Editorial

Computational Intelligence in Image Processing 2014

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Image processing is a dynamic and fast moving field of research. Recent advances in image processing have led to an explosion in the use of images in a variety of scientific and engineering applications. Therefore, each new approach that is developed by engineers, mathematicians, and computer scientists is quickly identified, understood, and assimilated in order to be applied to image processing problems.

Such growing interest has forged the need for including computational intelligence as a potential tool to provide novel solutions to challenging image processing problems. One of the most demanding issues is the handling of image uncertainties that cannot be otherwise eliminated, including various sorts of information that is incomplete, noisy, imprecise, fragmentary, not fully reliable, vague, contradictory, deficient, and overloading. They result in a lack of the full and precise knowledge of the system including the determining and selection of evaluation criteria, alternatives, weights, assignment scores, and the final integrated decision result. Computational intelligent techniques including fuzzy logic, neural networks, and evolutionary methods have shown great potential to solve such image processing problems as alternative to the existing classical techniques.

The importance of computational intelligence in image processing has increased in all engineering areas. Such a fact is evident from a quick look at special issues, congresses, and specialized journals that focus on such a topic. The main objective of this special issue is to bridge the gap between computational intelligence techniques and challenging image

processing applications. Since this idea was first conceived, the goal has aimed at exposing the readers to the cutting-edge research and applications that are going on across the domain of image processing, particularly those whose contemporary computational intelligence techniques can be or have been successfully employed.

The special issue received several high-quality submissions from different countries all over the world. All submitted papers have followed the same standard of peer-reviewing by at least three independent reviewers, just as it is applied to regular submissions to this journal. Due to the limited space, a very short number of papers have been finally included. The primary guideline has been to demonstrate the wide scope of computational intelligence algorithms and their applications to image processing problems.

The paper authored by P. Forczmański and A. Markiewicz presents a method for the detection and classification of rubber stamp instances in scanned documents. The approach works on typical stamps of different colors and shapes. For color images, color space transformation is applied in order to find potential color stamps. Monochrome stamps are detected through shape specific algorithms. Following the feature extraction stage, identified candidates are subjected to classification task using a set of shape descriptors. The authors perform two-tier classification in order to discriminate between stamps and no-stamps and then classify stamps in terms of their shape. The experiments carried out on a considerable set of real documents gathered from the Internet showed high potential of the proposed method.

K. Hu et al. propose an image filter method which combines the merits of Shearlet transformation and particle swarm optimization (PSO) algorithm. Firstly, the authors use the classical Shearlet transform to decompose noised image into many subwavelets under multiscale and multiorientation. Secondly, they gave weighted factor to those subwavelets obtained. Then, using classical Shearlet inverse transform, authors obtained a composite image which gathers those weighted subwavelets. After that, they have designed a fast and rough evaluation method to evaluate noise level of the new image; by using this method as fitness, authors adopted PSO to find the optimal weighted factor; after lots of iterations through the optimal factors and Shearlet inverse transform, the best denoised images are defined. Experimental results demonstrate that proposed algorithm eliminates noise effectively and yields good peak signal noise ratio (PSNR).

S.-S. Mu et al. present a multiframe superresolution reconstruction method based on self-learning methods. In the approach, first, multiple images from the same scene are selected to be both input and training images, and larger-scale images, which are also involved in the training set, are constructed from the learning dictionary. Then, different larger-scale images are constructed via repetition of the first step and the initial high-resolution (HR) sets whose scale closely approximates that of the target HR image are finally obtained. Lastly, initial HR images are fused into one target HR image. The simulation results demonstrate that the proposed algorithm produces more accurate reconstructions than those produced by other general superresolution algorithms, while, in real scene experiments, the proposed algorithm can run well and create clearer HR images from input images captured by cameras.

The paper by Z. H. Shamsi and D.-G. Kim proposed a new algorithm for image denoising. The approach involves two steps: the first step is a multiscale implementation of an accelerated nonlocal means filtering in the discrete stationary wavelet domain to obtain a refined version of the noisy patches for later comparison. The next step is to apply the proposed modification of standard nonlocal means filtering to the noisy image using the reference patches obtained in the first step. These refined patches contain less noise, and consequently the computation of normal vectors and partial derivatives is more precise. Experimental results show equivalent or better performance of the proposed algorithm compared to various state-of-the-art algorithms.

S. Gao et al. present a novel model for unsupervised segmentation of viewer's attention object from natural images based on localizing region-based active contour (LRAC) model. Considering a Harris detector and the core saliency map, authors get the salient object edge points. Then, these points are employed as the seeds of initial convex hull. Finally, this convex hull is improved by the edge-preserving filter to generate the initial contour for our automatic object segmentation system. Extensive experiments on a large variety of natural images demonstrate that their algorithm consistently outperforms the popular existing salient object segmentation methods, yielding higher precision and better recall rates.

The paper by F. Z. Chelali and A. Djeradi proposed a face recognition system using multilayer perceptron (MLP) and radial basis functions (RBF). In the approach, Gabor and discrete wavelet are considered for the extraction of features from facial images. The experiments over two standard facial databases demonstrate that the proposed method outperforms standard methods in terms of robustness and accuracy.

X. Xu et al. present a data driven approach to adaptively select proper features for different kinds of images. This method exploits low-level features containing the most distinguishable salient information per image. Then the image saliency can be calculated based on the adaptive weight selection scheme. A large number of experiments are conducted on a standard database to compare the performance of the proposed method against state-of-the-art saliency computational models.

The paper by E. Cuevas et al. presents an algorithm for the automatic selection of pixel classes for segmentation proposes. The approach combines a novel evolutionary method with the definition of a new objective function that appropriately evaluates the segmentation quality with respect to the number of classes. The new evolutionary algorithm, called Locust Search (LS), is based on the behavior of swarms of locusts. Different to the most of existent evolutionary algorithms, it explicitly avoids the concentration of individuals in the best positions, avoiding critical flaws such as the premature convergence to suboptimal solutions and the limited exploration-exploitation balance. Experimental tests over several benchmark functions and images validate the efficiency of the proposed technique with regard to accuracy and robustness.

X. Zheng et al. introduce a new method for text segmentation based on Radon-like features and adaptive enhancement filters. In the approach, first, an adaptive enhancement LM filter bank is used to get the maximum energy image; second, the edge image of the maximum energy image is calculated; finally, a set of Radon-like feature images is generated by combining maximum energy image and its edge image. The average image of Radon-like feature images is segmented by a classical image thresholding method. Compared with 2D Otsu, GA, and Fast FCM, the experiment results show that this method can perform better in terms of accuracy and completeness of the text.

The paper by L. Sun et al. presents a new image watermarking scheme based on Arnold Transform (AT) and Fuzzy Smooth Support Vector Machine (FSSVM). Compared with other watermarking techniques, the approach can promote the security by adding more secret keys, and the imperceptibility of watermark is improved by introducing fuzzy rules. Experimental results show that the proposed method outperforms many existing methods against various types of attacks.

M. Perez-Cisneros et al. introduce a predictive control strategy for an image-based visual servoing scheme that employs evolutionary optimization. The visual control task is approached as a nonlinear optimization problem that naturally handles relevant visual servoing constraints such as workspace limitations and visibility restrictions. As the predictive scheme requires a reliable model, this paper uses

a local model that is based on the visual interaction matrix and a global model that employs 3D trajectory data extracted from a quaternion-based interpolator.

Acknowledgments

Finally, we would like to express our gratitude to all of the authors for their contributions and the reviewers for their efforts to provide valuable comments and feedback. We hope that this special issue offers a comprehensive and timely view of the area of applications of computational intelligence in image processing and that it will grant stimulation for further research.

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