Special Section Guest Editorial: Machine Vision—Systems, Methods, and Applications

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The emergence of machine vision as a ubiquitous platform for innovations has laid the foundation for the rapid growth of information. Side by side, the use of mobile and wireless devices such as PDA, laptop, and cell phones for accessing the Internet has paved the way for related technologies to flourish through recent developments. In addition, machine vision technology is promoting better integration of the digital world with the physical environment.

This special section focuses primarily on research in the field of machine vision. The purpose is to review the progress and achievements of the research work to date.

Topics of interest for this special section include: machine vision systems and components (hardware and software, sensor fusion), machine vision applications (industrial inspection, navigation, optical metrology, autonomous vehicles, remote sensing, astronomy and astronautics, bio-medical imaging, face and gesture recognition, data compression, security and coding, document processing), computer vision (scene reconstruction, video tracking, 3D pose estimation, action recognition), active vision (autonomous cameras, wearable and assistive computing, real-time 3D scene segmentation and reconstruction), 3D vision (stereovision, laser triangulation, multi-cameras), machine learning (artificial intelligence, neural networks, deep learning, big data, and data mining), image processing (analog, digital, electronic, optical, acoustical, hybrid), image processing methods (pre-processing, image analysis, feature extraction, segmentation, classification, pattern recognition, coding, understanding, modeling, color, texture, shape, geometry, topology, SIMD, MIMD), and computational imaging.

We received a very good response to our open call for papers for the special section. All of the articles were rigorously evaluated according to the normal reviewing process of the *Journal of Electronic Imaging*. The evaluation process took into consideration factors pertaining to originality, technical quality, presentational quality, and overall contribution. In all, six articles were accepted for publication.

Jin et al. propose a dense vehicle detection network for surveillance images by embedding the deformable channel-wise column transformer (DCCT) into the current you only look once (YOLO)-v5l network with a novel asymmetric focal loss (AF loss). The proposed AF loss is used to balance the performance between easy and hard targets and to address class imbalance. Extensive results demonstrate that the proposed network can accurately detect on-road densely located vehicles, even the minority classes in real time.

Yeo and Yen propose a method for vision automation for edible bird's nest (EBN) hygiene inspection. They take into account inhomogeneous optical properties, various types and sizes of impurities, and limited sample size by developing a hybrid autoencoder model that contains an autoencoder and a single layer convolutional network. The results show that with only 50 EBN sample images, the hybrid model achieves a recall of 0.9282, a precision of 0.7718, and a 5.63% undetected rate for impurities.

Abubakr et al. focus their paper on the use of deep convolutional neural networks (CNN) for automatic industrial inspection of mechanical assemblies, where training images are limited and hard to collect. The ultimate goal is to obtain a deep CNN model trained on synthetic renders (by using computer-aided design model) and deployed to recognize the presence of target objects in never-before-seen real images collected by commercial RGB cameras. Different approaches are adopted to close the domain gap between synthetic and real images.

Bouchot et al. contribute to tribology by quantifying interacting surfaces in relative motion. They propose to characterize wear or third-body particles (generated by dry friction between two

bodies) using image acquisition and analysis. The most relevant geometrical and textural image descriptors are selected by a sensitivity study and correlated to tribological characteristics. The proposed tools give first quantitative results to better understand, for industrial purposes, the mechanisms involved in the wear phenomenon, and the morphology of ejected third body particles.

Nazir et al. develop a method for early detection of brain tumors, proposing a multi-task learning (MTL) model that can take 2D-magnetic resonance imaging (MRI) images as input and gives predictions for multiple outputs such as detection and segmentation. Experimental results show that the best model shows 98% accuracy for detecting MRI images as either normal/abnormal, whereas an overall Dice score of 92% for multi-class segmentation of high-grade gliomas into the whole tumor, enhancing tumor and core tumor. The overall performance of the proposed architecture proves that it can be the best-suited framework for clinical setup.

Saeed contributes to detecting phishing, a common cybercrime that tempts a target to reveal personal and financial information by imitating a legitimate webpage. He made the first attempt to detect phishing webpages based on visual similarity by modifying and retraining deep neural networks. A comprehensive evaluation of two publicly available databases has shown a marked improvement of around 7% classification accuracy.

We would like to express our sincere thanks to all the authors for submitting their articles and to the reviewers for their valuable comments and suggestions that significantly enhanced the quality of these articles. We are also grateful to Editor-in-Chief Prof. Zeev Zalevsky for the great support throughout the whole review and publication process of this special section, and, of course, all the editorial staff. We hope that this special section will serve as a useful reference for researchers, scientists, engineers, and academics.

Johan Debayle received his MSc, PhD, and Habilitation degrees in the field of image processing and analysis in 2002, 2005, and 2012, respectively. Currently, he is a full professor at the Ecole Nationale Supérieure des Mines de Saint-Etienne (MINES Saint-Etienne) in France, within the SPIN Center and the LGF Laboratory, UMR CNRS 5307, where he leads the PMDM Department interested in image analysis of granular media. He is also the deputy director of the MORPHEA CNRS GDR 2021 Research Group. His research interests include image processing and analysis, pattern recognition, and stochastic geometry. He published more than 180 international papers in international journals and conference proceedings.

Wolfgang Osten received the MSc/Diploma in physics from the Friedrich-Schiller-University Jena in 1979. From 1979 to 1984, he was a member of the Institute of Mechanics in Berlin, working in the field of experimental stress analysis and optical metrology. In 1983, he received a PhD degree from the Martin-Luther-University Halle-Wittenberg for his thesis in the field of holographic interferometry. From 1984 to 1991, he was employed at the Central Institute of Cybernetics and Information Processes ZKI in Berlin, making investigations in digital image processing and machine vision. Between 1988 and 1991, he was heading the Institute for Digital Image Processing at the ZKI. In 1991, he joined the Bremen Institute of Applied Beam Technology (BIAS) to establish and to direct the Department of Optical 3D-Metrology until 2002. From September 2002 until October 2018, he has been a full professor at the University of Stuttgart and director of the Institute for Applied Optics. From 2006 until 2010 he was the vice rector for research and technology transfer of the University Stuttgart. His research work is focused on new concepts for industrial inspection and metrology by combining modern principles of optical metrology, sensor technology, and digital image processing.

Dmitry Nikolaev received a master's degree in physics and a PhD degree in computer science from Moscow State University, Moscow, in 2000 and 2004, respectively. Since 2007, he has been the head of the Vision Systems Laboratory, Institute for Information Transmission Problems, Russian Academy of Sciences, Moscow, and since 2016, he has been a CTO of Smart Engines Service LLC, Moscow. Since 2016, he also has been an associate professor with the Moscow Institute of Physics and Technology, State University, Moscow, teaching the image processing and analysis course. He is the author of over 210 papers and six patents. His research interest includes computer vision with primary application to color image understanding.