GUEST EDITORIAL

Special issue on video and imaging systems for critical engineering applications [SI 1096]



Gwanggil Jeon 1 · Awais Ahmad 2 · Abdellah Chehri 3 · Salvatore Cuomo 4

Published online: 24 January 2020

© Springer Science+Business Media, LLC, part of Springer Nature 2020

A recent change in the global economy, experiencing an unparalleled integration of science and technology, i.e., smart watches, smartphones and other electronic gadgets, has dramatically changed the way we connect with the world around us. Various challenges and issues brought by this integration for mobile and video lie ahead, and many research questions remain to be answered. For instance, the complex nature of mobile and video imaging need radical version to the swift changes in our society, economy, environment, and technological revolution; there is an utmost need to address and propose dynamic and innovative solutions to problems which tend to be either complex or static or rapidly evolving with a large number of unknowns. Furthermore, the battle against the severe disease such as cancer, tuberculosis, high blood pressure and ECG, fight against the terror, exploration and management of the natural resources in remote area using remote sensing, underground and tunnel inspection, other and environmental monitoring are some of the areas that need to be addressed with urgency. In addition, the complication of involved imaging scenarios, and demanding design parameters, i.e., signal to noise ratio, high speed specification, high contrast and spatial resolution, complex background, harsh environment, requires the growth of multifunctional, scalable imaging suit of sensors, solutions driven by novelty, operating on diverse detection and imaging principles. Moreover, artificial neural network when combined with pattern recognition techniques, such

Awais Ahmad aahmad.marwat@gmail.com

Abdellah Chehri@uqac.ca

Salvatore Cuomo salvatore.cuomo@unina.it

- Incheon National University, Incheon, South Korea
- Bahria University, Islamabad, Pakistan
- Université du Québec à Chicoutimi, Chicoutimi, Canada
- University of Naples Federico II, Naples, Italy



as classification, feature selection, clustering, text analysis, image and color representation of video and image processing promise the solution of challenging technical problems, below the umbrella of complex video and imaging situations of stimulating technical problems, with applications in medical video and image processing, aerospace, radars and defense system, and other security appliances. Witnessing all these mobile breakthroughs, therefore, we believe that it is important to investigate the current advances and future trends in the mobile image and video processing.

This special issue is intended to provide a highly recognized international forum to present recent advances in Multimedia Tools and Applications. The ultimate objective is to bring together well-focused, top quality research contributions, providing to the general Multimedia Tools and Applications an opportunity to get an overall view of research results, projects, surveying works and industrial experiences that are dealing with theory and applications within the theme of Video and Imaging Systems for Critical Engineering Applications. We invited authors to submit original research articles that would enhance our understanding of emerging and innovative technologies and the strategies and methods that contribute to the Multimedia Tools and Applications applied to imaging sensors, processing and pattern recognition, medical imaging, bioinformatics, computer vision, remote sensing, surveillance, inspection and monitoring, towards complex and real-world engineering and computer science applications. We welcomed both theoretical contributions as well as papers describing interesting applications. Papers were invited for this special issue considering aspects of this problem, including:

- Emerging techniques for next generation mobile video/image coding
- · Summarization tools in hyper/multi-spectral domain
- Novel image and video applications taking advantage of mobile devices
- Relevance feedback techniques to assist experts in making complex decisions
- Mobile image/video indexing and retrieval
- 4D/5D image reconstruction
- Mobile visual content adaptation and adaptive streaming
- Semantic representation and content enrichment
- · Mobile visual search
- Behavioral analysis and actions recognition for complex engineering applications

After review, a total of 42 papers out of 97 submissions have been accepted for publication in this issue.

The contribution by Bakshi et al. "Single image super resolution for texture images through neighbor embedding" proposes an improved learning based super resolution scheme using manifold learning for texture images. In this work, the Pseudo Zernike moment has been employed to extract features from the texture images. For reconstruction of the high resolution patch, a collaborative optimal weight is generated from the least square and non-negative matrix factorization methods. The proposed method is tested on some color texture, gray texture, and some standard images.

There are many mobile devices which adopt single image sensors to acquire scene images. In the contribution by Wang et al. "Real time Demosaicking algorithm using derivative difference and curvature for digital camera", authors propose an adaptive and effective demosaicking algorithm using derivative difference and curvature which can estimate the directional component to reconstruct the to-be-interpolated color pixels. The authors introduce



a function to evaluate the image complexity, which is composed by the derivative difference and isophote smoothing which is calculated as the sign of image curvature.

In the contribution by Lee et al. "Implementation of autonomous driving of a ground vehicle for narrow high-curvature roads using surround view images", a new approach for the implementation of autonomous driving of a ground vehicle on narrow and high-curvature roads using a surround view system is proposed. The approach called the independent frame consecutive searching technique is an algorithm which is developed to detect the left and right lane markers of a lane stably and to generate virtual lane marker lines especially when the roads are narrow and have sudden corners and windings with some faded lane markers. Then the steering angle of an autonomous vehicle is calculated so that the vehicle drives along the desired path after deriving the smoothed virtual centerline.

Personal health record systems assist people to access, manage and share their own health information. In the contribution by Khan et al. "Awareness and willingness to use PHR: a roadmap towards cloud-dew architecture based PHR framework", authors have conducted a survey in Saudi Arabia to know the level of awareness of PHR systems and the willingness of people to adopt and use such systems. In order to conduct the survey, a total of one hundred and sixty-four individuals from different age groups were selected randomly keeping in perspective the target population. For reaching to the ends that stretch beyond the immediate data alone, authors have used the inferential statistics for their research work.

Seam carving is a widely used excellent content-aware image scaling method. When an image is processed by seam carving, its local texture changes. In the contribution by Sangaiah et al. "Detecting seam carved images using uniform local binary patterns", a blind detection based uniform local binary patterns (ULBP) is proposed to detect seam-carved image. Firstly, the image is transformed into gray-scale image. Then the ULBP histogram features and seam features are extracted from the gray-scale image. Finally support vector machine is adopted as classifier to train and test those features to identify whether an image is subjected to seam carving or not.

Health services research provides a multi-disciplinary area of scientific exploration in relation to financial systems, social factors, organizational processes, and health technologies. The contribution by Sivaparthipan et al. "Designing statistical assessment healthcare information system for diabetics analysis using big data" proposes a model of a statistical assessment, healthcare information system for Diabetes Analysis employing big data. The performance metric such as accuracy and F-measure for the proposed statistical assessment model is evaluated by Hadoop framework; the results are comparatively higher than existing methods.

The Mobile Ad Hoc Networks are a self-regulatory set of autonomous nodes which perform communication to all the other nodes within their communication ranges. In mobile ad hoc network, each and every autonomous node holds displacements and shifts based on the precise positions within the network. The contribution by Vignesh et al. "Predicting the position of adjacent nodes with QoS in mobile ad hoc networks" studies how to design a standard termed as Adjacent Node Location Confirmation for confirming the location of its transmitting adjacent nodes for interchanging the messages and confirms the location of the nodes in transmission within the network.

Automatic segmentation of the liver and lesion detection can be a very challenging task due to its variability in size, shape, position and the presence of other organs with similar intensities. Manual segmentation and detection of a tumor is a time-consuming task and greatly depends upon the expertise and experience of the physician. The contribution by Alavalapati et al. "Automatic segmentation of liver & lesion detection using H-minima



transform and connecting component labeling" proposes a method which consists of automatic segmentation and detection of liver and lesion using CT scan modality. To keep the technique simple and effective, an appropriate range of threshold values are defined to detect different types of lesions.

The image segmentation is the basic step in the image processing involved in the processing of medical images. Over the past two decades, medical image segmentation has remained a challenge for researchers while the use of this imaging modality is rapidly growing in research studies. The contribution by Alavalapati et al. "Comparative analysis of segmentation techniques based on chest X-ray images" surveys the techniques and their effect on chest X-ray images. The objective of this work is to study the key similarities and differences among the different published methods while highlighting their strengths and weaknesses on chest X-ray images.

Video shadowing is a blooming system with the intention of conserving the tangible and also capital resources in an organization. The motion capture approach is comprehensively utilized for creating animation as it yields best character equivalent to the real object motion. The contribution by Sindhia et al. "An efficient moving object detection and tracking system based on fractional derivative" studies forward tracking and backward tracking. By employing the Otsu thresholding approach on the resultant image, the object is detected on every frame.

Energy compaction property of the Discrete Cosine Transform leads its usage in image and video compression applications. Nowadays power consumption is the major problem in modern multimedia applications. In the contribution by Ezhilarasi et al. "Enhanced approximate discrete cosine transforms for image compression and multimedia applications", authors propose several approximate DCTs. Proposed approximate DCT Case I, II and III 8×8 matrixes satisfy the orthogonal property through a quantization process.

Due to recent development in technology, the complexity of multimedia is significantly increased and the retrieval of similar multimedia content is an open research problem. In the service of multimedia service, the requirement of Multimedia Indexing Technology is increasing to retrieve and search for interesting data from huge Internet. The contribution by Ahmad et al. "MDCBIR-MF: multimedia data for content-based image retrieval by using multiple features" is divided into three phases that feature extraction, similarities match, and performance evaluation. The average precision and recall measures are used to evaluate the performance of the proposed research.

The multimedia-based e-learning methodology provides virtual classrooms to students. The teacher uploads learning materials, programming assignments and quizzes on university Learning Management System. To solve the problem, the contribution by Wang et al. "Plagiarism detection in students' programming assignments based on semantics: multimedia e-learning based smart assessment methodology" proposes a new plagiarism detection technique between C++ and Java source codes based on semantics in multimedia-based e-learning and smart assessment methodology.

In the contribution by Bonanomi et al. "I3D: a new dataset for testing denoising and demosaicing algorithms", authors present a dataset of images to test the performance of image processing algorithms, in particular demosaicking and denoising methods. Despite the plethora of demosaicking and denoising algorithms present in the literature, only a few benchmarks are available to test their performance, and most of them are quite old, thus inadequate to represent the images captured by modern devices.

Industrial Internet of Things is the fast growing network of interconnected things that collect and exchange data using embedded sensors planted everywhere. It is an interconnection



of several things through a diverse communication system capable of monitoring, collecting, exchanging, analyzing, and delivering valuable and challenging amounts of information. The main interest of the contribution by Al-Turjman et al. "5G/IoT-enabled UAVs for multimedia delivery in industry-oriented applications" is the multimedia routing in IIoT and its facilities during and/or after operational hours.

There are three basic operational constituents of nodule detection systems, namely nodule candidate detection, classification of nodule and extraction of features. The contribution by Hussain et al. "An ensemble shape gradient features descriptor based nodule detection paradigm: a novel model to augment complex diagnostic decisions assistance" presents an ensemble shape gradient features descriptor for pulmonary nodule classification which uses the Histogram of Oriented Surface Normal Vectors and Multi-coordinate Histogram of Gradient descriptor. In order to show the performance of segmentation quality, the proposed model is compared through three quantitative measures inclusive of Variation of Information, Probabilistic Rand Index and Jaccard Measure.

Salient object segmentation in videos is generally broken up in a video segmentation part and a saliency assignment part. Recently, object proposals, which are used to segment the image, have had significant impact on many computer vision applications, including image segmentation, object detection, and recently saliency detection in still images. In the contribution by Kalboussi et al. "Object proposals for salient object segmentation in videos", authors investigate the application of object proposals to salient object segmentation in videos. In addition, authors propose a new motion feature derived from the optical flow structure tensor for video saliency detection.

A graphic recognition system involves representation of graphic symbols, description of features extracted from the symbol and classification of the unknown symbols. Due to the wide range of symbols, no generalized technique is available that can recognize the symbol for all the application domains. In the contribution by Khan et al. "A comparative study of graphic symbol recognition methods", authors present an overview of the many models and methodologies available to symbol recognition for representation, description and classification.

The exponential growth of the information technology has created a pathetic panorama in the field of Health Information System that draws the attention of the researchers. Watermarking is a trending topic that provides security to the encapsulated secret code in the medical image and hence, ensures security to the medical images and contributes towards efficient information extraction. The contribution by Hemamalini et al. "Wavelet transform and pixel strength-based robust watermarking using dragonfly optimization" proposes a robust watermarking approach that depends upon weight of the pixels. This method determines the effective pixel that follows the objective function based on ENeGW of the pixel.

Autism spectrum disorders (ASD) are pervasive neuro developmental conditions portrayed by disabilities in social intercommunication, besides stereotyped conduct. Since electroencephalogram (EEG) recording together with analysis stands one among the basic devices in diagnosing along with recognizing the issue in neurophysiology, utilized the signals of EEG aimed at diagnosing persons with ASD. The contribution by Kumar et al. "Recognition of autism in children via electroencephalogram behaviour using particle swarm optimization based ANFIS classifier" proposes an Adaptive Neuro-Fuzzy Inference System classifier joined with Particle Swarm Optimization that is named as PSO-ANFIS for classifying the diagnosing signals of EEG.

THz wave has advantages in targets detecting and imaging, however, the severe atmospheric attenuation limits its application range. To perform a higher transmittance through



clouds and higher resolution, upper troposphere should be considered to be the application scenario of THz wave. The contribution by Li et al. "THz wave background radiation at upper troposphere" studies atmospheric radiative transfer properties at different altitudes. Atmospheric Radiative Transfer Simulator was used to calculate path attenuation in 6 window frequencies selected, as well as 6 peak frequencies to analyze the difference.

Automatic segmentation of land use and land cover from high resolution remote sensing imagery has been an essential research area in image processing for the past two decades. Timely and reliable information of land use and land cover is very much essential in administration for proper planning and decision making in various areas like agriculture, urban development, environment protection, etc. In the contribution by Kavitha et al. "Unsupervised linear contact distributions segmentation algorithm for land cover high resolution panchromatic images", authors propose an Unsupervised Linear Contact Distributions Segmentation Algorithm for unsupervised segmentation of high resolution panchromatic data.

In multimedia scenario, number of saliency detection designs has been portrayed for different intelligent applications regarding the accurate saliency detection like human visual system. More challenges exist regarding complexity in natural images and lesser scale prototypes in salient objects. The contribution by Rakesh et al. "Short time Fourier transform with coefficient optimization for detecting salient regions in stereoscopic 3D images: GSDU" proposes a new saliency detection design that encompasses 2 phases like feature extraction and depth saliency detection. In addition, Gaussian kernel model is processed for extracting the Short-Time Fourier Transform features, texture features, and depth features.

Compressed sensing (CS) is the theory and practice of sub-Nyquist sampling of sparse signals of interest. Perfect reconstruction is possible with much fewer than the Nyquist required number of data samples. In the contribution by Liu et al. "Variable block-size compressed sensing for depth map coding," authors consider a variable block-size CS architecture for fast compression of depth maps for three-dimensional video applications. CS is then performed on edge blocks, and eight-bit encoding is performed on smooth blocks. At the decoder, high quality depth map reconstruction is achieved by minimizing the spatial total-variation.

The new generation of 3D video coding standard, denoted as 3D High Efficiency Video Coding, uses Multi-view Video Plus Depth format to represent stereo videos. Due to the reason that the fringe information of depth maps has great influence on the video quality of synthesized views, Depth Modeling Modes are introduced to maintain the quality of depth maps, while causing computational complexity increase tremendously. In the contribution by Feng et al. "Multi-strategy depth intra mode decision algorithm in 3D-HEVC," authors propose a multi-strategy depth intra mode decision algorithm. It incorporates early rough mode decision termination strategy, candidate mode reduction strategy and fast DMM decision strategy.

The contribution by Chan et al. "Manifold-defect depth-map restoration for very low-cost S3D videos" provides a fluent and efficient method for repairing very-low quality depth maps of considerable manifold defects for low-cost stereoscopic 3D photographing that such a depth map can be easily yielded by 1st-generation Kinect. The corresponding framework cascades two repairing portions named discriminative non-segmentation hole filling and edge rectification-by-deforming. The former can discriminatively fill a variety of depth-invalid holes with no need of practically making attribute-discrimination and target segmentation for depth holes. The main portions of the latter contain edge-shifting-rectification and texture-edge guided dual processing for tailoring possible twisted depth edges. The proposed algorithm can obtain the restoring coherency for successive depth maps.



Subspace-based models have been widely applied for hyperspectral imagery applications, especially for classification. The main principle of these methods is based on the fact that the original image can approximately lie on a lower-dimensional subspace. However, due to the existence of mixed samples, the subspace projection is unstable and affected by the selection of training samples. In order to improve the robustness and characterization ability of the subspace-based classification models, the contribution by Gao et al. "Subspace-based multitask learning framework for hyperspectral imagery classification" proposes a novel subspace-based multitask learning framework.

The limitation of optical sensors set a challenge to acquire high resolution images. Previous sparse coding-based SR methods fail to reconstruct satisfied high resolution image due to three problems. First, sparse representation calculation is time consuming, which restricts its application in real-time systems. Second, sparse coding-based SR methods cannot represent diversity of patterns with one dictionary pair. Finally, it is supposed that the sparse representations of HR-LR patch pair are identical. However, the hypothesis cannot deal with all patterns. To address these problems, the contribution by Wu et al. "Multiple Regressions based Image Super-resolution" proposes a multiple regressions based image super-resolution. Experiments demonstrate that the proposed method outperforms some previous methods in objective and subjective evaluation.

Mobile Adhoc Networks possess the open system condition, absence of central server, mobile nodes that make helpless to security assault, while conventional security components couldn't meet MANET security prerequisites in view of restricted correspondence data transfer capacity, calculation power, memory and battery limit in addition to the vitality enabled environment. The contribution by Anbarasan et al. "Improved encryption protocol for secure communication in trusted MANETs against denial of service attacks" focuses on rigid and robust networks when additional resources are added. For clustering of the nodes LEACH protocol is suggested in which the CHs and CMs are fixed for the data transfer in the network.

Performance of routing protocol at network layer in Cognitive Radio Adhoc Networks is mainly based on the probability of channel availability for application data transmission. To attain, end-to-end channel-route control messages should be disseminated in an efficient mechanism with minimal channel-route re-connection delays. The contribution by Sangi et al. "Cognitive AODV routing protocol with novel channel-route failure detection" proposes a channel-route failure based Cognitive-AODV routing protocol to detect the exact channel-route failure. In addition, the proposed method provides the best alternate end-to-end channel-route path in between source and destination.

Wireless sensor networks follow layered architecture for the fruitful and reliable working of distributed WSNs. The region of WSN is attaining importance in the research field on account of its wide-ranging scope of applications in different domains. The cross-layer design (CLD) is a rising trend in the network layer architectures. And it normally involves significant connections between disparate layers. The contribution by Farzana et al. "Secure architecture to circumvent collision using RSSI measurement in WSN: a cross layer design approach" manages CLD instead of single layer in order to attain good performance. Collision amid packet transmission is the chief issue that directly influences the performance and lifetime of distributed WSNs.

Remote sensing image data have been widely applied in many applications, such as agriculture, military, and land use. However, it is hard to obtain remote sensing images in both high spatial and spectral resolutions due to the limitation of implements in image acquisition and the law of energy conservation. In the contribution by Ran et al. "Remote



sensing images super-resolution with deep convolution networks", authors propose a novel deep convolution network SR method. Based on hierarchical architectures, the proposed SRDCN learns an end-to-end mapping function to reconstruct an HR image from its LR version.

Gene selection is imperative to clustering in light of gene articulation information, as a result of high clustering quality. Clustering gene articulation information is a vital research subject in bioinformatics on the grounds that knowing which genes act correspondingly can prompt the disclosure of vital natural data. In the contribution by Kavitha et al. "AGGLO-Hi clustering algorithm for gene expression micro array data using proximity measures", authors propose an Agglo-Hi clustering algorithm which is accounted for the fuse of vicinity similarity estimates like Euclidean Distance, Manhattan Distance Chebyshev Distance, and Cosine Similarity for their execution.

Since the limitation of optical sensors, it's often hard to obtain an image with the ideal resolution. Image super-resolution (SR) technology can generate a high-resolution image from the corresponding low-resolution image. Recently, deep learning (DL) based SR methods draw much attention due to their satisfying reconstruction results. However, these methods often neglect the diversity of image patches. In the contribution by Wu et al. "Clustering based multiple branches deep networks for single image super-resolution," authors propose a universal, flexible, and effective framework. The proposed framework can be adopted to any DL based methods. It can significantly improve the SR accuracy while maintaining the running time. In the proposed framework, K-means is employed to cluster image patches into different categories.

Nowadays, the advent of social networks has revolutionized the traditional communication media. In this context, one of the major problems is the on-demand video streaming provisioning. Therefore, a denial of service condition can cause for social media providers a loss of users and a consequent loss of money. In the contribution by Celesti et al. "A big video data transcoding service for social media over federated clouds", authors propose a Cloud federation system that enables social media providers to work together so as to take the advantages of a scalable video processing service. The authors also demonstrate how Cloud federation can lighten and speed up the whole video processing service, by introducing an additional parallelization level.

The contribution by Jaswanth et al. "Design of Three Stage Cascaded Low Power CMOS Operational Trans Conductance Amplifier for ECG Applications" primary tests incorporates intensifying the weak signal within the noisy environment. It is found that the execution of the ECG enhancer can be enhanced by three-arrange operational trans conductance amplifiers utilizing nanometer CMOS advancements with doping input transistor measuring, device coordinating and filtration process. This three phase configuration has a few favorable circumstances, for example, current part, source degeneration to expand the linearity of the device.

The contribution by Kim et al. "Thermal infrared image processing profiles for speech anxiety monitoring" proposes a method for analyzing speech anxiety by processing bio-signals in real time. The present study is a method to process the speech anxiety state in real time, and this is done by processing the facial thermal image of the presenter in real time. The root mean square waveform that tracks facial temperature changes in real time can be used as a useful indicator for diagnosing speech anxiety. The visualization of the speech anxiety profile feedback with a facial thermal image can be a better cognitive therapeutic strategy in speech anxiety education.



The detection of manmade disasters, particularly fire, is valuable because it causes significant damage in terms of human lives. Research on fire detection using wireless sensor network and video-based methods is a very hot research topic. However, the WSN based detection model needs fire and a lot of smoke and fire for detection. In the contribution by Paul et al. "Convolutional neural network based early fire detection", authors propose a fire detection method which is based on powerful machine learning and deep learning algorithms. The authors used both sensors data as well as images data for fire prevention. The proposed model has three main deep neural networks i.e. a hybrid model which consists of Adaboost and many MLP neural networks, Adaboost-LBP model and finally convolutional neural networks.

Internet applications are increasing and growing efficiently. By this technological growth, data communication in the internet in a secured way has got a challenging task. The contribution by Kumar et al. "Performance analysis of image steganography using wavelet transform for safe and secured transaction" proposes Discrete Wavelet Transform which has more advantages than other transform techniques like DCT. This is because of quality scalability, interest in region coding, low bit rate transmission which is quickly operating and also it is compatible to Visual System by Human that provides good perception quality. Image characters are analyzed well by Wavelet Space - frequency property of localization which makes additional strength to the attack, such as geometric.

Along with the rapid development of information technology, sightless persons have numerous visual difficulties in doing their day by day activities. In this technological world, we have many resources for the human to live their life, still blind people suffer a lot for their survival in this hi-tech world. Through computing, the solution can be obtained for their independent survival. The contribution by Arunkumar et al. "Implementation of enhanced canny recognition algorithm and non – natural neural system based speech fusion for sightless persons" implements a powerful speech fusion system to support sightless persons. This system produces the text image documents as voice.

We hope that this special issue would shed light on major developments in the area of Multimedia Tools and Applications and attract attention by the scientific community to pursue further investigations leading to the rapid implementation of these technologies.

Acknowledgments We would like to express our appreciation to all the authors for their informative contributions and the reviewers for their support and constructive critiques in making this special issue possible.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

