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Exposing Digital Forgery Detection by Illumination Using SVM classifier

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Abstract-Photographs often act as evidence for criminals cases in courts. It also plays a vital role in media such as newspapers, television, etc. But however, image forgery becomes easier nowadays as image editing software becomes available. Here we analyze the often utilized manipulation technique called splicing or image composition. Physics-based and statistical-based illuminate estimation technique is incorporated so that texture- and edge-based features are extracted to identify image forgery. Machine-learning approach is also employed; hence requires minimal human interaction.

Keywords: illumination estimation, splicing, machine learning approach and human interaction

I. INTRODUCTION

Many algorithms for detecting photographic tampering have been proposed. In particular, several schemes have been proposed to detect traces left by different kinds of tampering (see, for instance. However, in most cases, tampering is obtained by applying a small set of processing tools, hence only a part of the available trace detectors will reveal the presence of tampering. Furthermore, it may happen that the positive answer of one algorithm inherently implies the negative answer of another because they search for mutually excluding traces. Finally, trace detectors often give uncertain if not wrong answers since their performance are far from ideal. For these reasons, taking a final decision about the authenticity of an image relying on the output of a set of forensic tools is not a trivial task. The digital information revolution and issues concerned with multimedia security have also generated several approaches to tampering detection. Generally, these approaches could be divided into active and passive–blind approaches. The area of active methods simply can be divided into the data hiding approach and the digital signature approach. The area of blind methods tries to verify the integrity of digital images and detect the traces of tampering without using any protecting pre–extracted or pre–embedded information. This area is regarded as a new direction and is growing noticeably.

Geometric transformations such as scaling or rotation are common tools employed by forgery creators. There are two basic steps in geometric transformations. In the first step a spatial transformation of the physical rearrangement of pixels in the image is done. Coordinate transformation is described by a transformation function which maps the coordinates of the input image pixel to the point in the output image (or vice versa).

The second step in geometric transformations is called the interpolation step. Here pixels intensity values of the transformed image are assigned using a constructed low–pass interpolation filter, to compute signal values at arbitrary locations, discrete samples are multiplied with the proper filter weights when convolving them with w. This step brings into the image detectable periodic properties. Low–order piecewise local polynomials is mainly concerned nearest–neighbour, bilinear and bi cubic. These polynomials are used extensively because of their simplicity and implementation unassuming properties. Periodic properties present in the covariance structure of interpolated signals are analytically shown.

The set of image forensic tools can be roughly grouped into five categories. They are pixel-based techniques, format-based techniques, camera-based techniques, physically based techniques and geometric-based techniques.

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II. RELATED WORK

DyWT is shift invariant and therefore more suitable than discrete wavelet transform (DWT) for data analysis[2]. First decompose the input image into approximation (LL1) and detail (HH1) sub bands. Then divide LL1 and HH1 sub bands into overlapping blocks and measure the similarity between blocks. The key idea is that the similarity between the copied and moved blocks from the LL1 subband should be high, while the one from the HH1 subband should be low due to noise inconsistency in the moved block. Using thresholding, matched pairs from the sorted list are obtained as copied and moved blocks. The limitation is that this technique exploits different kinds of intrinsic fingerprints such as sensor noise of the capturing device or image specific detectable changes for detecting forgery.

There are various types of techniques to create forged images for various intentions. Here[7], attempt is made to verify the authenticity of image using the image quality features like markov and moment based features. Best results are founded in case of forgery involving splicing.

Sensitive quality features and markov process model was utilized to detect forgery in image data using histogram moments. Experiments were conducted on famous databases providing and authentic and forged images to find true positive and true negative results duly these training of data for various ratios like 65%, 75% and 85% respectively

A novel accurate detection framework is proposed that demosaic regularity from different source images. This framework first classify the demosaiced samples into several categories[4] and then estimates the underlying demosaicing formulas for each category based on partial second-order derivative correlation models, which detect both the intra-channel and the cross-channel demosaicing correlation. An expectation maximization reverse classification scheme is used to iteratively resolve the ambiguous demosaicing axes in order to best reveal the implicit grouping adopted by the underlying demosaicing algorithm.

Digital watermarking[1] has been proposed as a means by which an image can be authenticated. The drawback of this approach is that a watermark must be inserted at the time of recording, which would limit this approach to specially equipped digital cameras.

The bugbear of uncalibrated stereo reconstruction is the method where cameras which deviate from the pinhole model[3]. It has to be pre-calibrated in order to correct for nonlinear lens distortion. If they are not, and point correspondence is attempted using the uncorrected images, the matching constraints provided by the fundamental matrix must be set so loose that point matching is significantly hampered. This shows how linear estimation of the fundamental matrix from two-view point correspondences may be augmented to include one term of radial lens distortion. There is an algorithm for plane-based calibration of general radially distorted cameras[8]. By this, we can understand cameras that have a distortion center and an optical axis such that the projection rays of pixels lying on a circle centered on the distortion center form a right viewing cone centered on the optical axis. The camera is said to have a single viewpoint (SVP) if all such viewing cones have the same apex (the optical center).

A method of simultaneously calibrating the radial distortion functions of a camera and the other internal calibration parameters use a planar (or alternatively non-planar) calibration grid, which is captured in several images. In this way, the determination of the radial distortion is an easy add-on to the popular calibration method proposed. This method is entirely non-iterative, and hence is extremely rapid and immune from the problem of local minima[5].

A family of scale-invariant local shape features formed by chains of k connected is proposed, roughly straight contour segments (kAS), and their use for object class detection. kAS are able to cleanly encode pure fragments of an object boundary, without including nearby clutter[2]. Moreover, they offer an attractive compromise between information content and repeatability, and encompass a wide variety of local shape structures. However, for key curves lying on the object boundary, these patches will include nearby clutter edgels, which corrupt their descriptors and makes them difficult to put in correspondence.

III. METHODOLOGY

The proposed framework exploits knowledge about tool performances and about compatibility between various tool responses, and can be easily extended when new tools become available. It allows both a "soft" and a binary (tampered/nontampered) interpretation of the fusion result, and can help in analyzing images for which taking a decision is critical due to conflicting data.

a. Dense Local Illuminant Estimation

To compute a dense set of localized illuminate colour estimates, the input image is segmented into super pixels, i.e., regions of approximately constant chromaticity. Per super pixel, the color of the illuminant is estimated. The statistical generalized gray world estimates and the physics-based inverse-intensity chromaticity space, as we explain in the next subsection. We obtain, in total, two illuminant maps by recoloring each superpixel with the estimated illuminate chromaticities of each one of the estimators.

1)The classical gray world assumption by Buchsbaum states that the average color of a scene is gray. Thus, a deviation of the average of the image intensities from the expected graycolor is due to the illuminant.

2) The illuminate estimator we consider in this paper is the so-called inverse intensity-chromaticity (IIC) space. In contrast to the previous approach, the observed image intensities are assumed to exhibit a mixture of diffuse and specular reflectance.

b.Face Extraction

We require bounding boxes around all faces in an image that should be part of the investigation. For obtaining the bounding boxes, we could in principle use an automated algorithm, e.g., the one by Schwartz et al.. However, we prefer a human operator for this task for two main reasons: a) this minimizes false detections or missed faces; b) scene context is important when judging the lighting situation. For instance, consider an image where all persons of interest are illuminated by flashlight.

The illuminants are expected to agree with one another. Conversely, assume that a person in the foreground is illuminated by flashlight, and a person in the background is illuminated by ambient light. Then, a difference in the color of the illuminants is expected. Such differences are hard to distinguish in a fully-automated manner, but can be easily excluded in manual annotation

c.Texture Description

We use the Statistical Analysis of Structural Information (SASI) descriptor to extract texture information from illuminant maps. Recently, pointed out that SASI performs remarkably well. For our application, the most important advantage of SASI is its capability of capturing small granularities and discontinuities in texture patterns. Distinct illuminantcolors interact differently with the underlying surfaces, thus generating distinct illumination "texture".

d.Interpretation of Illuminant Edges

Differing illuminant estimates in neighboring segments can lead to discontinuities in the illuminant map. Dissimilar illuminant estimates can occur for a number of reasons: changing geometry, changing material, noise, retouching or changes in the incident light. Thus, one can interpret an illuminant estimate as a low-level descriptor of the underlying image statistics. We observed that the edges, e.g., computed by a Canny edge detector, detect in several cases a combination of the segment borders and isophotes (i.e., areas of similar incident light in the image). When an image is spliced, the statistics of these edges is likely to differ from original images

e.Classification

We classify the illumination for each pair of faces in an image as either consistent or inconsistent. Assuming all selected faces are illuminated by the same light source, we tag an image as manipulated if one pair is classified as inconsistent. Individual feature vectors, i.e., features on either gray world or IIC-based illuminant maps, are classified using a support vector machine (SVM) classifier.

IV. CONCLUSION

We have addressed a central problem in image forensics, namely the fusion of information stemming from the application of several tamper detection tools. The fusion strategy we have developed is easily extendable to even a large number of tools. Other advantages derive from the adoption of a framework, since such a theory permits to cope with situations in which incomplete information is available about the a-priori tampering probabilities. Information about the dependence among the output of the single tools and their reliability can also be easily incorporated within the model. Experimental results are encouraging: the proposed model gives significantly better results than a fusion approach based on logical disjunction, and also outperforms other methods (that presents the additional disadvantage of requiring a global training of the final, limiting the scalability of this approach).

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