Journal of Real-Time Image Processing
https://doi.org/10.1007/s11554-020-01026-2

GUEST EDITORIAL

Advances in deep learning for real-time image and video reconstruction and processing

Pourya Shamsolmoali[1] · M. Emre Celebi[2] · Ruili Wang[3]

Accurate reconstruction algorithms play a vital role in modern imaging techniques. Reconstructing image is a central problem in many key applications including super-resolution imaging, X-ray tomography, ultrasound imaging, remote sensing, and magnetic resonance imaging. The process of image reconstruction typically requires solving an inverse problem that is ill-posed and large-scale and thus challenging to solve. The main challenge of this method is its sensitivity to measurement noise in the input data, which will result in artifacts in the reconstructed image with a higher cost in computational time. Thus, it is very important to develop a robust method that can improve reconstruction accuracy while maintaining real-time operation. Real or near real-time processing capabilities are important in image reconstruction techniques for real-world applications. The research field of real-time image reconstruction is very active in image processing and computer vision since it proposes the ability to overcome some of the inherent resolution limitations of low-cost imaging sensors and generates better applications for the emergent capability of high-resolution displays. Deep learning for image reconstruction and processing is a relatively new area. Image reconstruction based deep learning can be efficiently performed by using neural networks, in which, weights are determined based on training data. This special issue provides 20 papers reporting the recent developments of deep learning in image reconstruction.

In "Deep Learning Methods in Real-time Image Super-resolution: A Survey", the authors provide a comprehensive survey on real-time image super-resolution. The paper "Investigating Low-Delay Deep Learning-Based Cultural Image Reconstruction", aims at completing missing regions in artwork through advanced deep learning and image reconstruction (inpainting) techniques. The authors in "A Deep Attention-based Ensemble Network for Real-time Face Hallucination", propose an end-to-end deep ensemble network that aggregates three sub-networks for extracting attention maps. The paper "A Novel Real-Time Fall Detection Method Based on Head Segmentation and Convolutional Neural Network", aims at developing a model for fall detection. A gaussian mixture model is proposed for geometric feature extraction to detect the human target and determine the minimum external elliptical contour. In "Effective and Efficient Multitask Learning for Brain Tumor Segmentation", the authors propose a revised multitask learning approach in which a lightweight network with only two scales is adopted for CT image segmentation. The paper "Optimised Highway Deep Learning Network for Fast Single Image Super-Resolution Reconstruction", aims at developing a novel model for single image super resolutions by using multi-scale connections, which composes of a nonlinear gating mechanism to further regulate the features. By using the global residual learning and replacing all local residual learning with a designed gate unit in different scale connections, the model can efficiently learn different hierarchical features and recover the hidden details during reconstruction.

In "Fast Intra Coding Unit Partition Decision in H.266/FVC Based on Deep Learning", the authors propose a fast quad-tree partitioning algorithm based on a deep convolutional neural network to predict the coding unit partition instead of rate-distortion optimization to enhance the performance of intra mode coding. In "Joint Multi-Task Cascade for Instance Segmentation", in order to make full use

✉ Pourya Shamsolmoali
pshams@sjtu.edu.cn

M. Emre Celebi
ecelebi@uca.edu

Ruili Wang
Ruili.wang@massey.ac.nz

[1] Institute of Image Processing and Pattern Recognition, Shanghai Jiao Tong University, Shanghai, China

[2] Department of Computer Science, University of Central Arkansas, Conway, AR, USA

[3] School of Natural and Mathematical Sciences, Massey University, Auckland, New Zealand

Published online: 30 September 2020

of the relationship between detection and segmentation, the authors propose a feature fusion process in a fully convolution network to enhance the contextual information for object detection and segmentation. The authors in "Dual Mode Power Reduction Technique for Real-Time Image and Video Processing Board", propose a dual-mode logic gate that can switch between two modes of operation. The static model provides low power consumption and the dynamic mode provides high speed. In "Toward a Robust and Fast Real-time Point Cloud Registration with Factor Analysis and Student's-t Mixture Model", the authors propose a robust and real-time point cloud registration, which combines the Student's-t mixture model with factor analysis. The proposed method extends the point cloud mathematical model to the orthogonal factor model and employs the point cloud data to extend the flexibility of the model. The paper "Low-delay Single Holoscopic 3D Computer Generated Image to Multiview Images", aims at developing a low-delay content adaptation framework for converting a single holoscopic 3D computer-generated image into multiple viewpoint images.

In "Real-Time UHD Video Super-Resolution and Transcoding on Heterogeneous Hardware", the authors focus on accelerating video enhancement workflow in a heterogeneous system with multiple hardware accelerators and the most time-consuming tasks are optimized to achieve real-time processing speed for a single video output frame. The paper "Low Delay Error Resilience Algorithm for H.265|HEVC Video Transmission", aims at developing a robust error resilience algorithm to reduce the impact of erroneous H.265|HEVC bitstream on the perceptual video quality at the decoder side. In "Low-Complexity CNN with 1D and 2D Filters for Super-Resolution", the authors propose a low-complexity convolution neural network for image super-resolution. The proposed model has two layers to deal with horizontal, vertical, and diagonal visual information. The front-end layer extracts the horizontal and vertical high-frequency signals with one-dimensional (1D) filters. In the image-restoration layer, the high-frequency signals in the diagonal directions are processed by additional two-dimensional (2D) filters. The paper "Real-time Watermark Reconstruction for the Identification of Source Information Based on Deep Neural Network", aims at developing an image reconstruction framework based on image watermarking.

In "Deep Learning Model for Real-Time Image Compression in Internet of Underwater Things (IoUT)", the authors propose a wavelet transform model for image compression on the internet of underwater things. The paper "An Efficient and Adaptable Multimedia System for Converting PAL to VGA in Real-Time Video Processing", aims at developing a hardware design for an FPGA based real-time video processing system to convert video formats. In "ROPDet: Real-time Anchor-free Detector based on Point Set Representation for Rotating Object", the authors propose a model to improve the object localization by using an anchor-free refined rotation detector. The paper "Efficient Image Encryption Scheme Based on Generalized Logistic Map for Real-Time Image Processing", proposes an encryption scheme with an efficient permutation technique based on a modular logistic map to bring down the size of the chaotic value vector. In "Real-Time Adversarial GAN-based Abnormal Crowd Behavior Detection", the authors design a real-time generative adversarial network to deal with the continually changing environment for crowd behavior detection and analysis.

Finally, the guest editors wish to thank the Editors-in-Chief Dr. Nasser Kehtarnavaz and Dr. Matthias F. Carlsohn, for providing the opportunity to edit this special issue. We would like to thank the authors for submitting contributions, and all the reviewers for their helpful and constructive comments. We hope that the readers benefit from this special issue.