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Research Article

Detection of Doctored Images using Demosaicing

Lalitha M[Ȧ*] , Venkatesh. Uppar[Ȧ], Uma Mudhengudi[Ȧ] and Muktanidhi S D[Ḃ]

[Ȧ]BVBCET, Hubli, India, [Ḃ]PESIT, Bangalore, India

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Abstract

The advanced development in image editing software's have made easy to doctor the digital images and they leave no visual clues. Digital doctoring has become a serious problem in various fields such as scientific publications, politics, internet etc. This has led to reducing trustworthiness and creating false beliefs in real world applications, hence it is necessary to protect against image doctoring using appropriate methods. The doctoring operations are performed using splicing, cloning and retouching. Digital image doctoring process introduces un-natural higher order correlations in doctored images. We detect these correlations using demosaicing artifacts. The proposed features are based on the differences in the acquisition process of images. More specifically variant of color filter array. The basic idea is that the correlation between bit planes of an image will be different in doctored image compared to real image.

Keywords: *Image processing, doctoring, classification, demosicing , demosaicing artifact*

1. Introduction

In this paper, we present novel methods for the detection of doctored images. Doctoring is to add ingredients so as to improve or conceal the taste, appearance, or quality of image. There are countless kinds of doctoring procedures and a little of the most public procedures are splicing, cloning and retouching (A. Upendra *et al*,2011). Splicing is a procedure of joining parts of disparate pictures or the alike picture to form a solitary image, whereas cloning is the procedure of removing unwanted parts from an picture or copy-pasting portions of an picture onto the same image. Retouching involves employing one or extra post-processing steps like adjusting colors, difference, white balance, sharpness and/or countless supplementary post-processing steps (H. Farid, 2006). Images deed as a basis of facts or data in the field of science, regulation, mass media etc.. These pictures can be easily tampered alongside the disparate picture affecting tools (J. Wang *et al*,2007). Therefore, detection of doctoring is vital. Typically, the detection of doctoring is categorized into active and passive approaches. The active ways needs a digital signature (J. Fridrich,1998) to be embedded into the picture, whichever across the capturing of an picture or afterward the picture is captured. In most cases, the camera does not implant a signature onto an image. The passive ways need no data of the image capturing procedure and assumes that, after an picture is captured, the picture statistics are altered. Researchers have made an effort to arrest these disturbances for the detection of doctored images employing countless passive ways like bispectral analysis (A. Upendra *et al*,2011), (H. Farid,,1999), re-sampling the picture (A. Popescu *et al*,2005), DCT, DWT (W. Chen *et al*,2007), blind deconvolution (A.Swaminathan *et al*,2006), JPEG compression etc..

We discern that the passive ways counselled by the researchers are competent after dealing alongside a particular kind of doctoring process. For instance, the authors in (D. Fu *et al*,2006) and (W. Chen *et al*,2007) propose disparate passive schemes for the detection of spliced images. The authors in (A. Upendra *et al*,2011) and (A. Upendra *et al*,2012) propose different passive schemes to examine the disparate types of doctoring procedures like splicing, cloning and retouching, without a method . In demosaicing artifact method, to detect doctored regions we use altered demosaicing patterns created during doctoring process. In this technique, pattern number estimation, CFA based noise analysis and traces of demosaicing are used. The detected regions are indicated using dots on doctored regions(A. E. Dirik *et al*). In total we make the following contribution,

- We use demosaicing algorithm to identify the image, whether the image is doctored or authentic.
- We consider Non-linearities in authentic during doctoring process.
- Calculate MSE (mean square error) values of interpolated doctored image.
- Ratio of interpolated and non-interpolated doctored images.
- We implement these frameworks on three most common types of doctoring process i.e. spliced, cloned and retouched images.

2. Description of Features

We assume that altering an image changes the correlation between and within bit planes. Therefore the quantal-

*Corresponding author: **Lalitha M**

spatial correlation between the bit planes of the original image will differ from that of the bit planes of the doctored images. Consequently certain statistical features extracted from the bit planes of image can be instrumental in revealing the presence of image manipulations.

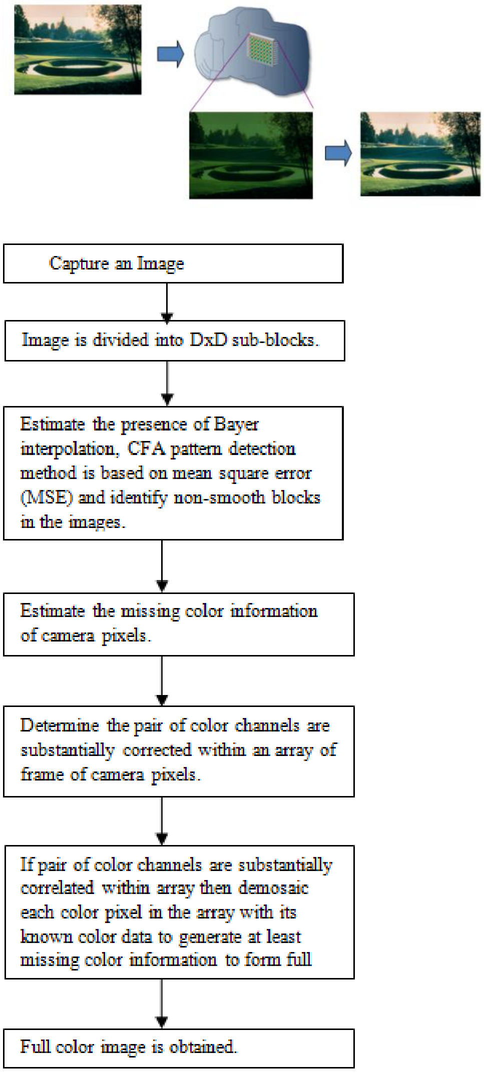

Fig: Flow chart is flow of operation

Features used

To estimate the presence of Bayer interpolation, the image is divided into D × D sub-blocks. CFA pattern detection method is based on the mean square error (MSE) variations depending on different kind of demosaicing methods so mean square error is calculated. The non smooth blocks whose high frequency. Components energy (pixel values, standard deviation) is above a certain threshold are used solely. We choose the demosaicing algorithm, f, to be bilinear interpolation. We denoted each non-smooth block with Bi, where i =1, ...,N. N is the number of non smooth blocks in a given image. The corresponding re-interpolated blocks, using filter k, is denoted with ˆBi,k. Essentially,

ˆBi,k is computed as a convolution between the bilinear kernel and the re-sampled block Bi with the kth CFA pattern Mk. Denoted by

ˆBi,k = f(Bi,Mk), and k = 1, ..., 4. (A. E. Dirik *et al*)

The MSE error between the blocks B and ˆB is computed in non smooth regions all over the image as:

Ei(k,c)=1/D*D

$$\sum_{x=1}^{D}\sum_{y=1}^{D}(B1(x,y,c)-Bi,k(x,y,c))^2$$ (A. E. Dirik *et al*)

To detect the relative error distances between color channels, a new error matrix Ei(2) is created by normalizing all the rows of the Ei, as

$$Ei^2(k,c) = \frac{E(k,c)}{\sum_{l=1}^{3} Ei(k,l)}$$ 100*() , c = 1, ..., 3. (A. E. Dirik *et al*)

Due to the higher presence of green channel elements, most significant MSE variations due to different CFA patterns are observed in green channels. Therefore, the green channel column of the normalized error Ei , Vi(k), is used in extraction of some features which are directly correlated with CFA demosaicing operation. From Vi(k) vector, it is possible to get the index of CFA pattern which yields the minimum MSE, as P1(i) = argmink Vi(k). The pattern number which yields the second minimum MSE in the error matrix is stored in a separate P2 vector as well. Thus, another feature can be derived to capture the uniformity of Vi vector such as

$$P3(i) = \sum_{l=1}^{4} \left| Vi(l) - 25 \right|$$ (A. E. Dirik *et al*)

P1(i), P2(i), and P3(i) values are computed for all non smooth blocks. If the given image is interpolated with any demosaicing algorithm, histograms of P1, P2, and P3 should concentrate in particular values which can be consequently used to detect demosaicing operation. We have changed the threshold value which results in change in output of the result i.e. we get more accurate portion of doctored area.

In this paper, Pearson technique is used to determine the correlations in an image which may be original or doctored. Here, correlation is calculated between the successive rows or columns, to determine the non-dependencies between rows or columns, if the image is doctored. This process is repeated for three times, to calculate accurate correlations in an image. Correlation is a statistical technique that can show whether and how strongly pairs of variables are related.

We estimate the correlation pattern for the Fourier Transform of the estimated overall transfer function, ^H and calculate the deviation in the correlation pattern. The deviation in the correlation pattern is treated as a feature to distinguish the authentic image from a doctored image. We compute row wise correlation patterns and column-wise correlation patterns as,

CPRstep(i) = Corr(^H(i; :); ^H(i + step; :))

CPCstep(j) = Corr(^H(:; j); ^H(:; j + step))

where, CPRstep and CPCstep are the row-wise correlation patterns and the column-wise correlation patterns

Fig. 1 Real image result with graph

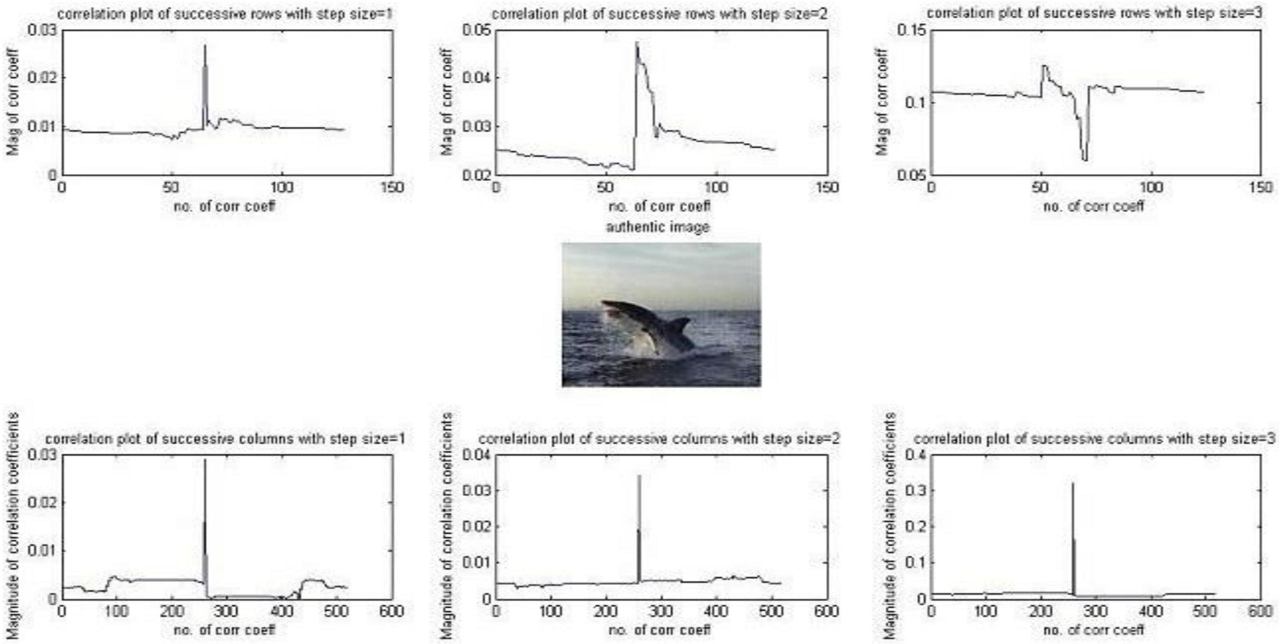

Fig. 2 Correlation graph

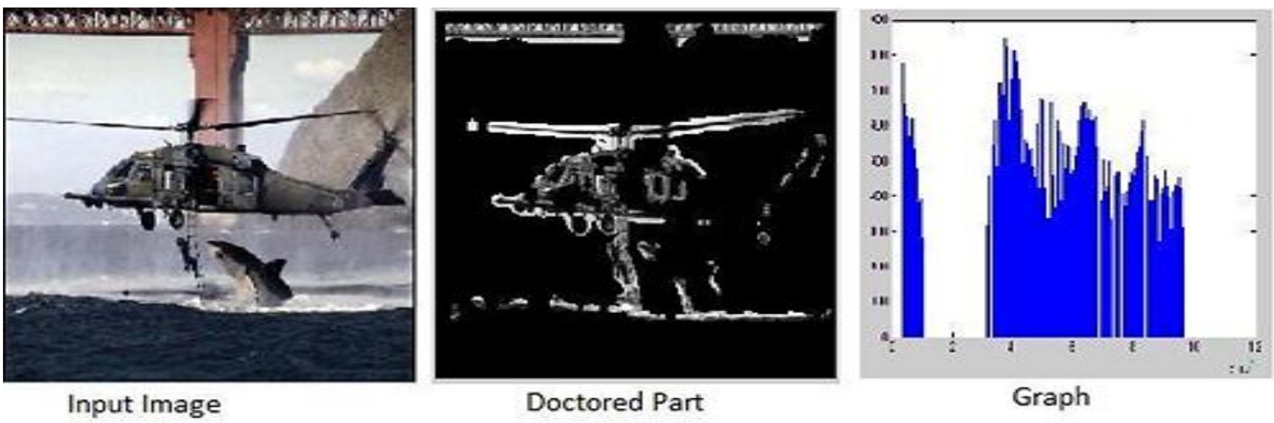

Fig. 3 Doctored image result with graph. (Highlighted part is doctored)

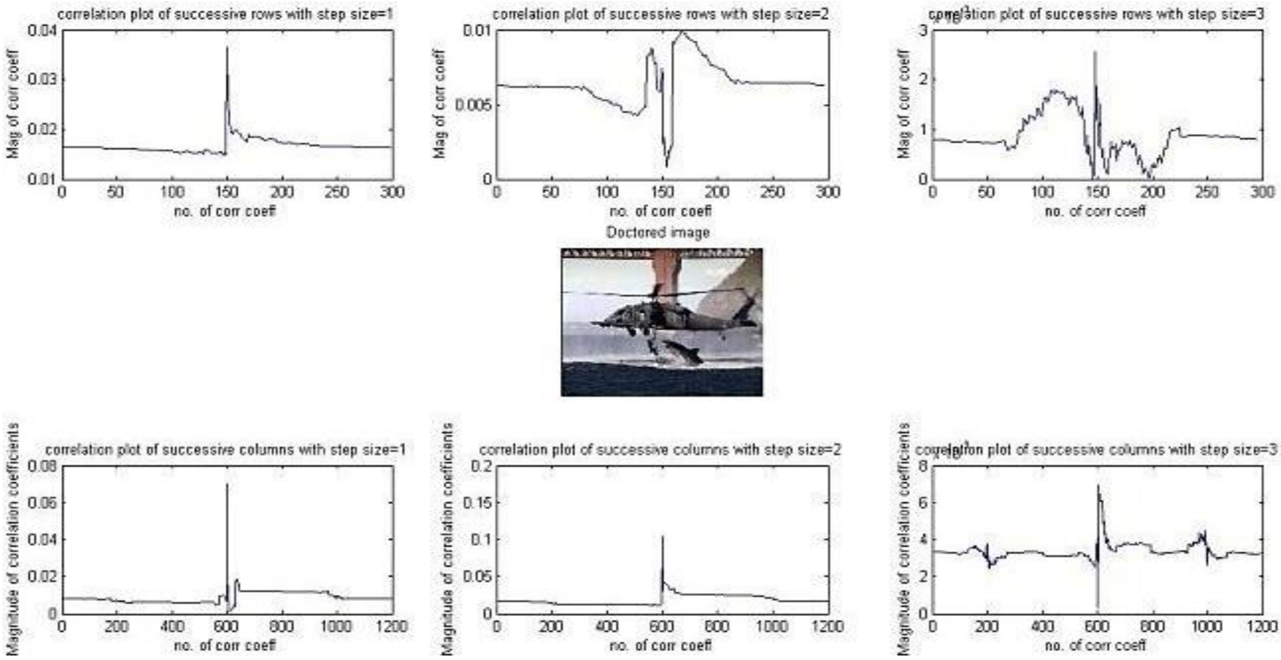

Fig. 4 Correlation graph

Fig. 5 Doctored image result with graph. (Highlighted part is doctored)

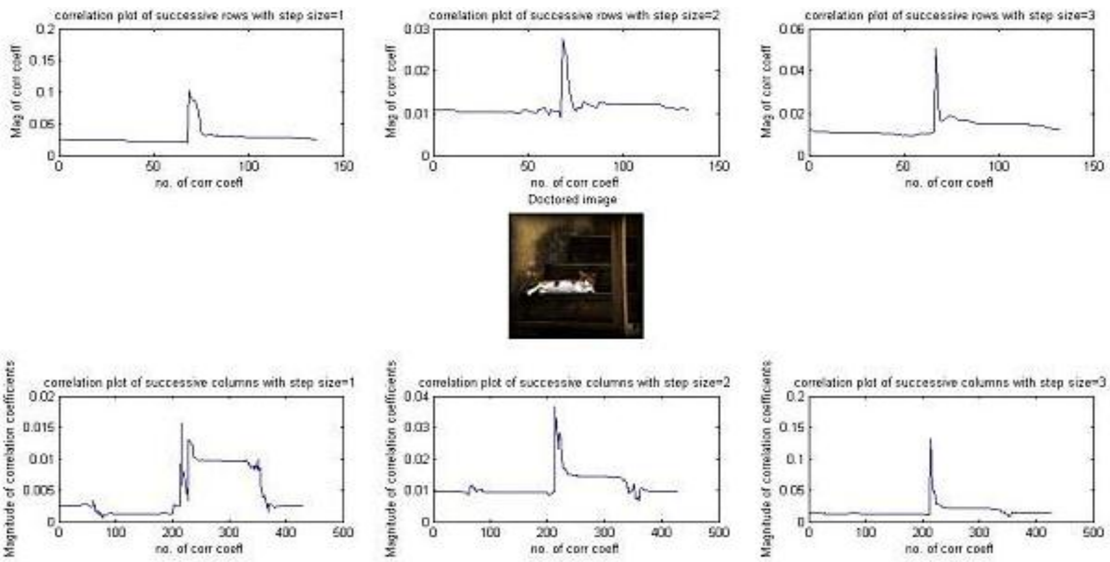

Fig. 6 Correlation graph

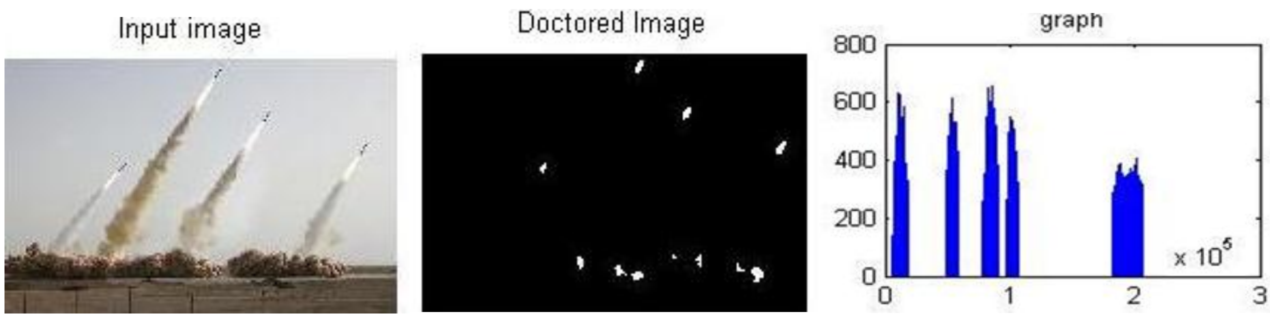

Fig. 7 Doctored image result with graph. (Highlighted part is doctored)

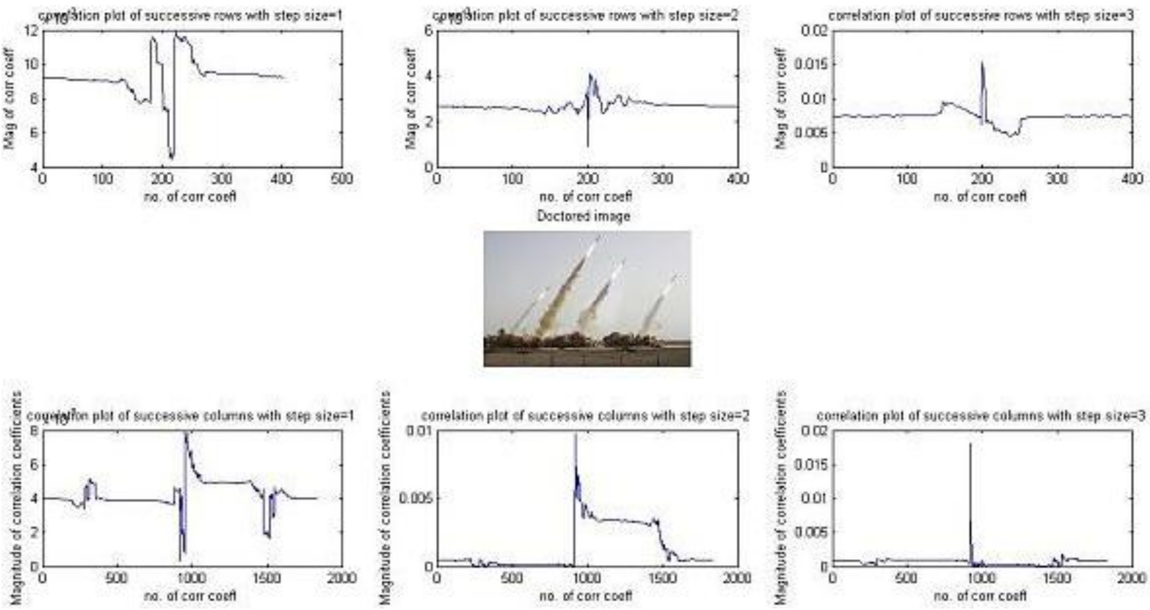

Fig. 8 Correlation graph

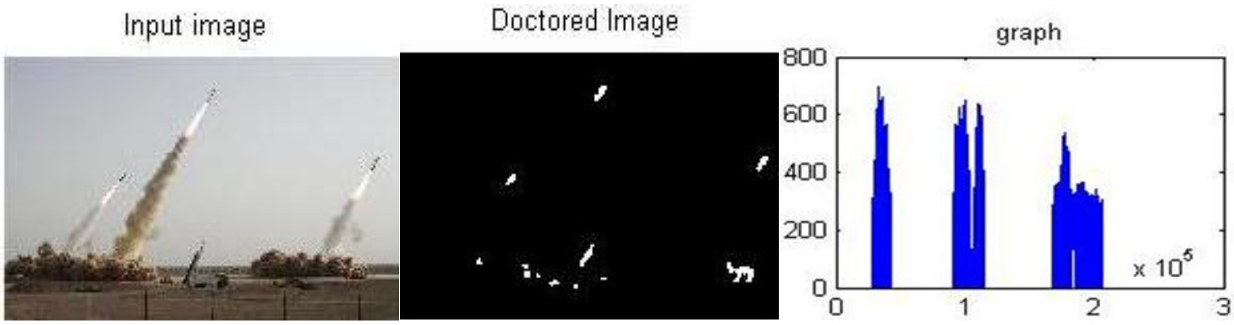

Fig. 9 Authentic image along with the graph

respectively, step = 1, 2 and 3, x is the number of rows, y is the number of columns, i = 1…..(x - 1) and j = 1…. (y - 1). The deviation of correlation pattern is more in doctored images.

We further generate the feature set by taking the deviation in the row-wise and the column-wise correlation patterns. The deviation in the row-wise correlation pattern for 3 different steps i.e the features Step-1, Step-2 and Step-3 and the deviation in the column-wise correlation pattern for 3 different steps i.e the features Step-1, Step-2 and Step-3 respectively. We also assume that the image intensity increases when an image undergoes doctoring.

3. Experiments

The Bayer features described above are expected to take relatively high values if the given image is obtained through a Bayer color filter array.

The graph in the above figures 3,5,7,9 show the portion of doctoring in an image with x –axis representing no. of pixels and y-axis representing pixel values. By looking into the graph we get to know the amount of doctoring in an image. The straight line in the graph in fig 1. shows that there is no doctoring done for that image.

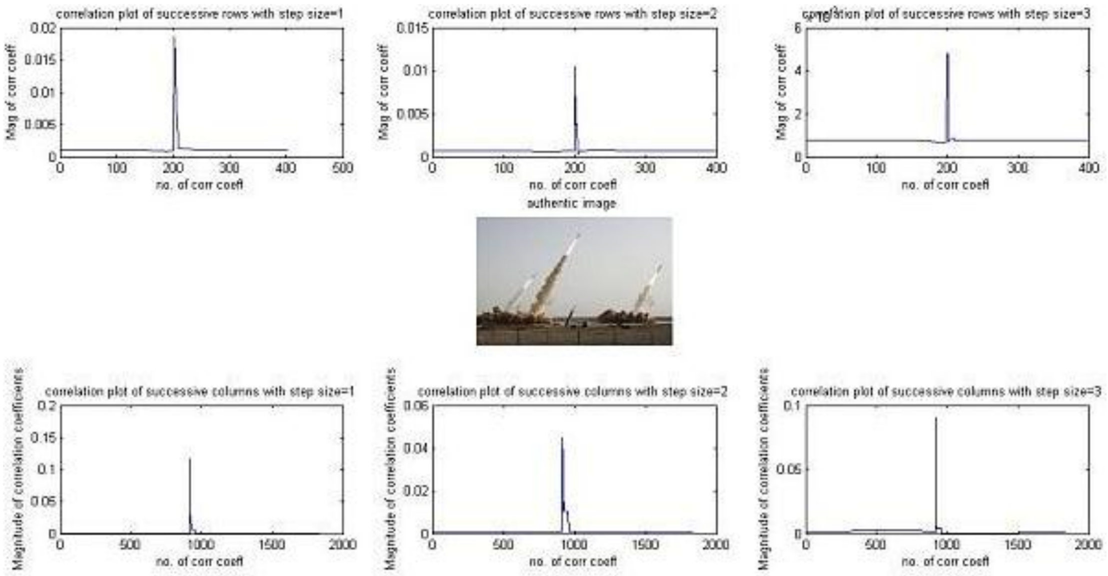

Fig. 10 Correlation graph

4. Results and Discussions

We demonstrate proposed demosaicing for spliced, cloned and retouched images with the feature set. In all the mentioned cases, we consider a group of authentic images and a group of the particular doctored images.

Our image dataset consists of a total of 800 images, comprising of authentic images and doctored images (cloned images, retouched images and spliced images). We obtained an overall average accuracy of 78.03% for spliced set, 80.13% for cloned set and 80.33% for retouched set.

Conclusion

In this paper we have addressed the matter of detection of image doctoring victimization using demosaicing. We have analyzed the detection of doctoring for spliced, cloned and retouched doctored images. There are many methods to detect doctored images but the method which we have proposed i.e Detection of doctored image using demosaicing is the good method which gives better result when compared to other methods. Hence the results obtained are shown above. Here we have used correlation plot, which best depicts the results of images with clear analysis of doctoring in the image and we can easily identify whether the image is doctored or authentic from correlation pattern. We have already tested for about 800 images, results are also obtained for the same and are saved in database.

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