Forgery Detection Based on Blur Inconsistencies: A Review

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***Abstract*— In this Digital era,due to the availability of easy-to-use photo-manipulation software tools, image security has become a prominent question as people are using them for their malicious purposes in various fields for example in journalism, social networking, politics, criminalism etc. Whenever tampering is done, it affects or changes the basic characteristics of images such as blurriness, sharpness ,noise, luminance intensity etc.There are various methods which detects divergence in different characteristics. Now days, blur operation has become a common tool to hide visual blueprints such as discontinuity in intensities among different regions. This tool is being used to commit copy& move and splicing forgeries. But this operation changes blur consistencies pattern of original image. If these blur inconsistencies get detected, we can conclude that image has been tampered. Therefore, in this paper, we provide a review of tampering detection methods based on blur inconsistencies.**

***Index Terms*— Blur estimation, Blur inconsistencies ,perceptual , non-perceptual**

I. INTRODUCTION

Tampering methods/forgeries can be

- Copy and Move/Region Duplication
- Splicing/Image Composites
- Cloning

Although Digital image tampering has become easy Yet it can be detected using different techniques. These techniques are classified into two categories: 1) Active 2)Passive

Active Techniques: They all require some prior /extra knowledge about original image that should be embedded at the time of image production as mark of originality. These techniques are good only if embedded code/information remains intact in the forged image also. *Watermarking and Digital signatures* are common examples of Active techniques. But Their drawbacks are

- They cannot work if embedded code get damaged.
- They require special expensive hardware and software requirements to detect forgery.

***Passive techniques**:* Unlike active techniques, they do not require additional information such as digital watermarking and digital signatures to detect forgery. They are based on the fact that tampering makes changes in statistical characteristics of original image. They detect forgery based on inconsistencies in different characteristics of different parts of the forged image.

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Passive techniques have been classified on the basis of
(1)Tampering operations
(2)Intrinsic regularities and inconsistencies
(3)Natural and computer graphic image

Clues for Passive forgery detection methods

Based on Tampering operations	Based on Intrinsic regularities and inconsistencies	Natural and computer graphic image
JPEG compression properties	Ilumination	Color features
Copy and Move	Lens Radial	Image Quality metrics
splicing	Distortion	Natural image statistics
Resampling	chromatic aberration	
Brightness and Contrast		
Cropping and Recompression		
Sharpening and Blurriness		

Here our aim is to present how blurring can be used to detect image forgery. Blurring is very common method used often to reduce the degree of discontinuity or to hide splicing effects or to give real situation effect using artificial blur. Blurring is being used in splicing and copy and move forgeries. An image can have different types of blurs such as Defocus blur, Motion Blur, Out-of-focus blur. But, identifying blur inconsistencies in whole forged image can aid to detect forgeries. Blur can be introduced in a region or at the edges. Therefore, different techniques detecting blur inconsistencies are categorised as Edge based ,Region based ,Edge-cum-Region based.

II. Previous Work

A. *Edge based blur inconsistencies*

Zhang and Zhang[1] proposed method to detect presence of feather operation that is useful to create a smooth transition between the selected region and its surroundings. Xin Wang et.al[2] proposed a method to detect forgery using defocus model. It estimates blurring at edge pixels to check defocus blur inconsistency through local blur estimation using Elder-Zucker method.It is based on the fact that image patches with similar distances to lens have similar blur kernel sizes.This method is robust to digital photofinishing and scanning. Junwen Wang et. al[3] developed a method to detect manual edges from a tampered image. It uses subsampled contourlet transform to analyse image edges.It extracts the difference between the normal edge and blur edge by analysing phase congruency and prediction –error image. And these features are used to train the SVM to differentiate blurred edges. This method detects blurring and locates the tampering boundary with a relative high accuracy. Patchara et.al[4] proposed a method to detect color image forgery based on image luminance and image chroma. It extracts some image features from image luminance using rake-transform and from image chroma by using edge statistics.

B. Region Based Blur inconsistencies

D.Y.Hsiao and S.C.Pei[5] proposed a method to detect blurred region using image DCT coefficients and optimal morphological operations. Y.Sutcu,B.Coskun [6] developed a method to detect copy and move forgery based on the idea that sharpness/blurriness of the tampered region is affected due to copy &move of particular region on the original image.It is based on the regularity property of wavelet coefficients that measure the decay of wavelet coefficients across scales. R.M Bora et.al [7] proposed a method to detect splicing forgery. It is gradient based PBM method which is more effective than Cepstral method.It uses blur estimate measure to help in segmentation of inconsistent regions of images that has small amounts of motion blur and no-reference Perceptual blur Metric(PBM) to detect directional motion blur in forged image.It uses K-means algorithm to achieve its effectiveness.Tao Wang et.al.[8] proposed a method to detect copy and move forgery. It is based on merging blur and affine moments invariants.It detects duplicated and distorted regions.But it cannot detect forgery when degradation scales get increased. Pravin kakar et.al[9] provides a novel method based on discrepancies in motion blur.It is based on estimation of motion blur through image gradients to detect motion inconsistencies to help in splicing detection.Fei Peng [10] proposed a method to detect the presence of artificial blur which is considered as digital image forgery.It is based upon the fact that blur operation destroys joint consistency of color channel in the image. Firstly, it obtains blur region through blur estimation measure and then locates the artificial blur region by detecting abnormal hue in the blur region .It achieves better performance in detecting defocus blur and artificial blur. Pravin et. al[11] proposed method to detect motion blur inconsistencies using spectral matting to help splicing detection. They also developed a new measure to do inconsistent region segmentation in images that contain small amounts of blur.It has been proved an effective method than other existing blur based techniques.Zhipeng[12] et.al provides another method to detect image tampering. It detects global or local blur manipulation using no-reference image quality metric.It extracts image features from MSCN (meansubtractedcontrastnormalized)coefficients of different regions to quantify tampered regions. But it does not work good for images with poor resolution. Khosrobahrami et.al[13] developed a method to detect multi-type blurred images. It clusters the blocks having similarity of local blur kernels using K-means clustering algorithm. And Then it classifies the blur types of the clustered region into out-of-focus or motion blur using a minimum distance classifier.

C. Blur Estimation

Most of the Forgery Detection method based on blur inconsistencies use blur estimation metric to measure the amount of blurriness in the tampered image. To assess image quality by human himself is quite time consuming process, inconvenient and expensive method. Therefore, there is need to automate image quality assessment methods.They all calculates blur scores for blurriness. There are two types of image quality assessment techniques as objective(non-perceptual) method and subjective(perceptual) method. Objective image quality assessment methods predict the perceived image quality automatically. Image quality assessment methods are classified according to the availability of a reference (original)asFull reference(FR),reduced-reference(RR) and no-reference(NR). Full reference based metrics requires both distorted and original image to estimate the quality of distorted image. Whereas reduced reference approaches requires some information about the original image apart from the distorted image. But no-reference approaches do not require any original image to assess the distorted image quality. As there is usually problem of availability of original images as reference, therefore, no-reference based quality metrics are more useful and purposeful. There are many non-perceptual (objective)and perceptual(subjective)blur metrics for image quality assessment. Each type of blur metric has its advantages and limitations.

Type of blur metric	**Advantages**	**Limitations**
Non -Perceptual	Ensures accuracy	More time complexity
Perceptual	Less Time complexity	Estimates only human perceptible image degradation in quality but doesnot assess low level degradation

Perceptual/subjective metrics have been developed because of the reason to automate the process to assess image quality in terms of blurriness amount. Now we introduce latest developed perceptual no-reference blur image quality metric for image quality assessment. Yongfeng Wang et.al [14] proposed no-reference perceptual-based blur metrics that detects blurred edges in cost effective way. It is based on perceptual-based edge analysis. Zhirong et. al[15] also developed a new no-reference perceptual blur metric that is based on the analysis of the spread of edge and the study of human blur perception for varying contrast values. This metric yields high accuracy.. Fatma Kerouh et.al [16] proposed another perceptual blind blur image quality metric that was developed in wavelet domain. It combines objective measure based on edge analysis through wavelet transform resolutions and Just Noticeable Concept(JNB).

III. Conclusion

In this paper, we have presented a review of approaches based on blur inconsistencies to detect different forgeries.To analyse these blur inconsistencies, firstly we need to estimate blur amount in different regions of the forged image.For this purpose we also presented different blur estimation metrics in

[14],[15],[16]that measures the blur amount. These metrics have been tested over different datasets. So, in future, we will work to compare these metrics.

Overview of the Previous work on forgery detection based on blur inconsistencies.

Year	Author	Proposed Model/ Method	Advantages	Limitations
2005	Hsia and Pei	DCT coefficients and optimal morphological operations.	Detects blurred regions	Some detected inconsistent regions lead to false interpretations
2007	Y.Sutcu,B.Coskun	Regularity of wavelet coefficients	Detects copy and move forgery	
2008	XinWang et.al	Defocus	Robust to photofinishing and scanning	Detects defocus blur inconsistencies only
2010	Junwen et.al	subsampled contourlet transform	Locates tampering boundary with high accuracy	Tested images are from PEWNTAX K100D and canon A710 digital camera.
2010	Patchara et.al	Based on Natural image model and Rake transform and edge statistics	•Better for natural images •Its computation time is relatively low	Cannot be used for internet images .
2010		based on discrepancies in motion.	Detects splicing forgery, Effective method	Good only for motion blur
2010	Pravin et. al	matting the components of the image.	•estimates the motion blur effectively. •detects splicing forgery •Better inconsistent region interpretation for user	Slower than DCT based technique
2010	Fei Peng et.al	abnormal hue in the blur region .	•detects the presence of artificial blur and defocus blur efficiently. •Good detection rate •No any influence of the texture of the background and image size	Detects only motion blur inconsistencies
2011	Pravin kakar et.al	Based on spectral matting	•Simple and speedy segmentation to detect inconsistent regions efficiently •estimates the motion blur effectively. •detects splicing forgery •Better inconsistent region interpretation for user	More number of steps are involved
2013	Tao Wang et.al	Merge blur and affine moments invariants.	detects copy and move forgery	cannot detect forgery large degradation scales
2013	Zhipeng et.al	MSCN coefficients	Good for detecting guassian blur and blur operation by mean filter	•Not good for images with poor resolution. •Cannot detect guassian blur with sigma 0.1
2014	Khosrobahrami et.al	similarity of local blur kernels using K-means clustering algorithm and minimum distance classifier.	Detects multi-type blurs (Symmetric out-of-focus or uniform motion blur)	Cannot detect other complex forms of kernel

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