanones substituées synthetisées par Alves (1983) ont présenté une importante activité inhibitrice sur la croissance de la radicelle du *Lepidium sativum* L (crésson alénois). Ce phytotest est un test primaire pour le composés à visée anticancereuse. Ce test nous a permit djobtenir des valeurs

d'activités suffisament précises, pI_{50}, pour établir des rélations quantitatives entre la structure de ces composés et leurs activités inhibitrices, en utilisant la méthode de Free et Wilson modifié.

Microhaematocrit determination in conventional centrifuges (PhCh)

The microhaematocrit determination is accomplished in microcentrifuges, which are not always available in small laboratories of clinical analyses. The present work aims to comparing the values of haematocrit achieved in capillary tubes utilizing conventional centrifuges with the haematocrit values obtained according to the method of Wintrobe employing microcentrifuges. The results obtained indicate that the accomplishment in conventional centrifuges is perfectly practicable.

Modified Version of MacFarland-Kubinyi Model and its use in QSAR (PhCh)

The impact caused by the use of digital computers has provided a great advance in the drug design. In the last 35 years several mathematical models have been developed with the purpose of establishing a correlation between physicochemical parameters and biological activities. Nowadays the most used QSAR model is probably the MacFarland nonlinear model modified by Kubinyi. A more realistic version of this model is mentioned in the literature and it is represented by the following equation: Equation 1. The aim of this work is to analyze and apply the above version to data fitting from several series of compounds. This model is investigated demonstrating how to determine the value of the lipophylic parameter that achieves maximum activity. Besides, it is shown how to separate the contributions of the lipophylia to the transport and the interaction with the receptor. In both cases, results are expressed by using regression coefficients derived from the fitting experimental data. The asymptotic characteristics are analyzed by studying the behavior of the biological response for very hydrophilic and very lipophylic compounds. One of the fundamental results is the possibility to suppress the constraint beta less than one without introducing any incompatibility to the conceptual hypothesis. The model is applied and discussed for several chemical series presenting different biological activities, namely guanylhydrazones that inhibit the vegetal cellular growth; picolinic acids that inhibit the dopamine oxydase; phenols that inhibit bacteria. In every case a slight improvement is obtained in relation to the classical MacFarland-Kubynyi model.