Fast Exploration of Copy-Move Forgery Image

Yong-Dal Shin

Dept. of Information Communication & Securities, Asan Campus Youngdong University
52-70 Younamsan-ro Dongam-ri Eumbong-myon Asan-city Choongnam, Korea
ydshin@yd.ac.kr

Abstract. In this paper, we proposed fast exploration method of copy-move forgery image. We proposed a new simple search algorithm using a half block size for copy-moved forgery image detection. Our algorithm reduced computational complexity more than conventional algorithms. We didn’t use 8x8 pixel block exhaustive search method and frequency algorithm to reduce computational complexity in this paper.

Keywords: copy-move forgery image, fast exploration

1 Introduction

Recently, advanced high resolution digital cameras and photo editing software packages such as Photoshop, Paintshop Pro software, make it relatively easy to create digital forgery image [1-4]. Also, various watermark techniques have been proposed in recently years, which can be used not only for authentication, but also for being an evidence for the tamper detection [1-6].

Fig. 1. Example of Copy-Move forgery (a) original image (b) tampered image

A common form of digital tampering is copy-move forgery, in which a part of the image itself is copied and pasted into another part of the same image to conceal an important object [7]. From figure 1, the original image is a figure 1(a) and the forgery image is a figure 1 (b). J. Fridrich [1] proposed exact match for detection and an effective blocking approach, in which the image blocks are represented by quantized discrete cosine transform coefficients, and a lexicographic sort is adopted to detect the
Copy-Move blocks [1]. A. C. Popescu [2] worked by applying a principal component analysis (PCA) on small fixed size image blocks to yield a reduced dimension representation.

In most methods of copy-move forgery detection, suppose a detected image of size $N \times N$ is divided into $(N-B+1)^2$ overlapping blocks of size $B \times B$ [6]. Copy-move forgery image detection methods is demanded huge computation of the exhaustive search method in the spatial domain [1], also demanded computational complexity in the frequency domain such as discrete cosine transform (DCT) and wavelet transform [1, 4, 7, 8].

Shin [8-9] worked by three step search and DCT algorithm to reduce computation complexity.

In this paper, we proposed a fast detection method of copy-move forgery image using a quarter block size to reduce computational complexity in the spatial domain. We proposed a new fast algorithm for copy-moved forgery image detection. Our algorithm reduced computational complexity more than conventional algorithms. We didn’t use exhaustive search method and frequency to reduce computational complexity in this paper.

2 The proposed method

The conventional copy-move forgery image detection methods are demanded huge computation of exhaustive search method in the spatial domain [1].

In this paper, we proposed fast detection method of copy-move forgery image using shading 16 pixels of 8x8 pixel block in the spatial domain. We need shading 4x4 pixel block instead of 8x8 pixel block search regions to reduce compute complexity more than conventional methods.

![Fig. 2. 4x4 pixel block search area](image)

We used block distortion measure (BDM) for matching criterion (MC) of copy-moved forgery image detection. The BDM expressed equation (1).

$$\text{BDM} = \sum |I(i, j) - I(i+x, i+y)|$$  \hspace{1cm} (1)
where, \( I_{(i, j)} \) is gray level of 8x8 pixel block at the position \((i, j)\) of reference region image, the \(i\) and \(j=0,1,2,3,\ldots,N-B+1\). The position \(i\) and \(j\) are shifted one pixel vertical and horizontal of the image from 0 to N-B+1. In the matching search area, \(ii=0,1,2,3\) and \(jj=0,1,2,3\). The position \(x\) and \(y\) are shifted one pixel vertical and horizontal of the image from 0 to N-B+1 overlapping blocks in the copy-moved forgery search regions.

The BDM is summation of difference between gray level of reference image block and copy-move forgery search regions.

We used a matching criterion of copy-moved forgery image detection. The matching criterion expressed eq. (2).

\[
\text{If } (\text{BDM} == 0) \\
\quad \text{Copy-moved forgery block} \\
\text{Else} \\
\quad \text{Not copy-moved forgery block}
\]

From equation (2), if the BDM were 0, the block is a copy-moved forgery block. This means that the copied block image is same moved block image. If the BDM were not 0, the block is not copy-move forgery block. This means that the copied block image is different from moved block image. The flow chart of proposed method shows figure 3.

The proposed method reduced computational complexity because it doesn’t frequency domain such as discrete cosine transform and wavelet transform. In order to search the copy-moved forgery image blocks, we require 16 pixels computation complexity to match duplicated pairs images.

### 3 Experimental Results

We proposed fast method to explore copy-moved forgery image using 4x4 pixels block in the spatial domain to reduce computational complexity more than conventional methods.

The test image is a Bridge 8 bits and 256x256 pixels. We tampered a test image by copy-moved forgery image. The copy-moved forgery image search regions of test image are shifted by one pixel from the upper left corner \(I(0,0)\) to the lower right corner \(I(N-B+1, N-B+1)\) overlapping blocks. The BDM of copy-moved forgery image detection used equation (2) based on half block size search algorithm. From equation (2), if the BDM were 0, the block is a copy-moved forgery block. This means that the copied block image is same moved block image. If the BDM were not 0, the block is not copy-moved forgery block. This means that the copied block image is different from moved block image.

In this paper, the search algorithm need 16 pixels checking points for 8x8 pixel block. The BDM of the search algorithm is sufficient by 16 pixels checking points instead of 64 pixels for exhaustive search.
Fig. 3. The flow chart of the proposed method

The table 1 shows computational complexity results of the proposed method and conventional methods for Bridge image. The criterion for computation complexity was used 100% by references [1]. From table 1, the proposed method reduced 75% of computational complexity more than exhaustive search [1]. The figure 4 showed original images, copy-move forgery image, detection of copy-move forgery image. The Bridge image of the figure 4(c), the left black box is original copied image block, the right black box is moved forgery image block.

4 Conclusions

In this paper, we proposed fast detection method of copy-move forgery image using a half block size in the spatial domain. We proposed fast algorithm for copy-moved forgery image detection. Our algorithm reduced computational complexity more than conventional algorithms. We didn’t use exhaustive search method and frequency domain (ex. DCT, Wavelet Transform) to reduce computational complexity in this paper.

Table 1. Comparison results of other methods for Bridge image

<table>
<thead>
<tr>
<th>Algorithms</th>
<th>Image representation</th>
<th>Block size</th>
<th>Block number</th>
<th>Feature dimension</th>
<th>Computation complexity (reference [1])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhaustive search</td>
<td>Gray level</td>
<td>8x8</td>
<td>(256 – 8 + 1)^2</td>
<td>64</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Fridrich [1] DCT 8x8 \((256 - 8 + 1)^2\) 64 100.0%
Popescu [2] PCA 8x8 \((256 - 8 + 1)^2\) 32 50.0%
Proposed method Gray level 8x8 \((256 - 8 + 1)^2\) 16 25.0%

![Original Image](a) | Copy-move forgery (b) | Detection copy-move forgery (c)

Fig. 4. Bridge image

References