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EDITORIAL

Journal of real-time image processing: fourth issue of volume 14

Matthias F. Carlsohn[1] · Nasser Kehtarnavaz[2]

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This issue is the final issue of the fourteenth volume. As noted in the previous editorial, the remainder of 2018 will be dedicated to a second volume or the fifteenth volume of the Journal of Real-Time Image Processing. The reason for publishing two volumes in 1 year is to reduce the backlog of online first published articles waiting to appear in print. For the same reason, in consultation with Springer, it has been decided to increase the number of issues to 6 issues per year from the current 4 issues per year starting in 2019. In other words, starting with volume 16, there will be 6 issues per year with a total page count of 1500 pages or 250 pages per issue. This increase in the number of issues from 4 to 6 is expected to address the delay in the printing of online first articles in a fundamental way and to provide the pages needed to shorten the time between the online and print versions of accepted articles. Furthermore, this increase will enable us to cope with the steady growth in the number of manuscript submissions per year which is currently about 400.

It is worth pointing out two items here. The first item is that the editorial board meeting of JRTIP will take place in conjunction with the SPIE Conference on Real-time Image and Video Processing as part of the SPIE umbrella symposium on Defense and Commercial Sensing to be held 16 and 17 April, 2018 in Orlando, FL, USA. The program of this conference can be viewed at this link: http://spie.org/SIC/conferencedetails/real-time-image-video-processing. Discussion issues in this meeting will be reported in an editorial appearing after the meeting.

The second item is that currently four special issue calls for papers are active that are being conducted by four guest editor teams to highlight the hot and modern topics in real-time image processing. These calls for papers can be viewed at this link: http://www.springer.com/computer/image+processing/journal/11554/PSE?detailsPage=societies and in the backmatter of this issue as well. Furthermore, we would like to encourage colleagues and researchers to submit proposals for special issues in their areas of expertise. Such issues provide a collection of focused articles on contemporary subjects of interest as related to the real-time aspects of image and video processing addressing issues such as computational complexity reduction compared to existing solutions, real-time hardware implementation on various processors or platforms, actual real-time processing rates and real-time software optimization.

This final issue of volume 14 is a regular issue which comprises 10 original research articles covering different image processing topics as related to the real-time theme of the journal.

The first article by Lee and Lam is entitled "Computationally efficient brightness compensation and contrast enhancement for transmissive liquid crystal displays." High-quality displays tend to consume significant power in mobile devices. Currently, transmissive liquid crystal displays are among the most common. They are non-emissive and rely on a backlight behind the display panel. Fast computation of the brightness compensation algorithm is essential for adaptive dimming the backlight to reduce the power consumption, while increasing the pixel values to preserve the visual quality of the images or even enhance their contrast. This paper shows that brightness compensation can be solved with a closed-form solution instead of computationally demanding iterative methods. The reported experimental results confirm an approximate speedup factor of 800, while maintaining identical images compared to previous methods.

The second paper entitled "Suitability of GPUs for real-time control of large astronomical adaptive optics instruments" by Bitenc, Basden and Dipper describes a technique for correcting aberrations introduced when light propagates through a medium like through turbulent atmosphere. The components of adaptive optics consist of a

✉ Matthias F. Carlsohn
Matthias.carlsohn@t-online.de

Nasser Kehtarnavaz
kehtar@utdallas.edu

[1] Engineering and Consultancy for Computer Vision and Image Communication, Bremen, Germany

[2] University of Texas at Dallas, Richardson, TX, USA

camera for recording aberrations, a corrective mechanism and a real-time controller for processing images and steering the corrections within milliseconds implemented on graphics processing units for speedup. It is important to process images before atmospheric turbulence changes, i.e., within milliseconds time frame. The challenge is to transfer images to the GPU memory with minimum delay using commercial frame grabbers and standard CUDA tools, which is demonstrated in this work. The examined images are characterized and reduced into a set of 9248 numbers consuming 1/3 of the processing time, while another 2/3 of it is needed to calculate the commands for the corrective system. The processing performance using a single GPU achieves approximately 700 frames per second (fps) that can be increased to 1100 fps or 1565 fps using two or four GPUs, respectively.

The third paper by Torti and Fontanella entitled "Parallel real-time virtual dimensionality estimation for hyperspectral images" deals with one of the most important tasks in hyperspectral imaging, i.e., the estimation of the number of endmembers in a scene, which are the most spectrally pure components. The high dimensionality of hyperspectral data makes this calculation computationally expensive. In this paper, several new real-time implementations of the well-known Harsanyi–Farrand–Chang method for virtual dimensionality estimation are presented. The proposed solutions use multi-core processors and graphic processing units for achieving real-time speed of this algorithm and improved estimation performance compared to competing methods. The experimentations conducted using synthetic and real images demonstrate their superiority to other hardware-based solutions.

The fourth article entitled "A pre-processing scheme for real-time registration of dynamic contrast-enhanced magnetic resonance images" by Chambers, Milenkovic and Tasic proposes a fully automatic pre-processing scheme for real-time registration of the dynamic contrast-enhanced magnetic resonance images (DCE-MRIs) of the breast. It consists of an intensity inhomogeneity correction followed by a region of interest segmentation in breast images, where the correction is achieved by a combination of a morphological closing operation and Gaussian filtering applied to gray images. The segmentation of the breast region of interest is done based on fitting the human chest by an ellipse. The main advantages of the proposed pre-processing scheme are its low computational complexity and robustness to variations of breast density. The scheme was evaluated on 50 T1-weighted DCE-MRIs demonstrating a significant decrease in the time taken for registration (factor 2 for the affine and 9 for nonlinear B-spline free-form deformation).

The fifth paper entitled "GPU-based segmentation of retinal blood vessels" by Argüello, Vilariño and Heras proposes a fast and accurate technique for retinal vessel tree extraction. It applies a hybrid strategy based on global image filtering and contour tracing. With the aim of increasing the computational speed, the algorithm is tailored for efficient execution on commercial graphics processing units achieving low execution times and high speedups over the CPU execution. The performance of the proposed method was tested on STARE and DRIVE databases measuring accuracy, sensitivity and specificity with the results shown to be in-line with other state-of-the art techniques while achieving vascular tree segmentation on average in 14 and 18 ms, respectively, which is currently one of the highest accuracy/performance rates in the retinal blood vessel extraction domain.

The sixth article entitled "Low-complexity inter-layer residual prediction for scalable video coding" by Lim, Kim, Lee and Sim proposes an inter-layer residual prediction method that has low-complexity and minimal syntax changes improving the rate-distortion performance of scalable video coding. The proposed method employs a new inter-layer reference picture that is compensated by a residual signal from the corresponding base layer. The compensated reference picture is inserted into the reference picture lists. Thus, the residual prediction is adaptively conducted by motion estimation and compensation with this added inter-layer reference picture. To evaluate the performance of the proposed method, it was applied to the scalable high-efficiency video coding (SHVC) coder. The experimental results performed show that the coding performance for the luma component is improved by about 1.0%, compared to the SHVC reference software. The encoding time for the proposed algorithm is not increased and the decoding time is increased by about 5% against SHVC.

The seventh paper entitled "Fast and accurate circle tracking using active contour models" by Martínez-Mera, Tahoces and Carreira deals with the problem of circle tracking across an image sequence by an active contour model. The center and radius of the circle are optimized in each frame by computing via a Newton–Raphson-type algorithm, and the local minima of a new energy measure without the need for edge extraction but image convolution with a Gaussian kernel and its gradient implemented are done in CUDA for fast GPU processing. The combination of an active contour model, which does not require edge detection and a GPU–CUDA implementation, provides a fast and accurate method for circle tracking. The experimental results are presented on synthetic data, on real images and on medical images in the context of aorta vessel segmentation in computed tomography (CT) images.

The eighth paper entitled "VLSI implementation of an ultra-low-cost and low-power image compressor for wireless camera networks" by the research group Chen, Nie,

Lin, Chung, Hsia, Liu, Lin and Wu proposes a novel hardware-oriented color image compression algorithm based on digital halftoning and block truncation coding (BTC) techniques for very-large-scale integration (VLSI) implementation consisting of a threshold generator, a bitmap generator, a BTC training module, a predictor and a signed Golomb–Rice coding module. Each camera sensing node within the WLAN is designed to achieve low cost, small size, high compression rates and low power consumption. Accordingly, a new low-complexity, high-performance, transform-free, hardware-oriented color image compression algorithm based on digital halftoning and BTC is proposed. Targeting real-time compression, this proposed algorithm was VLSI implemented involving only 8.1-k gates occupying a core area of 81,000 μm^2 synthesized in a 0.18-μm CMOS process. The operating frequency is indicated to be 100 MHz, and power consumption is indicated to be 2.91 mW. Compared with JPEG- and JPEG-LS-based designs, this work reduces gate counts by about 71% and power consumption by 53% and requires only a one-line-buffer memory.

The ninth paper entitled "GPU-parallel interpolation using the edge-direction based normal vector method for terrain triangular mesh" by Wu, Deng, Jeon and Jeong discusses how the normal vector to the surface at the nodes of a triangular mesh plays an important role in terrain reconstruction and display. However, noting that they cannot be generated directly, they must be computed using known data. Currently, the most common method of computing the normal vector at the nodes on a triangular mesh is to sum the normal vectors of the adjacent triangular facets using various weighting factors. For complex terrain surfaces, such a method is not very effective. Instead a normal vector interpolation method based on the edge-direction for a terrain triangular mesh is used that can be implemented in CUDA on a parallel architecture of a GPU. The experimental results show that the accuracy of the normal vector to the surface at the node increases significantly, and compared to serial algorithms processed on CPUs, a speedup by 646.4 times is achieved including I/O transfer time, i.e., meeting the real-time requirements.

The tenth and final paper of this issue by Chang and Kehtarnavaz is entitled "Fast J-linkage algorithm for camera orientation applications" which presents a computationally efficient approach to obtain vanishing points in images for camera orientation applications. Modifications are made to the conventional J-linkage algorithm, named Fast J-linkage, so that the detection of vanishing points is achieved in a computationally efficient manner. This fast algorithm recovers camera orientation or rotation matrices from video sequences. Both the computational efficiency and performance aspect of the fast J-linkage algorithm are compared with the conventional J-linkage algorithm by examining the York Urban image database. In addition, the results of an actual camera rotation implementation are provided and validated by using inertial sensors data. The results obtained indicate the higher computational efficiency and accuracy aspects of the developed vanishing point detection solution.