Special issue: Design and architectures for real-time signal and image processing

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The Conference on Design and Architectures for Signal and Image Processing-DASIP addresses the development of complex applications involving signal, image and control processing based on a new approach called Algorithm-Architecture-Matching, which aims to leverage the design flow by a simultaneous study of both algorithmic and architectural issues, taking into account multiple design constraints, as well as algorithm and architecture optimizations.

The goal of DASIP is to present the latest results in the domain of design and architecture for signal and image processing along several axes: methods and tools; development platforms, architectures and technologies; use-cases and applications as well as smart-sensing systems.

The best papers from the conference were invited to submit considerable extended manuscripts to this special issue with a topic in relation to the paper they presented during the conference. All the papers which appear in this special issue went through a peer review process.

Embedded Systems and Cyber-physical Systems (CPS), especially in relation to image and signal processing, are a big step forward from the basic data-gathering networks, and they have been called to be the fourth industrial revolution. Therefore, the important contribution of CPS is its integration and connection of the hardware elements, e.g., sensors, actuators and computing units, with the software functionalities, e.g., automated routines and supervisor software, to perform energy efficiency and simultaneously keeping safety requirements. Many fields employ CPS into their operations, e.g., transportation, defense, energy and industrial automation, health and biomedical, agriculture and critical infrastructure. To automate the processes, the data gathering and the actions they can perform, while also lowering the quantity of human-made errors during run

time. Furthermore, critical applications that must deal with several challenges find in CPS a powerful ally, since the system's level of automation and independence is higher than those of basic manually supervised networks.

CPS supports directly the agenda of Industry 4.0, which is a key driver of Europe's economy and growth in industrial production, industrial automation and the related logistics. Only with novel concepts for sensors in a network, which goes far beyond what the current state of the art can deliver, the current and future requirements in terms of flexibility, safety and security can be provided. The leading industries in this area need novel solutions to develop energy efficient, highly flexible, robust, safe and secure sensor nodes for the next generation of factories in the age of Industry 4.0 with a holistic toolset. The key elements here are to increase efficiency, decrease time to market and to enhance flexibility. The Industrial Internet offers industry players the potential for high growth and improved efficiency.

Real-time image processing plays a major role in several applications in the academic and industrial field. As an example, the application in a modern industrial environment includes camera data to handle the production of complex components. In robotic applications, real-time image processing is crucial to enable a fast movement of robot arms. Last but not least, advanced driver assistance systems in the automotive domain, and recent achievements for autonomous driving would not be possible without real-time image processing. This special issue collects recent research results within this domain of research and presents scientific achievements regarding the algorithms and architectures for the design of real-time image-processing systems.

In this special issue, contributions from the domain of applications such as motion estimation hardware for H.264 multi-view video coding [1], a hardware implementation for traffic road sign detection [2] and identification system and retinal blood vessel segmentation in high-resolution fundus images [3] are collected. An additional contribution in this domain can be found in the manuscript [4],

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Three-level Pipelined Multi-Resolution Integer Motion Estimation Engine with Optimized Reference Data Sharing Search for AVS. This variety of applications shows the benefit of underlying hardware such as FPGA for maximal parallel execution of algorithms and multicore platforms. The hardware architecture-oriented contributions show specialized hardware blocks for an improved data throughput. The paper “Hardware implementation-oriented fast intra-coding based on down sampling information for HEVC” [5] and also “Optimizing memory bandwidth exploitation for OpenVX applications on embedded many-core accelerators” [6] show such approaches. This is underlined with the paper [7], “Accelerated Image Factorization Based on Improved NMF Algorithm” where specific algorithms are in the focus of the manuscript. Additionally, papers where an optimized integration of algorithms on hardware has been reported, including their evaluation, are within this special issue. The paper [8], targets even VLSI integration. The paper “Real-time hardware–software embedded vision system for ITS smart camera implemented in Zynq SoC” [9] shows exactly such an approach. Furthermore, the paper [10], “Heterogeneous SoC-based Acceleration of MPEG-7 Compliance Image Retrieval Process”, also refers to a SoC-based approach for image processing. In the area of optimization, the paper “Parallel Light Speed Labeling: an efficient connected component algorithm for labeling and analysis on multi-core processors” [11] and “A linked list run-length-based single-pass connected component analysis for real-time embedded hardware” [12] are completing this excellent special issue.

The contributions span an excellent view over a highly important topic which will even increase the impact in future applications, e.g., coming from the domain of machine learning and its deployment in industrial internet of things applications.

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