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Editorial

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This second special issue on nonlinear signal and image processing includes another group of high-quality papers selected among the more than 60 submissions received in response to the EURASIP JASP call for papers.

The high number of submissions testifies for the vitality of the field and the great interest existing in the signal processing community for nonlinear theories and tools.

The special issue features 18 papers mainly related to the solution of classical problems in the area of nonlinear image and video processing such as noise suppression and image restoration. In addition, contributions in the field of communications together with other interesting applications are considered. The wide range of topics dealt with clearly demonstrates the ubiquitous role played by nonlinear techniques in signal processing tasks.

The first group of papers deals with models and techniques for noise estimation and suppression from images.

The estimation of the standard deviation of noise contaminating an image is a fundamental step in wavelet-based noise reduction techniques. In the paper authored by A. De Stefano et al. three novel and alternative methods for estimating the noise standard deviation are proposed and compared with the MAD method.

Using notions from robust statistics, a variational filter referred to as a Huber gradient descent flow is proposed by A. Ben Hamza et al. It is a result of optimizing a Huber functional subject to some noise constraints, and takes a hybrid form of a total variation diffusion for large gradient magnitudes and of a linear diffusion for small gradient magnitudes.

Achieving a good performance in the suppression of impulsive noise is usually at the expense of blurred and distorted image features. One way to avoid this problem is to include a decision-making component in the filtering structure based on effective impulse detection mechanism. The function of the detection mechanism is to check each pixel to detect whether it is distorted or not, and then apply nonlinear filtering only on distorted pixels. E. Beşdok proposes an impulse noise removal filter based on an adaptive neuro-fuzzy inference system. The proposed filter comprises three main steps: finding the pixels that are suspected to be corrupted, carrying out Delaunay triangulation, and finally, making estimation for intensity values of corrupted pixels within each of the Delaunay triangles.

P. Çivicioğlu et al. present in their paper an impulsive noise exclusive filter. For the impulse detection mechanism, the filter uses chi-square goodness-of-fit test-based statistic.

The following three papers cover different aspects of nonlinear methods for image restoration and deblurring.

In the first one, K. Ichou et al. propose a nonlinear image restoration method based on the generalized radial basis function network to estimate the nonlinear blurring

function. A regularization method is also proposed and used to recover the original image from the nonlinearly degraded image and a cost function is then minimized using the steepest descent technique.

In their paper, M. E. Yüksel et al. present a new operator for the restoration of digital images corrupted by impulse noise. The proposed operator for efficient restoration of digital images corrupted by impulsive noise is a hybrid filter constructed by combining a recursive switching median filter with a simple neuro-fuzzy network functioning as an impulse detector.

The work presented by S. Colonnese et al. addresses the problem of blind image deblurring, that is, of recovering an original image observed through one or more unknown linear channels and corrupted by additive noise. They resort to an iterative algorithm, belonging to the class of Bussgang algorithms, based on alternating a linear and a nonlinear image estimation stage.

A couple of papers are related to speckled imagery.

The paper presented by A. C. Frery et al. deals with numerical problems arising when performing maximum likelihood parameter estimation in speckled imagery using small samples.

A novel approach to reduce speckle noise and enhance structures in speckle-corrupted images is proposed by Z. Yang and M. D. Fox. A median-anisotropic diffusion compound scheme is proposed, where the median-filter-based reaction term acts as a guided energy source to boost the structures in the underlying image.

The next two papers deal with problems encountered in the area of pattern recognition.

In their contribution, T. Géraud and J.-B. Mouret propose a technique for the extraction of curvilinear objects in images. The devised application is the recognition of road networks in satellite imagery. The proposed algorithm is based on four steps; first, a "potential" domain in which road-like structures are more evident is chosen; then, morphological operators are applied to obtain a watershed representation, and a curve adjacency graph is built. The problem at this step is one of graph labelling, and it is solved based on a Markov model and simulated annealing.

In pattern recognition problems, different types of prior knowledge are encountered. It is important to incorporate such knowledge into classification methods. Distance-based classification methods make use of a modified distance measure called geodesic distance. Q. Yong and Y. Jie introduce a new kind of kernel for support vector machine (SVM) which incorporates geodesic distance and therefore is applicable in cases such as when transformation invariance is known.

The following three papers deal with different significant applications of nonlinear techniques.

A statistical analysis of the behavior of a blind robust watermarking system is presented by V. Solachidis and I. Pitas. Their method is based on 1D pseudorandom signals embedded in the magnitude of the Fourier transform of the data and on the design of an optimum detector for multiplicative watermark embedding.

C.-H. Thomas Yang et al. propose a novel face image matching algorithm which is robust against illumination variations. A high recognition rate with three reference images for different datasets under different lightening conditions is obtained.

A medical application is dealt with in the paper authored by H. Hassanpour et al. The authors propose a novel time-frequency technique to detect EEG seizures. A neural network is trained to discriminate between seizure and non-seizure patterns.

The special issue is completed by a group of contributions in the area of video coding and communication systems.

A frame-aware nonlinear layering scheme for transporting DCT-based video over packet-switched networks is proposed by P. Cuenca et al. It is, in particular shown that proper tuning of encoding parameters enables graceful degradation and even maintaining video quality while reducing the bit rate.

In the next paper, Z. Yao and R. Wilson report a novel hybrid 3-dimensional compression scheme which combines fractal coding with neighbourhood vector quantisation for video and volume data. The low-complexity hybrid coder outperforms other fractal coders.

Modern third generation (3G) and future fourth generation (4G) mobile communication systems offer many challenges, such as high data rates, multimedia communications, seamless global rooming, quality of service management, high user capacity, and so forth. To meet these challenges, presently researchers are focusing their attention on the satellite domain. As a result, a new generation of satellite communication systems is being developed to support multimedia and Internet-based applications. In this context, M. Ibnkahla and J. Yuan describe a maximum likelihood sequence estimator (MLSE) receiver for satellite communications.

In recent years, there has been an increasing interest in the investigation of hostile media, such as power-line channels, for high-rate transmissions. It has been demonstrated that power-line channels are as good as telephone and cable TV channels for the transmission of broadband signals in the last-mile environments. However, they require special schemes to cope with various problems, one of them being the strong intersymbol effect. In this respect, equalization techniques are widely applied. In the paper by M. V. Ribeiro, the development of nonlinear equalization techniques based on adaptive fuzzy systems is considered. The proposed fuzzy solutions combine the equalization of the power-line channels with the reduction of impulse noises.

It is the opinion of the editors of this special issue that the contributions presented here, together with those published in the first special issue, actually offer to the EURASIP JASP readers a complete illustration of the scenario including the tasks that can be efficiently faced using nonlinear methods. Therefore, such special issues constitute a firm and reliable reference even in the rapid evolution of nonlinear signal and image processing.

The editors would like to thank Gianluca Foresti and Giovanni Ramponi for their assistance in editing two of the papers published in this special issue.

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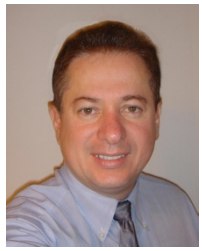

Gonzalo Arce received the Ph.D. degree from Purdue University, West Lafayette, in 1982. Since 1982, he has been with the faculty of the Department of Electrical and Computer Engineering, University of Delaware, where he is the Charles Black Evans Distinguished Professor and Department Chairman. His research interests include statistical and nonlinear signal processing, multimedia security, electronic imaging, and signal processing for communications and networks. He received the NSF Research Initiation Award. He is a Fellow of the IEEE for his contributions to nonlinear signal processing and its applications. Dr. Arce was the Cochair of the 2001 EURASIP/IEEE Workshop on Nonlinear Signal and Image Processing (NSIP'01), Cochair of the 1991 SPIE's Symposium on Nonlinear Electronic Imaging, and the Cochair of the 2002 and 2003 SPIE ITCOM conferences. Dr. Arce has served as an Associate Editor for the IEEE Transactions on Signal Processing, Senior Editor of the EURASIP Journal on Applied Signal Processing, as Guest Editor for the IEEE Transactions on Image Processing, and as Guest Editor for Optics Express. He is the coauthor of the textbooks *Digital Halftoning*, Marcel Dekker, 2001, *Nonlinear Signal Processing and Applications*, CRC Press, 2003, and *Nonlinear Signal Processing: A Statistical Approach*, Wiley, 2004. He is a frequent consultant to industry in the areas of image printing and digital video. He holds seven US patents.

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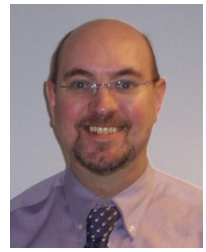

Stephen Marshall received a first-class honours degree in electrical and electronic engineering from the University of Nottingham in 1979 and a Ph.D. degree in image processing from University of Strathclyde in 1989. In between, he worked at Plessey Office Systems, Nottingham, University of Paisley, and the University of Rhode Island, USA. In recent years, his research activities have been focused in the area of nonlinear image processing. He has pioneered new design techniques for morphological filters based on a class of iterative search techniques known as genetic algorithms. The resulting filters have been applied as four-dimensional operators to successfully restore old film archive material. The work is now the subject of a Scottish Enterprise, *Proof of Concept Program*, to commercialise these techniques. He has published over 100 conference and journal papers on these topics including IEE, IEEE, SPIE, SIAM, ICASSP, VIE, and EUSIPCO. He is an Executive Team Member of the IEE Professional Network on Visual Information Engineering (VIE), a former Director and Chairman of the Scottish Chapter, the British Machine Vision Association, and a Founding Member of the Nonlinear signal and Image Processing (NSIP) Board.