# A Novel Approach Of Image Forgery Detection Using Lateral Chromatic Aberration

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***Abstract-*** In image forgeries the image data is copied and changes done in image structure, inconsistencies in an imaging feature called lateral chromatic aberration (LCA). A new method for detecting forged image regions to identify localized LCA inconsistencies. This proposed method has a new statistical model that shows the inconsistency between global and local estimates of LCA. Using an efficient LCA estimation algorithm, we implement a block matching algorithm called diamond search. It efficiently measures the LCA in a localized regions and performs with different experiments, characterize the effect of up sampling factor and forgery size on forgery detection. Calculates the performance with standard systems to reduce estimation time.

**Keywords-** Lateral Chromatic Aberration, Forgery Detection, Efficient Block Matching.

## 1. INTRODUCTION

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In Digital image forgery the identification of a forged image is essential for originality and to preserve truthfulness of the image. Image forgery detection had gain more attention and incredible investigation in various fields such as computer visualization, image processing, biomedical tools, immoral analysis, image forensics, etc. The, image forensic has found a way to identify these forgeries to avoid the illegal issues. Numerous techniques are utilized to recognize the forged images but still there is a need to be more focus on accuracy and time complexity[1].Forgery detection technique uses lateral chromatic aberration (LCA) as imaging feature to detect image regions that was copy-paste or copy-move type manipulations. Forgeries are detected by comparing the inconsistencies in local and global observations of LCA displacement vectors. This method classifies in two distributions;

(1) LCA inconsistency in original image regions, has a random noise variable that is Gaussian, which identical distributed with near-zero mean and independent.

(2) The distribution describes LCA in forged regions with related assumed properties and with a forgery related bias.

In local LCA estimation algorithm it reduces the number of similar calculations performed in the displacement search and done by implementing LCA algorithm optimized for Moving Picture Experts Group (MPEG) motion-vector estimation [3], called the diamond search. It show that our LCA estimation algorithm achieves two orders of magnitude time-efficiency gains, less execution time without introducing additional estimation error and characterize the affect of forgery size on detection performance. This algorithm improves the run-time performance of LCA forgery detection for all types of image formats, document and compares the performance with standard systems allowing to conduct large scale investigations on a reasonable time scale.

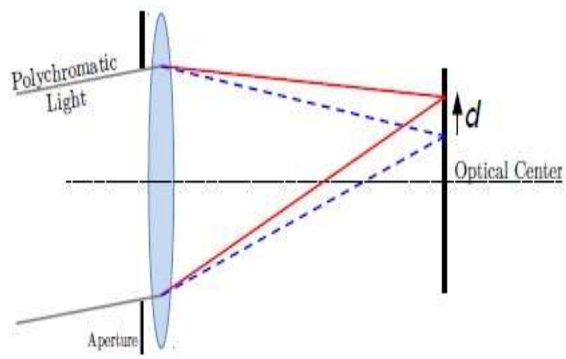


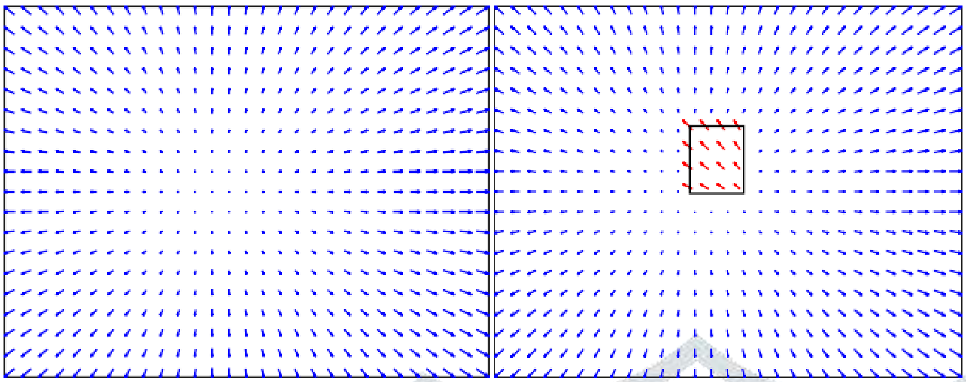

Fig.1.Ray diagram of lateral chromatic aberration. Two rays of polychromatic light from a single point source.

Lateral chromatic aberration is a phenomenon that occurs in optical imaging systems. An example of how LCA manifests in an image is shown in Fig(1). Since the angle of refraction is also dependent on a light ray's angle of incidence with the lens, the distance between the focal locations for different wavelengths of light becomes greater as the distance from the optical center increases. Due to a lens's inability to focus all wavelengths of a single light ray to a single location on a sensor and, as a result, the focal locations of different wavelengths are surface parallel from each other in the image [10]. The focal location of the red channel is laterally offset from the focal location of the blue channel by displacement vector **d**. These displacements are often invisible to the human eye, but can be measured computationally.

## 2. PROPOSED MODEL

In forgery image detection using lateral chromatic aberration the proposed method solve the inconsistencies global and local estimations of lateral chromatic aberration. In existing methods to detect an forged region in image uses block discrimination and object to object types. So, it takes more time for execution with less accurate result. The new approach of our proposed system analyzes the issues of identifying the forgery image and detection of forgery size. Calculates the standard system performance of local and global aberration values and relative speed with the existing methods and improve the performance of the system.

### 2.1 PRE-PROCESSING:



(A) Original Image (B) Forged Image

Figure 2: Lateral chromatic aberration (LCA) displacement fields

A distinct patterning is observed with all displacement vectors pointing radially outward from the image optical center, growing in magnitude as distance from the optical center increases. An example of an authentic image's LCA displacement vector field is shown in The LCA displacement in the forged region (in red) is inconsistent with the LCA in the rest of the image. Using the absolute angular difference between a LCA displacement determined locally to a displacement determined by the global model as a forgery detection feature [11].

$$\emptyset = \frac{1}{N}\sum^{N} |< \hat{d}(r_i) - < d(r_i, \theta^*)|_{i=1}$$

Where the N local displacement estimates, dˆ(ri), and global displacement estimates, N is the number of corner points found in the region. d(ri , θ ∗ ), are at corresponding points, ri , in a region of interest for i∈ {1, . . , N}. The other types of chromatic aberrations can be found in digital images including axial chromatic aberration and purple fringing aberration. Purple fringing aberration (PFA) is another type of chromatic aberration and is used in [7] as a feature for forgery detection. PFA appears as blue-purple halos around edges of objects in an image. Only considered optically induced lateral chromatic aberrations as a feature for forgery detection.

### 2.2.ACCURATE FORGERY DETECTION

In Lateral Chromatic Aberration based forgery detection on a larger dataset and a diverse set of imaging scenarios, characterizes the forged size and compares the performance of standard systems with proposed block matching algorithm called diamond search pattern. This method utilizing a subset of all possible displacements and increases time efficiency. Diamond search measures between color channel [3] block with the comparison block by Non-local means approach it segments the image into many small non-overlapping pixels through entire corners within image. Using lateral chromatic aberration it calculates the global and local features, detects the inconsistencies for the forged region. Mark the forged region of digital image. This method supports for all image formats and documents to find the forged areas with accuracy and less computational time.

In this approach the LCA of local estimates deviate from global LCA model of image. Using the average absolute angular differences between local and global displacement vectors for inconsistencies. It performs global and local features of LCA checks the inconsistencies and shows the forged regions by performing diamond search pattern shows the enhanced forged region. when image content originates from a location the near the image optical center, an angular error metric is unable to render a decision on it. This is because LCA at locations near the optical center is small and so local displacements have zero-magnitude when near the optical center. Local displacement estimates with zero magnitude have undefined angle. Thus, when forged image content is sourced from near the image optical center, angle based detectors are unable to make a decision.

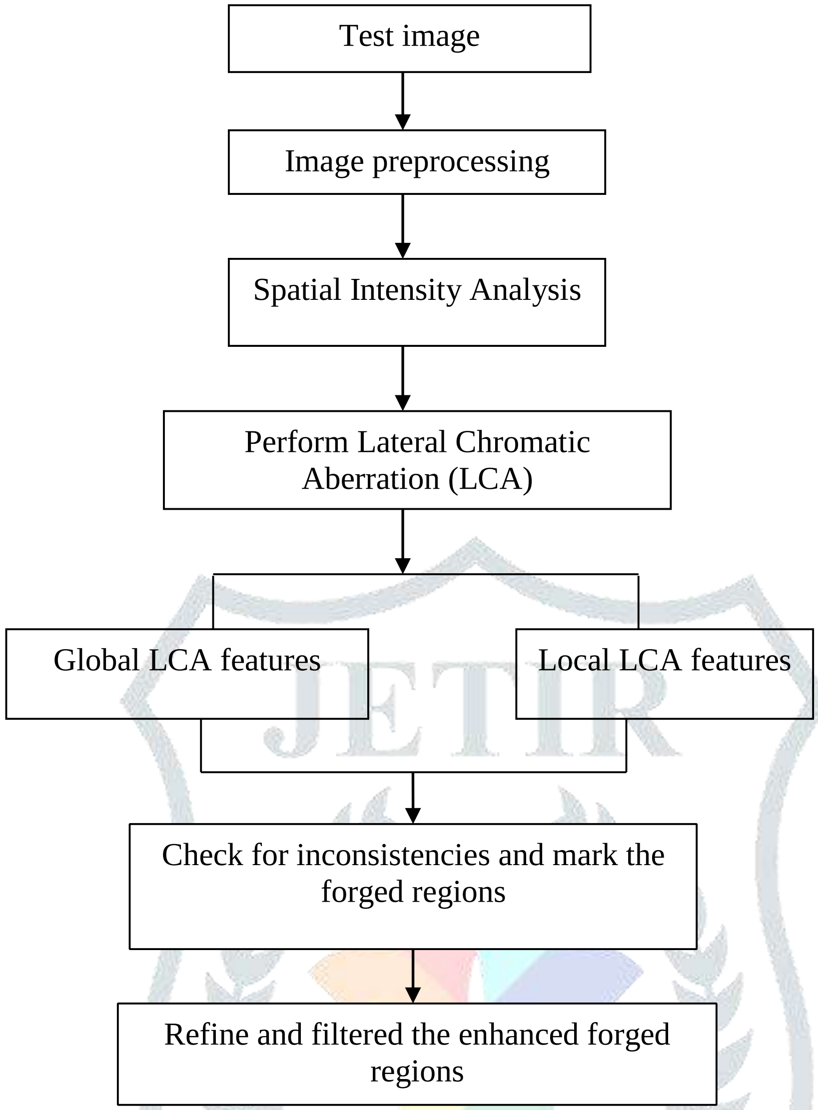



Figure 3: Procedure for detecting forgery system

**2.3 ESTIMATION OF LCA INCONSISTENCIES**:

In this approach, we first observe that local LCA estimates noisily fit the global model estimate. This can be seen in Fig. 4 which shows the local LCA displacement field for a forged image, as well as the global model. The local LCA displacement estimates fit, but do not exactly match, the global LCA model. We propose a new model that captures this inconsistency between local and global LCA with two possible distributions; one for inconsistency in authentic regions and the other for forged regions.

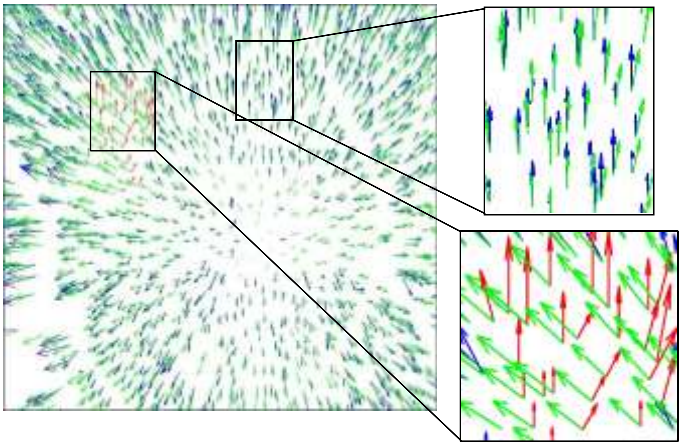


Figure 4: Lateral chromatic aberration displacement field in a forged image Global model (green), local estimates in authentic regions (blue), and local estimates in forged regions (red).

From the above figure top right inset highlights that authentic local estimates noisily approximate the global model, whereas the local estimates in a forged region, as in the bottom right inset, are additionally biased by a forgery related offset. local estimates of lateral chromatic aberration displacement can be viewed as noisy approximations of the global model. In this figure, the local estimates in the authentic regions closely approximate the global model, and any inconsistency between the global model and authentic local estimates we attribute to observational noise. This observational noise arises from the discrete and quantized nature of the local estimation method, compression artifacts, other chromatic aberration artifacts like purple fringing aberrations, as well as scene-dependent biases. Our proposed a new model that incorporates a model mismatch term, **n** = (*nx; ny*)T that, when added to the scaled reference location of the global model, captures the discrepancy between a local estimate of LCA to the global model.

$$d(r) = \alpha(r \hat{+} n - \zeta) + \zeta - r$$

Where ^ **d**(**r**) is the local estimate for LCA displacement at pixel location **r** in the reference color channel, determined by our proposed estimation method. Thus, calculate the intensity of image pixels in one block and compares with other block perform sampling factor with different image sizes and shows 5 aberrated regions.

## 3. RESULTS AND DISCUSSION:

Performing the image forgery detection in digital images using lateral chromatic aberration with accuracy.
The results are shown using MATLAB version R2016.

Figure 5: Test image for forgery detection

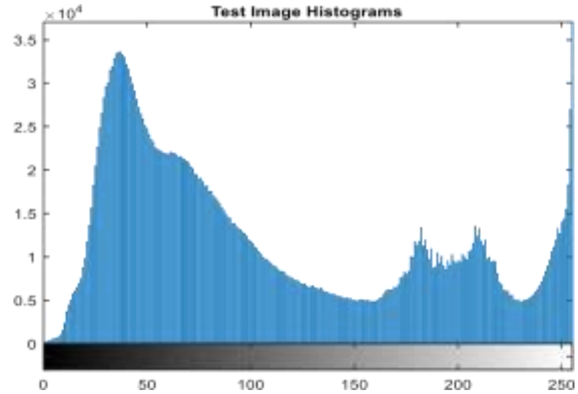



Figure 6: Test image histogram

Figure 7: Refined and filtered inconsistent image region

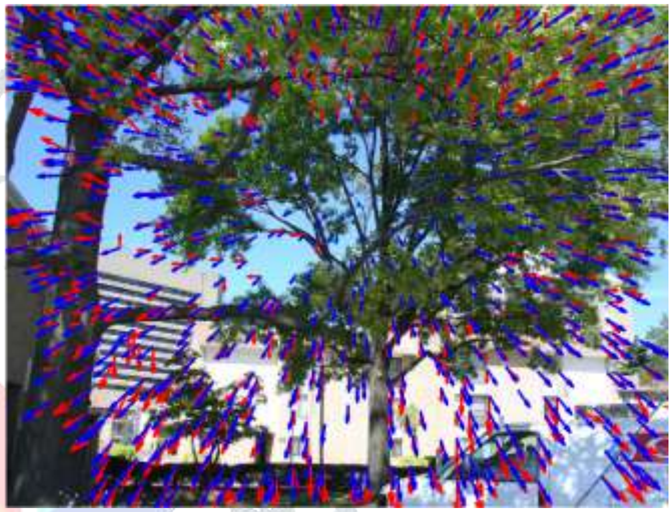


Figure 8: Detected Global and Local aberrative features

Fig 7,8 shows the detected inconsistencies in digital image using lateral chromatic aberration. Local estimates in authentic region shows in (blue), in forged regions (red).

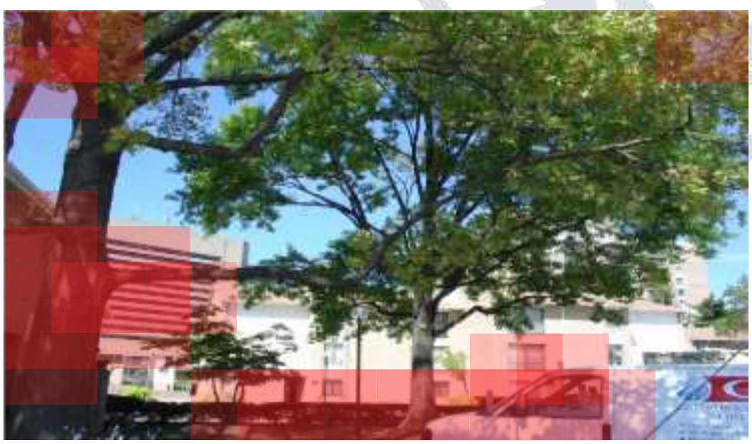


Figure 9: Final Detected manipulated regions in the image.

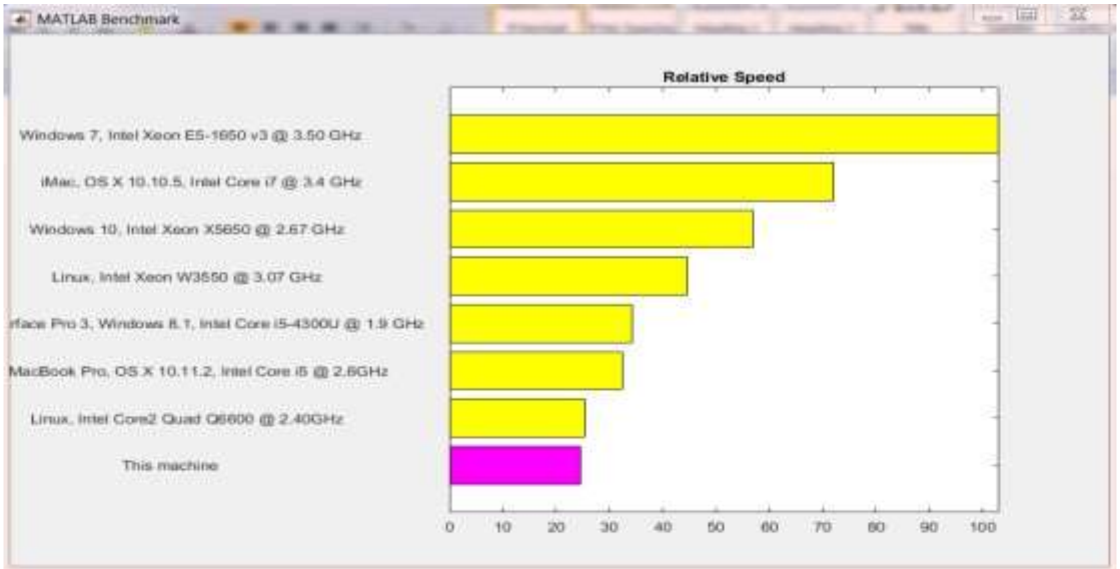



Figure 10: Performance of the proposed system compared with the benchmark techniques.

The forged areas are shown in the above fig 9,10 and the detection performance is calculated and compared with other standard systems to improve the efficiency of detection.

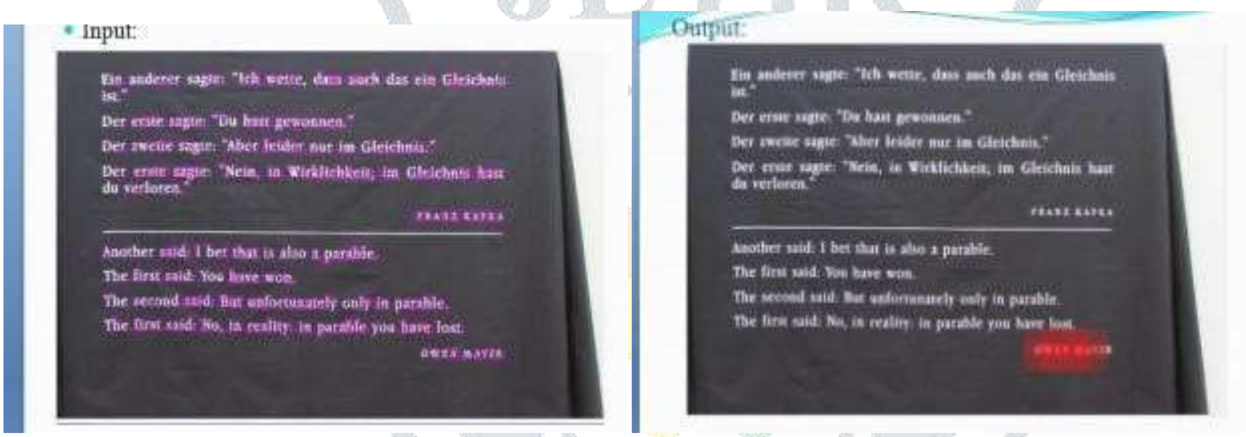



Figure 11: Detected the forged region in the texted image.

```
Mean Overall Aberration:0.005206
Min Overall Aberration:0.764193
Max Overall Aberration:0.464496
Variated Overall Aberration:0.009448
Mean Local Aberration:1090.390395
Min Local Aberration:39.000000
Max Local Aberration:2009.000000
Variated Local Aberration:285585.181855
Mean Global Aberration:711.580856
Min Global Aberration:39.000000
Max Global Aberration:1497.000000
Variated Global Aberration:176826.391908
Elapsed time is 3.358483 seconds.
```

Figure 12: The aberration values of local and global with the estimation time.

MATLAB Benchmark (times in seconds)

| Computer Type | LU | FFT | ODE | Sparse | 2-D | 3-D |
|---|---|---|---|---|---|---|
| Windows 7, Intel Xeon E5-1650 v3 @ 3.50 GHz | 0.1228 | 0.1090 | 0.0615 | 0.0887 | 0.1966 | 0.2270 |
| iMac, OS X 10.10.5, Intel Core i7 @ 3.4 GHz | 0.1425 | 0.1444 | 0.1041 | 0.1102 | 0.3964 | 0.3219 |
| Windows 10, Intel Xeon X5650 @ 2.67 GHz | 0.2560 | 0.1809 | 0.1112 | 0.1490 | 0.4603 | 0.3478 |
| Linux, Intel Xeon W3550 @ 3.07 GHz | 0.2528 | 0.1790 | 0.1762 | 0.1540 | 0.6825 | 0.6712 |
| Surface Pro 3, Windows 8.1, Intel Core i5-4300U @ 1.9 GHz | 0.4704 | 0.2599 | 0.1365 | 0.2163 | 0.9987 | 0.8042 |
| MacBook Pro, OS X 10.11.2, Intel Core i5 @ 2.6GHz | 0.2472 | 0.1862 | 0.0760 | 0.1217 | 2.0229 | 1.7001 |
| Linux, Intel Core2 Quad Q6600 @ 2.40GHz | 0.6738 | 0.4044 | 0.2202 | 0.3244 | 0.9605 | 0.8179 |
| This machine | 0.5848 | 0.3840 | 0.2257 | 0.3320 | 1.2400 | 1.0077 |

Place the cursor near a computer name for system and version details. Before using this data to compare different versions of MATLAB, or to download an updated timing data file, see the help for the bench function by typing "help bench" at the MATLAB prompt.

Figure 13: Statistical comparison of the performance of the proposed system with standard systems.

The above results shows the detected forged image regions, Global and local regions inconsistencies in lateral chromatic aberration. It calculates global and local mean and variated aberration values. Performs detection for images and documents and compares the system performance for accuracy and estimation time.

## 4. CONCLUSIONS

In this paper proposed a method to detect forged image regions using inconsistencies in lateral chromatic aberration. Our methodology overcomes significant deficiencies of previous methods, when local estimates of LCA are inconsistent in magnitude only and not angle. By conducting a series of experiments that characterize the effect of up sample factor and forgery size on forgery detection performance and calculating the local and global aberration values. It improves the efficient performance of detecting with standard systems and reduces estimation time.

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