

Guest Editorial

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The present issue enlists a series of six articles describing some novel contributions in image processing in the framework of machine learning. Image processing has been the subject of increasing interest to researchers for about five decades. Image information processing has seen a lot of changes with time in terms of methodology development and application. The maturity of the field can be characterised by the significant growth of active applications in the related domains. For example, remote sensing, technical diagnostics, autonomous vehicle guidance, medical (2D and 3D) imaging and automatic surveillance are the most rapidly developing areas. Machine learning is a rapidly evolving field dedicated to developing and improving algorithms that allow computers to learn from data and recognise patterns. In recent years, machine learning has experienced a surge in popularity due to the growing need for more powerful and efficient means of analysing complex data. In several cases the use of machine learning methods has demonstrated merits over other approaches in image processing. For example, the edges or boundaries detected by machine learning methods from an image have been shown to be more consistent with those perceived by human visual system and more semantically meaningful.

The problem of classification is one aspect of machine learning that is of particular importance to researchers in several fields. As the scale of datasets grows larger and the need for greater classification accuracy increases, new techniques for classifying data are more highly sought after. Examples of growing data volumes can be found in image categorisation and automatic image retrieval tasks, as well as in automated person recognition. Pattern classification methods have proven to be eminently successful in many such real-life applications.

Machine learning has changed the various fields of computer science and the image processing community has become a user of the machine learning paradigm. The Big Data challenge of handling large volumes of visual information has become an integral part of the digital universe. Today, like voice and text data, the volume and size of images to be processed for various applications are becoming very large. Application areas such as medical imaging, remote sensing using multispectral and hyper-spectral images, image archival and retrievals, biometrics, video processing and surveillance deal with advanced machine learning and pattern recognition technologies for their efficient processing and analysis. Various data mining schemes have been developed to process images in order to enable enhanced decision-making and knowledge discovery. Granular computing and soft computing technologies are being used to provide speedy, approximate and effective solutions. Recently the Big Data issues characterised by “3Vs”, namely, volume, variety and velocity have begun to demand a revolutionary change in approaches, research methodologies and tools to meet the new challenges in all levels of image processing and mining. As a result, novel machine learning and computational intelligence techniques may need to be developed.

The objective of this Special Issue is to present novel research contributions in this interdisciplinary research area as it enters maturity and a new phase of its development. It consists of six articles related to certain tasks and applications of image (including video) processing and analysis. These are described as follows:

The issue starts with the article of Suranjana Samanta and Sukhendu Das, where a method of unsupervised domain

adaptation is proposed using eigen-analysis in kernel space for categorisation tasks. Eigenvectors and eigenvalues of both the source and target domains are used in the analysis. The method involves optimal linear transformation of data in source domain such that the transformed source and target domains have similar eigenvectors and eigenvalues. Moreover, for non-linear projection of the data they used the concept of reproducing kernel Hilbert space and estimated a suitable transformation in the (reduced) sub-space. The method is fast, as eigen-decomposition in lower dimensional subspace and the use of kernel Gram matrix help in reducing the time complexity in the case of very large dimensional datasets. These features have been demonstrated on real-world datasets for tasks like object, video and text categorisation.

Meiyu Liang *et al.*, describe in their article a super-resolution reconstruction method using Pseudo-Zernike moments and nonlocal similarity matching. By learning the nonlocal similarity between dynamic images, similarity weights are computed to estimate the high resolution image. Due to trans-scale fusion of nonlocal similarity information between dynamic images, the technique can be adapted to complex motion patterns and it is robust to noise and rotation. Here, the luminance compensation is implemented based on multisource bidirectional similarity, which can eliminate the influences of multi-exposure factors on registration accuracy.

The next contribution is on multi-step radiographic image enhancement, where the authors, Changying Dang *et al.*, explain an algorithm that provides very high accuracy for weld defect segmentation. A linear combination is taken adaptively between the original image and the contrast-limited adaptive histogram enhanced image, and then an anisotropic diffusion filter is applied. Finally, the method uses an iterative fuzzy enhancement which is adaptive based on improved Otsu's relation. By taking the inverse transformation of the fuzzy image the enhanced image is obtained for segmentation. Conflicting issues of noise amplification, image blur, edge loss, over-enhancement – which often exist in conventional enhancement algorithms – have been dealt with, and greater accuracy in segmentation is achieved.

The paper of Seba Susan *et al.*, proposes a new fuzzy set theoretic classifier for scale invariant feature transform (SIFT) features that involve all the key-points required for decision making. As an application, the problem of face recognition using a single training template is considered where uncropped images of frontal faces in the presence of high background clutter are used. Facial features are given more importance using feature entropy as weight in the classifier. The product of cumulative fuzzy measure, corresponding to fuzzy classifier with SIFT features and entropy weighted fuzzy SIFT classifier, is seen to be a good criterion for face recognition under weak supervision. Comparative results with state-of-the-art methods on benchmark facial databases confirm the efficiency of proposed method.

The next two articles deal with video tracking and gait recognition. In the article of Shinfeng D. Lin *et al.*, a patch-based appearance model is presented for handling occlusion in object tracking. The model contains two main features: colour and motion vector. In case of failure in tracking, the speeded up robust features (SURF) are used for error recovery. The use of particle filter makes the tracking against occlusions robust. A gait recognition system using Kinect depth stream, captured in the frontal view, is used in the article of Pratik Chattopadhyay *et al.*,

for person re-identification. The method involves information fusion for multi Kinect cameras to combine partial gait features. The effectiveness of the system is demonstrated experimentally.

These papers provide various applications including a wide range of techniques applied to different image processing tasks. We believe, they will enhance the knowledge in the field and encourage further research activities in the interface between image processing, machine learning and their applications.

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