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EDITORIAL

IEEE ACCESS SPECIAL SECTION: DIGITAL FORENSICS THROUGH MULTIMEDIA SOURCE INFERENCE

With the prevalence of low-cost imaging devices (smartphones, tablets, camcorders, digital cameras, scanners, wearable, and IoT devices), images and videos have become the main modalities of information being exchanged in every walk of life. The ever-increasing convenience of image acquisition has facilitated instant distribution and sharing of multimedia on digital social platforms. In the meantime, powerful multimedia editing tools allow even unskilled people to easily manipulate digital content for malicious or criminal purposes. In all cases where multimedia serves as critical evidence, forensic technologies that help to determine the origin, the authenticity of multimedia sources, and the integrity of multimedia content become essential to forensic investigators. Imaging devices and post-acquisition processing software leave unique ''fingerprints'' in multimedia content. This allows many challenging problems faced by the multimedia forensics community to be addressed through source inference. Source inference is the task of linking digital content to the source device or platform (e.g., social media such as Facebook) responsible for its creation. It can facilitate applications such as identification and verification of source device and platform, common source inference, content integrity verification, and source-oriented image clustering. It also allows the establishment of digital evidence or the history of multimedia processing steps applied to the content, starting from the acquisition procedure and up to tracking the spread. The recent adoption of multimedia source inference techniques in the law enforcement sector (e.g., U.K. Sussex Police, Guildford Crown Court, and INTERPOL) in real-world criminal cases and child sexual exploitation databases has manifested the significant value of multimedia source inference in the fight against crime. This Special Section in IEEE ACCESS aims to collect a diverse and complementary set of articles that demonstrate new developments and applications in digital forensics through multimedia source inference.

The Call for Papers received a positive response from the scientific community, and nine articles were accepted for inclusion in the Special Section after a thorough review process by at least two independent referees.

The nine accepted articles range from camera and smartphone identification, including the proposal of new databases for video identification, to emerging challenges in multimedia forensics.

In the article ''Camera identification based on domain knowledge-driven deep multi-task learning,'' by Ding *et al.*, the authors describe a domain knowledge-driven method for camera identification, composed of one preprocessing module consisting of a sequential multiscale high-pass filter to achieve a residual image, feature extractor, and a hierarchical multitask learning procedure. The classification phase is made through a Convolutional Neural Network (CNN) that can distinguish among camera brands, models, and devices.

The article ''A deep and scalable unsupervised machine learning system for cyber-attack detection in large-scale smart grids,'' by Karimipour *et al.*, presents an anomaly detection method able to differentiate an actual fault from a cyber-attack in a smart grid. The proposed method applies feature extraction utilizing symbolic dynamic filtering.

The article ''FD-GAN: Face de-morphing generative adversarial network for restoring accomplice's facial image,'' by Peng *et al.*, studies a face de-morphing generative adversarial network (FD-GAN) to restore a facial image. A face morphing detector is devised employing the symmetric dual network architecture.

The article ''Estimation of primary quantization steps in double-compressed JPEG images using a statistical model of discrete cosine transform,'' by Thai and Cogranne, discusses the estimation of the first compression parameter of double compression in JPEG images to help reveal the software used to create an image or the camera that acquired it. In detail, the article proposes an accurate method for estimating the possible value for the quantization of primary DCT coefficients with respect to the secondary quantization step.

The article ''The video authentication and camera identification database: A new database for video forensics,'' by Hosler *et al.*, introduces a video authentication and camera identification database (videoACID) with a large collection of videos. The videoACID database contains more than 12 000 videos from 46 physical devices representing 36 unique camera models.

The article "Daxing smartphone identification dataset," by Tian *et al.*, presents a new smartphone identification dataset (Daxing), which collects images and videos from a large number of smartphones of different brands, models, and devices. Specifically, the data set includes 43 400 images and 1400 videos captured by 90 smartphones of 22 models belonging to five brands.

The article "Template matching using time-series averaging and DTW with dependent warping for online signature verification," by Okawa, proposes a single-template strategy using a reference template for online signature verification useful in biometrics and forensics. The reference template is created using a global averaging method for dynamic time warping named DTW barycenter averaging (DBA).

The article "Smartphones identification through the built-in microphones with convolutional neural network," by Baldini and Amerini, proposes a smartphone identification and authentication approach through the use of distinctive features extracted from the audio recording by stimulating the built-in microphone with nonvoice sounds at different frequencies. A convolutional neural network architecture is then proposed, demonstrating its superiority in the presence of different types of noises with respect to other machine learning algorithms.

Finally, the invited article "An in-depth study on open-set camera model identification," by Ribeiro *et al.*, aims to detect whether an image comes from one of the known camera models of a known dataset, or from a completely unknown and unrelated one. Different feature extraction algorithms and classifiers are compared targeting open-set recognition. A convolutional neural network is then selected as a feature extractor paired with a properly trained classifier to solve the open-set camera model attribution problem even on small-scale image patches.

These nine articles provide new perspectives and further research directions for the development of appropriate digital forensics and security enhancement approaches for image- and video-related applications.

Finally, the associate editors and guest editors of the Special Section on "Digital forensics through multimedia source inference" would like to thank all the authors for their contributions, the reviewers for their constructive comments and suggestions, the Editor-in-Chief of IEEE Access, and the whole IEEE Access editorial staff for their invaluable support.

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