Editorial

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Biographical notes: Khalifa Djemal received his diploma degree in Optical, Image and Signal Processing in 1999 from the National School of Physics at the University of Marseille, France and his Ph.D. in Image and Signal Processing, 2002, from the University of Toulon, France. Since 2003, he is an Associate Professor at the Electrical Engineering Department of the Institute of Technology at the University of Evry Val d'Essonne, France. He works now within the T.A.D.I.B. team of the IBISC Laboratory. His current research interests are in the areas of image and data processing (Restoration, Segmentation, Clustering and CBIR). Dr. Djemal chaired the International Conference on Image Processing Theory, Tools and Applications IPTA, in 2008 and 2010, and also International Workshop on Medical Image Analysis and Description for Diagnosis Systems, MIAD, since 2009. He was the chair of some special sessions in a number of conferences. He acted as technical chairman for a number of conferences. He is a reviewer for a number of international journals and conferences.

Many computer vision system applications, such as computer-human interaction, detecting events and many other specific applications have created a great need for searching and recognizing images in databases. Commonly, image recognition process involves three main steps. Feature extraction and detection is the first step, aiming at identifying a set of image locations presenting with rich visual information. The second step is the feature description and selection which consisting in defining robust descriptors based on the extracted features. The selected descriptors are then used in the last step of the system which relates to the image representation, recognition and indexing.

This second issue for 2012 of the International Journal of Signal and Imaging Systems Engineering (IJSISE) comprises a special issue on "Feature Extraction and Selection for Images Recognition in Large Databases". It contains nine papers covering the main topic of the considered special issue.

The research reported in this special issue deals with the different steps of an image recognition system. I believe that the selected papers present rigorous techniques for developping tools that can be applied in image recognition problems.

The first paper by Tomas Fabian, Jan Gaura and Petr Kotas describes in detail a new method for detecting iris in digital images, based on curve fitting and cost function maximization. When we are searching for limbic boundary we use the inverse gradient and starlike sampling scheme. They define the cost function reflecting the properties of brightness distribution in the pupil region. Tne proposed algorithm can be described in three simple steps; at first, the detection of the bright point inside the pupil; at second, outer limbic boundary is found via statistical measurements of outer boundary points; and at third, inner boundary points are searched by means of defined cost function maximization. Performance of the presented method is evaluated on series of iris images and compared with the traditional Hough method as well.

Riad Khelifi, Mouloud Adel and salah bourennane propose in the second paper new approach of multi-spectral texture classification based on both spatial and spectral information. This is made by extending the concept of spatial Gray Level Difference Method (GLDM) and assuming texture joint information between spectral bands. In this manner, they characterize multi-spectral texture by statistics of absolute difference distributions of pairs of spectral vectors and define new texture features by computing various statistics from such distributions in given relative positions. Extensive experiments have been carried out on many multi-spectral images for use in prostate cancer diagnosis and quantitative results showed the efficiency of this method compared to the Gray Level Difference Method. The results indicate a significant improvement in terms of global accuracy rate.

The third paper by Chao Zhu, Huanzhang Fu, Charles-Edmond Bichot, Emmanuel Dellandra and Liming Chen proposes to adopt two different kinds of feature to characterize different aspects of object appearance. The first is multi-scale local binary pattern (LBP) operator, which is extracted from coarse-to-fine image blocks to well describe texture structures while keeping its computational efficiency. The second is line segment feature, which is based on Gestalt-inspired region segmentation and fast Hough transform, and aims at capturing accurate geometric information of visual objects. The experimental results on the SIMPLIcity database and PASCAL VOC 2007 benchmark show the effectiveness of line segment feature,

and significant accuracy improvement by using fine level image blocks for LBP. Moreover, combining LBP from different image block levels can further boost its performance, and outperform the state-of-the-art SIFT. Both descriptors are also proven to provide complementary information to the SIFT.

The fMRI data dimensionality problem is studied in the fourth paper by Samuel Emeriau, Frederic Blanchard, Jean-Baptiste Poline, Laurent Pierot and Eric Bittar. Indeed, as fMRI data is high dimensional, applications like connectivity studies, normalization or multivariate analyses, need to reduce data dimension while minimizing the loss of functional information. In the prposed study, authors use connectivity profiles as a new functional feature to aggregate voxels into clusters. This offers two major advantages in comparison with the current clustering methods. It allows the analyst to deal with the spatial correlation of noise problem, that can lead to bad mergings in the functional domain, and it is based on the whole data independently of a priori information like the General Linear Model (GLM) regressors. They validate that the resulting clusters form a partition of the data in homogeneous regions according to both spatial and functional criteria.

The fifth paper by rashmi gupta and Rajiv Kapoor presents four broadly representative graph based techniques for manifold learning: Isomap, maximum variance unfolding, locally linear embedding, and Laplacian eigenmaps have been reviewed and compared for nonlinear dimensionality reduction. These methods begin by constructing a sparse graph in which the nodes represent input patterns and the edges represent neighborhood relations. The resulting graph can be viewed as a discretized approximation of the submanifold sampled by the input patterns. From these graphs, matrices can be constructed whose spectral decompositions reveal the low dimensional structure of the submanifold. Though capable of revealing highly nonlinear structure, graph-based methods for manifold learning are based on highly tractable polynomial time optimizations such as shortest path problems, semidefinite programming, and matrix diagonalization. All the four techniques are implemented on Swiss roll, helix, twin peak and broken Swiss roll dataset. From the experimental results, it is concluded that nonlinear techniques for dimensionality reduction are, despite their large variance, often capable of outperforming traditional linear techniques such as PCA.

The sixth paper by Alexander Ceron, Augusto Salazar and Flavio Prieto presents relevance analysis of descriptors such as main curvatures, mean curvature, Gaussian curvature, Shape index, Curvedness, Multiresolution Spin Images, and the Multi-scale Shape Index, all of them in regions of the human face. This study aims to determine which descriptors offer the most relevant information in particular locations of the face by using the Fisher's discriminant analysis. Therefore, the most adequate descriptor that can be used in facial anthropometry or face recognition can be identified. Authors show a face recognition experiment that support the advantage of the relevance analysis. The characterization can be extended to different parts of the body and can be applied to diverse fields that include animation, forensic medicine, reconstructive surgery, among others.

Signature identification and verification system was proposed in the seventh paper by Samaneh Ghandali, Mohsen Ebrahimi Moghaddam and Javad Khosravi. The identification phase is based on TSR (triangle spatial relationship) that is a rotation invariant feature extraction method. Also, a symbolic representation of signature has been employed to make using TSR possible. In the verification phase, a hybrid method is proposed that combines discrete wavelet transform, Gabor filter, and image fusion methods. Experimental results on some benchmarks have confirmed the robustness and precision of proposed method together with its robustness against translation, scaling, and rotation.

The eighth paper by Imene Cheikhrouhou Kachouri, Khalifa Djemal and Hichem Maaref proposes a new shape descriptor allowing to characterize simultaneously the number, the depth and the width of spicules. Consequently, the proposed Spiculated Mass Descriptor (SMD) allows to distinguish between ambiguous cases such as lobulated benign masses and microlobulated malignant masses which are hard to classify using common shape analysis methods. In addition, it ensures invariance to geometrical transformations which preserve a robust descriptor insensitive to shifts, orientations and scalings. SMD efficiency is evaluated on the known Digital Database for Screening Mammography (DDSM) using the area under the Receiver Operating Characteristic (ROC) curve analysis. Experimental results show that the new descriptor outperforms several shape features and provides satisfying classification results of benign and malignant masses.

A novel image database categorization approach is proposed in the nineth and last paper by Mohamed Maher ben Ismail and Hichem Frigui, they use Robust Modeling of finite Generalized Dirichlet Mixture (RM-GDM). The proposed algorithm is based on optimizing an objective function that associates two types of memberships with each data sample. The first one is the posterior probability and indicates how well a sample fits each estimated distribution. The second membership represents the degree of typicality and is used to identify and discard noise points and outliers. These properties make RM-GDM suitable for noisy and high-dimensional feature spaces.

I hope that the presented papers offer some new perspectives and further research in image representation and recognition. This special issue would not have become possible without the continuous help at each moment given by Editor-in-Chief of Int. J. Signal and Imaging Systems Engineering, Prof. Dimitrios A. Karras. Cordial gratitude to him by the guest editor! Finally, I would like to thank all contributors and referees for their expertise and commitment to the quality of this work.