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Counterterrorism, Crime Fighting, Forensics, and Surveillance Technologies

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Introduction

The Counterterrorism, Crime Fighting, Forensics and Surveillance conference held 11–12 September 2017 in Warsaw, Poland, brought together emerging technologies for countering terrorism and crime and providing support to forensics, surveillance, security and defence forces. The conference addressed the big issue of maintaining security and safety by detecting and identifying dangerous, hidden, and camouflaged materials and recognizing suspicious behaviour from video imagery, all the while working within a legal and moral framework that respects individuals' rights.

Sensors for explosives, narcotics, and chemical and biological warfare agents must provide a prompt alert with fast, wide area coverage and must cope with unexpected hiding places. If they are to be routinely deployed, such sensors must offer accurate detection and low false alarm rates, use few consumables, and need little operator involvement. Optical sensing now extends from UV, through visible and infrared, into terahertz and RF wavelengths, offering novel imaging systems with increased penetration through barriers, and spectroscopic techniques that can help characterize suspicious materials.

The threat from people's activities can be reduced by identifying suspicious behaviour and by tracking individuals across multiple TV cameras. Increased computing power and advanced algorithms are expected to help in difficult scenarios such as crowded environments (face and iris recognition or other biometrics), and longer range imagery through turbulent atmospheres. Improved handover techniques from TV imaging will reduce the burden placed on local sensors.

The first session of this conference focused on the detection and identification of CBRNE. The first presentation showed an inexpensive method for upconversion of MMW/THz imaging that is based on a glow discharge detector (GDD) and silicon photodiode or simple CCD/CMOS camera [Aharon et al.]. The second presentation showed a standoff LIBS-based method to remotely detect explosive traces from several to tens of metres distance. A Cassegrain telescope was used to make the LIBS system more compact and a Schmidt corrector plate was used to eliminate spherical aberrations [Bhavsar et al.]. The third presentation aimed to avoid counterfeit banknotes by adding chaotic elements based on fibres in the paper pulp. The fibres result in a unique ID and a related QR code is printed on the banknote during the production. The authenticity of the banknote should be verifiable by any person who receives the note [Prabhu et al.].

The second session was on spectroscopy and Raman/LIBS. The first presentation in the session showed that rotating impeller increases allows the detection of traces of explosives at a larger distance than with existing systems based on fixed impeller

[Kotkovskii et al.]. In the second paper of the session was on a Raman lidar that was designed for remote detection of more than 4000 Raman shifts of various chemical, toxic or dangerous substances, explosives, and drugs [Grishkanich et al.]. The last paper of this session proposed a new approach for the detection and identification of substances using a THz TDS [Trofimov et al.].

The third session was on computer vision and video content analysis. The first presentation in this session proposed to use the terminology of managed analytics and makes a separation between primary (e.g., aggression detection) and supporting analytics (e.g., PTZ-preset recognition) [Den Hollander et al.]. The second presentation showed face verification in infrared images [Kowalski et al.]. The third presentation showed a system to generate a three-dimensional point-cloud model that can be used to create an overview of a crime scene. This overview model can be combined with details recordings about blood stains and it supports automatic blood stain analysis [Adamczyk et al.]. The best student paper prize was awarded to this last presenter of the session, Marcin Adamczyk, who is a PhD student at the Warsaw University of Technology.

The fourth session was about person and object detection, tracking and behaviour analysis. The first presentation of this session is about robust visual object tracking. The initial tracker is extended by enabling the use of rotated rectangles as tracking states. The fixed aspect-ratio assumption is dissolved by constructing a confidence map from the on-line boosting-based tracker [Becker et al.]. The second presentation showed the subjective and objective factors that influence the error in aiming a rifle at a UAV. Experimental measurements and theoretical analysis with Monte Carlo simulations were shown [Racek et al.]. The third presentation used 3D object segmentation for tracking, based on an integral imaging system with an array of lenses or cameras [Aloni et al.].

The fifth session was on big data analysis and deep learning. The first presentation used a CNN to detect threats in x-ray cargo scanners. Transfer learning and fine tuning is used to generalize better for multiple scanners [Caldwell et al.]. The second presentation used semantic technologies for forensic investigations in financial crimes. The technology helps the investigator to find relations between different case entities and relations to other cases. The crime field ontology is based on knowledge obtained from online search, forensic investigators, and captive interviews of detained criminals [Scheidat et al.]. The third presentation showed results of the concept detection with SSD and instance search with Fisher vectors on the datasets of VOC2012 and FlickrLogos [De Boer et al.]. The fourth presentation combined the end-to-end convolutional neural network (YOLO) with a recurrent neural network (LSTM) for multi-frame analysis to perform vehicle tracking [Fischer et al.]. The last presentation of this session used AlexNet to distinguish not only car makes, but even the different models within that make.

The last session was chaired by Prof. Piotr Szykarczyk from the Industrial Research Institute for Automation and Measurements in Poland. Dr. Szykarczyk also

contributed in the creation of this session. The session focused on autonomous sensors and mobile robots. The first presentation of the session was on auctions and multi-criteria analysis for task allocation a group of inspection robots [Panfil et al.]. The second presentation was about simultaneous localization and mapping (SLAM) to estimate the position of a mobile platform and generate a 3D point cloud to describe the scene [Mitka et al.]. The third presentation gave an overview of the capabilities of a mobile robot developed by PIAP that could be used for forensic investigations on crime scenes [Kowalski et al.]. And finally, the last presentation presented a security system for counterterrorism and surveillance applications with stationary radars, mobile radars and an intervention robot with an acoustic gun. This session summarized a wide range of several possibilities with mobile robots [Moczulski et al.].

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