Editorial

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Biographical notes: G.R. Sinha is an Adjunct Professor at the International Institute of Information Technology Bangalore (IIITB). Prior to this, he was deputed as a Professor at the Myanmar Institute of Information Technology (MIIT) Mandalay Myanmar. He has been a Visiting Professor (Online) in the National Chung Hsing University Taiwan, University of Sannio, Italy and Visiting Professor (Honorary) in Sri Lanka Technological Campus Colombo. He has published 314 research papers, book chapters and books at international and national levels. He is an associate editor of five SCI/Scopus indexed journals and has been guest editor in various SCI journals. His research interests include biometrics, medical/biomedical image processing, cognitive science, computer vision, outcome-based education (OBE) and ICT tools for developing employability skills.

Silvia Liberata Ullo is an IEEE senior member and Industry Liaison for the IEEE Joint ComSoc/VTS Italy Chapter. She is a national referent for FIDAPA BPW Italy Science and Technology Task Force (2019–2021). She is a researcher since 2004 at the University of Sannio, Benevento, Italy and member of academic senate and PhD professors' board. She has taught signal theory and elaboration, telecommunication networks, optical and radar remote sensing. She has authored more than 80 research papers, co-authored many book chapters, and served as editor of two books. Her research interests include signal processing, remote sensing, satellite data analysis, machine learning and quantum ML, radar systems and sensor networks. She was graduated with

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Chih-Peng Fan received his BS, MS and PhD, all in Electrical Engineering, from the National Cheng Kung University, Tainan, Taiwan, in 1991, 1993 and 1998, respectively. During October 1998 to January 2003, he was a Design Engineer for the cable modem and multimedia transmission project at the Customer-Provided Equipment (CPE) and Interface Technology Department (N100), Computer and Communications Research Laboratories (CCL), Industrial Technology Research Institute (ITRI), Hsinchu, Taiwan. In 2003, he joined the Department of Electrical Engineering at National Chung Hsing University in Taiwan as an Assistant Professor. He became an Associate Professor in 2007 and Full Professor in 2013. He has more than 110 publications, including technical journals, technical reports, book chapters, and conference papers.

In all biometrics and computer vision applications, the quality of signals which is given as the input plays a very important role. If the quality of the image signal is not good, then the accuracy of biometric recognition or biometric matching is adversely affected. In other computer vision tasks as well, where the analysis and classification of the image data or other similar data, depends on how good the signal is and therefore to obtain the proper quality of signal before subjecting it to the further stages such as feature extraction, analysis, classification and post processing, we generally use some image enhancement method or preprocessing method. The literature suggests that there are numerous preprocessing and enhancement methods available for different applications and there is no general theory on image enhancement. Image enhancement is always considered as a subjective to the application for a particular real time uses. This means that an example of image enhancement for a particular type of image may not be useful for other types of images, similarly an image enhancement used for a particular application may not be used for all the images under different conditions for same application. This problem in image enhancement is called as robustness. So, the aim of this special issue is to investigate some robustness in computer vision and biometric-based applications where a general purpose or a robust enhancement method can actually help in obtaining the robust performance of the real time applications where images are used.

The robustness of image enhancement method depends on a number of factors, namely, type of enhancement method can be used for all different types of images, irrespective of the modalities of images. Secondly, the same image enhancement method for a particular type of image can be used for other applications where same image type is used. Thirdly, an image enhancement and its performance remain same even if we change the different metrics to evaluate the performance of matching accuracy. Keeping all these factors, the special issue aims at bringing out some noteworthy contributions that highlight the investigation towards robustness of the preprocessing and image enhancement method used in their respective research articles and contributions.

In this special issue, 14 articles were accepted and brief description of all these accepted articles is as follows. Chandrakar et al. presented a paper on computer succoured vertical integration of multi-object detection and histogram enhancement in

low vision. In this work, the histogram-based image enhancement was implemented in such a manner that even under low light conditions, the edges of the objects were properly highlighted in the real time videos, irrespective of different lighting conditions and presence of occlusion and clutter kind of noise signals, and the enhancement worked very well. In another work by Nagwanshi et al., human footprint biometrics for personal identification was implemented using artificial neural network. In this work, neural network-based method and the principal component analysis (PCA) method were used. For recognising the biometric human footprints, the algorithm was very robust and provided accuracy of 99.55% for a number of persons using descriptive statistics, irrespective of unstable regions and varying features. The robustness was obtained in terms of features being used in order to get the robust performance of the footprint-based person identification. Bhaskar et al. presented a work on pulmonary lung nodule detection and classification through image enhancement and deep learning where the role of deep learning was very important in optimal selection of ROI and a thresholding-based method using CNN approach that could provide accuracy of 96% with minimum validation loss. The histogram equalisation was also used that helped to obtain a robust performance in denoising result. Bahadure et al. implemented MRI enhancement and brain tumour detection using soft computing-based enhancement technique. In this method, image enhancement method was proposed where the colour image enhancement which is a difficult task was successfully implemented. It was possible to enhance the images in better quality so that the visualisation was efficient and brain tumour detection was done successfully. Pandimurugan et al. presented investigation of COVID-19 symptoms using deep learning-based image enhancement for X-ray medical images wherein the deep learning-based image enhancement method was used for computer tomography, magnetic resonance imaging and X-ray images. For MRI images and also X-ray images, the generative adversarial network method was proved to be extremely well and the enhancement and extraction of the features are easier and simpler. The synthetic dataset was used and due to very good performance of image enhancement, the COVID-19 symptoms were easily identified in this work.

Khan et al. implemented vehicle recognition using CNN convolution neural network where the MobileNet pre-trained network was used for recognising the license plate and the enhancement using CNN model performed well, and 99.1% of accuracy was obtained for correctly recognising the number plates in this work. In Gupta et al., a hybrid approach for face recognition using LBP and multilayer classifier was used where random forest and support vector machine methods were used for classification and in this work, the enhancement was performed in such a manner that the classification of the vehicle was achieved up to 98.6%. Kumar et al. studied performance optimisation of face recognition based on LBP with SVM and random forest classifier. The performance of face recognition was achieved and optimal performance due to the usage of SVM and role of image enhancement was obtained, to get classifier performance up to 97.5%. Agrawal and Sharma presented a modulation-based medical image watermarking for assessing the quality of service of communication channel. In this method, the performance metrics, peak signal to noise ratio, similarity index measure were optimised and with a better visual quality by using the modulation-based medical image watermarking method. Garg et al. presented enhancement of retinal fundus image using multi-scale transformation in method for retinal image enhancement. The contrast enhancement index, peak signal to noise ratio were optimised by using this image

enhancement in better detection of retinal fundus image in this application. Davix et al. presented optimised denoising sparse auto encoder for the detection of outliers for face recognition. The sparse autoencoder method was proved to be very efficient using deep learning-based network and the enhancement method. The accuracy was achieved higher than the existing and similar work using sparse autoencoder method in this work. Sharaff et al. implemented an empirical analysis of deep ensemble approach on COVID-19 and tuberculosis X-ray images. In this paper, an empirical analysis was made using deep ensemble approach on X-ray images of the patients who were suffering from COVID-19. So, the ML model using ensembles was successfully used and the enhancement was achieved in such a manner that the accuracy was raised up to 93%. In Baynath and Khan, application of revised firefly algorithm and grey wolf optimisation was used on keystroke dynamics and in this method of biometrics, the algorithms proved the robustness in terms of false acceptance ratio and recognition rate especially against various types of attacks the method provided robust result. Pandey et al. has presented deep learning-based lightweight approach to thermal super resolution in which super resolution-based method of image enhancement technique has been successfully implemented using deep learning framework.

The set of these accepted articles in this special issue will give the readers an idea of choosing a robust approach of image enhancement and its importance for a suitable application so that the general purpose finding of the implementation made in the work can produce a robust performance.

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