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Editorial

Advanced Video-Based Surveillance

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Over the past decade, we have witnessed a tremendous growth in the demand for personal security and defense of vital infrastructure throughout the world. At the same time, rapid advances in video-based surveillance have emerged and offered a strategic technology to address the demands imposed by security applications. These events have led to a massive research effort devoted to the development of effective and reliable surveillance systems endowed with intelligent video-processing capabilities. As a result, advanced video-based surveillance systems have been developed by research groups from academia and industry alike. In broad terms, advanced video-based surveillance could be described as intelligent video processing designed to assist security personnel by providing reliable real-time alerts and to support efficient video analysis for forensics investigations.

This special issue presents recent theoretical and practical advances in the broad area of video processing for advanced surveillance. We have received numerous papers covering a wide range of topics related to image and video surveillance. Among the fifteen papers accepted for publication in this issue, ten papers focus on issues related to the early processing stages of video-based surveillance systems such as background subtraction, object detection, and tracking, whereas only five papers are focused on high-level processing tasks in video surveillance including scene understanding and reasoning, biometrics, and multicamera surveillance. This is an indication of the fact that within the surveillance community, improvement in the effectiveness and robustness of the computations devoted to extract elementary visual cues, upon which higher-level knowledge is formed, are still perceived as key to the overall performance of surveillance systems. Indeed, one often witnesses a strong correlation between practical performance of video-based systems such as activity recognition and human behaviour analysis and how well objects of interest are detected and tracked throughout the video streams. As also witnessed by recent advances on object/category recognition in the related field of computer vision, we believe that significant progress in low-level processing will be required to foster major breakthroughs in intelligent video-based surveillance. This would permit leveraging of sophisticated reasoning methods, drawing primarily from recent advances in pattern recognition and machine learning, which are becoming increasingly popular within the surveillance community and used to deal with the high complexity and uncertainty characterizing high-level video surveillance tasks.

Among the 10 papers dealing with early processing stages in video surveillance, two are in the area of tracking, five devoted to background subtraction, and three relate to object detection. In particular, the first two contributions are focused on visual tracking. In the first paper (P. L. M. Bouttefroy et al., "*Integrating the projective transform with particle filtering for visual tracking*"), the authors propose to integrate the projective transform into the importance density of a particle filter in order to improve vehicle tracking for traffic monitoring. The paper is an extended version of the paper that won the Best Student Paper Award at the 6th IEEE AVSS Conference, held in Genoa in 2009.

A similar scenario is considered in the second paper (K. Quast and A. Kaup, "*Auto GMM-SAMT: an automatic object tracking system for video surveillance in traffic scenarios*"), which describes a shape adaptive mean-shift tracker relying on Gaussian mixture models to adapt the kernel to the object shape.

The subject of the second group of five papers is devoted to background subtraction. The third paper (C. Zhao et al., "*Background subtraction via robust dictionary learning*") relies on sparse representation and dictionary learning to address the problem of reliable background model estimation from a cluttered training sequence.

The fourth paper (Vikas Reddy et al., "*A low complexity algorithm for static background estimation from cluttered image sequences in surveillance contexts*") addresses the same problem by describing a Markov random field framework targeted at embedded applications.

Embedded surveillance systems are also the scope of the fifth paper (A. Verdant et al., "*Three novell analog-domain algorithms for motion-detection in video surveillance*"), which focuses on power efficiency and proposes analog processing techniques to perform motion detection at the sensor.

The sixth paper (M. R. Bales et al., "*BigBackground-based illumination compensation for surveillance video*") deals with automatic illumination compensation in order to minimize false positives in foreground segmentation in the presence of nuisances such as sudden changes of the lighting conditions or camera parameters.

The seventh paper (R. H. Evangelio and T. Sikora, "*Static object detection based on a dual background model and a finite-state machine*") presents an algorithm whereby background estimation allows for detection of static (e.g., abandoned or removed) objects in crowded scenes.

A third group of papers includes three contributions addressing detection of objects of interest in surveillance videos. The eighth paper (W. Louis and K. N. Plataniotis, *Co-occurrence of local binary patterns (CoLBP) features for frontal face detection in surveillance applications*) proposes a novel feature—referred to as co-occurrence of local binary patterns (CoLBP)—to detect frontal faces.

The ninth paper (A. Gualdi et al., "*Contextual information and covariance descriptors for people surveillance: an application for safety of construction workers*") demonstrates the use of contextual information to improve the performance of a pedestrian detector based on the LogitBoost classifier. The paper then uses the detection system for monitoring of a construction site to detect workers that do not wear a hard hat.

The tenth paper (N. Fakhfakh et al., "*3D objects localization using fuzzy approach and hierarchical belief propagation: application at level crossings*") introduces a robust stereo-matching algorithm aimed at detection and localization of obstacles in the 3D space and relies on the algorithm to address the problem of visual monitoring at level crossings.

The five remaining papers in this special issue are concentrated on high-level processing in video-based surveillance including three contributions in scene understanding and reasoning, and each of the areas of biometrics and multicamera surveillance includes a single paper.

The next three contributions are focused on scene understanding and reasoning. The eleventh paper (Y. Benabbas et al., "*Motion pattern extraction and event detection for automatic visual surveillance*") relies on extraction of associated motion patterns from optical flow fields by means of probabilistic clustering for automatic detection of events related to crowds and groups of people.

In the twelfth paper (Z. L. Husz et al., "*Behavioural analysis with movement cluster model for concurrent actions*"), the authors propose a method for recognition of complex behaviors of a single individual by use of a movement cluster model (MCM) that relies on sequences of human pose parameters that can model global actions (e.g., full body movement) as well as elementary actions (e.g., arm movement).

The thirteenth paper (N. M. Robertson and I. D. Reid, "*Automatic reasoning about causal events in surveillance video*") introduces a rule-based reasoning process whose aim is to generate causal descriptions of mutual interactions among people, for example, statements such as "person A crossed the road in order to meet person B."

The last two papers in the special issue deal with biometrics for surveillance and multicamera systems, respectively. In the fourteenth paper (S. Chen et al., "*Face recognition from still images to video sequences: a local facial feature based framework*"), the authors propose averaging multi-region histogram features as the most promising technique to tackle the challenging problem of face recognition in low-quality CCTV videos.

The fifteenth and final paper in this issue (Y.-C. Xu et al., "*Camera network coverage improving by particle swarm optimization*") presents a new method to improve the field of view coverage of a camera network by use of a particle swarm optimization algorithm to efficiently determine the optimal orientation of each camera.

We hope that the papers presented in this special issue will serve as a catalyst for future developments in the exciting and rapidly moving field of video-based surveillance systems.

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