

GUEST EDITORIAL PREFACE

Special Issue on Machine Learning and Sensor Fusion Techniques for Surveillance and Monitoring Applications

Sanjay Boddhu, Synthos Technologies, Division of Qbase LLC, Springfield, OH, USA & Department of Computer Science and Engineering, Wright State University, Dayton, OH, USA

Olga Mendoza-Schrock, Air Force Research Laboratory, Wright-Patterson AFB, Dayton, OH, USA

The recent advances in the smart sensor technology and proliferation of their availability in conjunction with ubiquitous communication platforms have tremendously enabled researchers in surveillance and situational understanding area to propose and build cutting edge *Monitoring and Surveillance* applications with high quality and fidelity. The purpose of this special issue is to provide details on some of these developments of advanced techniques and tools, which would cover areas concerned with monitoring, modeling, control, and the management of surveillance data. Further, although the primary target audiences for this issue are the researchers in surveillance and monitoring techniques, the researchers in areas of machine learning, cognitive intelligence, and image processing would also find the papers

covered in the issue equally beneficial. The issues contains four papers selected after a very strict review process towards providing the readers with novel, well presented, and high quality research contributions.

The issue contains a paper from Dr. Erik Blasch and his colleagues that describes their latest work, Qualia-based Exploitation of Sensing Technology (QuEST). QuEST, is an approach to create a cognitive exoskeleton to improve human-machine decision quality. In this paper, authors presented QuEST-motivated man-machine information fusion with an example for multimedia narratives. In QuEST, the user-based situation awareness includes both elements of external sensory perception and internal cognitive explanation. Further, the paper outlines QuEST elements and tenets towards a reason-

ing approach that achieves human intelligence amplification (IA) in relation to data aggregation from machine artificial intelligence (AI). In a use case example for multimedia exploitation, authors showcased the need for enhanced understanding of the man (mind-body cognition) and the machine (sensor-based reasoning) for establishing a cohesive narrative of situational activities. In addition, working applications of QuEST tenets of structurally coherent, situated conceptualization, and simulated experience towards organizing multimedia reports of Video Event Segmentation by Text (VEST) has been presented.

In another paper of this Issue, Dr. Jie Wei and his colleagues, have described a non-invasive and remote sensor, the Laser Doppler Vibrometer (LDV) and presented argument for its broad spectrum of surveillance applications in various areas such as civil engineering, biomedical engineering, and even security and restoration within art museums. Further, the authors have presented the details of the innate features of LDV datasets from many vehicles collected in pilot project initiated by Air Force Research Laboratory, USA and provided a systematic process to demonstrate LCV's feature differences compared to human speech signals. A novel spectral tone-pitch vibration indexing scheme is described to capture the engine's periodic vibrations and the associated fundamental frequencies over the vehicles' surface, along with a neural networks based classifier is proposed so that it can classify vehicles' engines based on their spectral tone-pitch indices. It is demonstrated that the classification results using the proposed novel machine learning approach have consistently produced higher than 96% accuracies on all the datasets presented in the paper.

Continuing with the general machine learning techniques, that can aid *Surveillance and Monitoring* applications, Dr. Roman Ilin and his colleagues, have presented a new learning paradigm "Learning Using Privileged Information"

(LUPI). In brief, the presented paper, proposed the LUPI technique that improves general classification accuracy by incorporating additional information available at training time and not available during testing. In this contribution, the LUPI paradigm is tested on a Wide Area Motion Imagery (WAMI) dataset and on images from the Caltech 101 dataset. It was demonstrated that in both the datasets a consistent improvement in classification accuracy is observed. Moreover, the paper discussed details of the results and also provides the readers with ideas to advance the research in machine learning with LUPI technique.

A fully integrated Small Unmanned Aerial System (SUAS) platform, capable of gathering multispectral image data and novel approach for skin detection on SUAS acquired data, has been presented by Stephen R. Sweetnich and his colleagues. The paper presents the challenges of analyzing and employing data from aerial platform in comparison to their counterpart, ground-based platforms. In addition, the construction details of SUAS's dismount system for skin detection, employed customized tools, and techniques spanning the areas of computer vision registration, stereo camera calibration, geolocating, autopilot, and telemetry have been described. Further, the developed system has been compared to a larger line scan hyperspectral imager (HSI) in terms of skin detection performance based on Receiver Operating Characteristic (ROC) Area Under Curve (AUC) measurements. Finally, it was demonstrated that that SUAS-based Spectral Imagers are capable tools in dismount detection protocols.

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Sanjay Boddhu
Olga Mentoza-Schrock
Guest Editors
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