

MATLAB Algorithms for Rapid Detection and Embedding of Palindrome and Emordnilap Electronic Watermarks in Simulated Chemical and Biological Image Data

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Abstract

Electronic watermarks are used everyday to protect copyrighted materials on the web. But watermarks can also be used to inform the viewer of data (such as photographs and images) as to important aspects of the image such as ownership, location and environmental conditions during the image's creation.

This paper examines the use of palindrome images, images in which the data can be flipped in the left-right direction and leave the image untouched. This is similar to words such as RADAR which when flipped left right is still RADAR. An emordnilap image forms a totally different images when flipped. This is similar to words such as STOP which when flipped left right gives the new word POTS. Emordnilap is palindrome spelled backwards. This paper explores the use of MATLAB algorithms in the rapid detection and embedding of palindrome and emordnilap electronic watermarks in simulated chemical and biological Image Data

Introduction

Watermarking Materials

Electronic watermarks are used everyday to protect copyrighted materials on the web. But watermarks can also be used to inform the viewer of data (such as photographs and images) as to important aspects of the image such as ownership, location and environmental conditions during the image's creation.

This paper examines the use of palindrome images, images in which the data can be flipped in the left-right direction and leave the image untouched. This is similar to words such as RADAR which when flipped left right is still RADAR. An emordnilap image forms a totally different images when flipped. This is similar to words such as STOP which when flipped left right gives the new word POTS. Emordnilap is palindrome spelled backwards. This paper explores the use of MATLAB algorithms in the rapid detection and embedding of palindrome and emordnilap electronic watermarks in simulated chemical and biological Image Data

Objective

The standard approach (Ref 2-4) to watermarking involves putting the cover image in the first 4 significant bits of each pixel and the watermarked image in four least significant bits. Most watermarking tools look for this pattern. But a new class of image has come to our attention called "palindrome and emordnilap". This new type of image may be causing some watermarking detection tools to miss their target.

Data

Photograph of building credit:

Post Office and Custom House, Battery Street, San Francisco

CALL NUMBER: LOT 3544-37, no. 138 [item] [P&P]

Find any corresponding online LOT(group) record

REPRODUCTION NUMBER: LC-USZ62-27229 (b&w film copy neg.)

Method and Results

Matlab code is give in table marked program 1 and program 2. This is the code that extracts the lower and upper bits in each image and recombines them into the palindrome image and the watermark

Step by step details of the process are given on page 3.

Conclusions

1. Palindrome and Emordnilap watermarking is possible in copyrighted and non copyrighted materials
2. Since they are easily detected and removed Palindrome and Emordnilap watermarks are **probably** not the best of ways to watermark the rightful owner's signature showing that this material is his copyrighted work
- 3 Palindrome and Emordnilap Watermarked images are easily detected and decoded
4. The Matlab code can easily be paralleled on multiple computers. One computer per image.

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Acknowledgements

General Reference

A very good online web reference on Watermarking

1) Fabien A. P. Petitcolas The information embedding homepage: digital watermarking [http:// www.petitcolas.net/ fabien/ steganography/](http://www.petitcolas.net/fabien/steganography/) email: fapp2@cl.cam.ac.uk

References

Watermarking Copyrighted Materials

- 1) Will Knight, "Massive search reveals no secret code in web images", NewScientist article online @ <http://www.newscientist.com/news/news.jsp?id=ns99991340>, 25 Sept 01
- 2) Gray, Rich, "On the Edge: Hidden in Plain Sight Special to SPACE.com", 01 July 2003 online @ http://www.space.com/businesstechnology/technology/ontheedge_0307.html
- 3) Weeks, Kevin D., "Hiding in plain sight", online on the web at [http:// community.borland.com/article/0,1410,20586,00.html](http://community.borland.com/article/0,1410,20586,00.html), also see <http://www.jjtc.com/stegdoc/stegdoc.html>
- 4) Katzenbeisser, Stefan; Petitcolas, Fabien A. P. editors, "Information Hiding Techniques for Digital Watermarking", Artech House Books, January 2000. ISBN 1-58053-035-4, Hardcover, approx. 220 pages

Program 2

MATLAB code to display watermarked images

watermark_flip_display.m

```
function y= watermark_flip_display (watermark_image)
%show that images are palindromes and emordnilaps
image(watermark_image/255) %divide image by 255
axis image % set axis of figure
title('orginal image') % title
figure(gcf) % pick current figure window
pause % pause
```

```
[I,J,K]=size(watermark_image); % save dimentionions of image
watermark_image=dec2bin(watermark_image,8); % change to 8 bit
binary
watermark_image=flipplr(watermark_image); % flip matrix left to right
watermark_image=bin2dec(watermark_image); % change to decimal
watermark_image=reshape(watermark_image,I,J,K); %reshape to
image size
image(watermark_image/255) % display image
axis image % pick axis and image shape
title('flipped image') % title after flipped left right
figure(gcf) % pick the most current figure window
```

Program 1. Matlab Code for watermark_test.m M file

```
a=double(imread('custom_a.jpg')); %load in image one
b=double(imread('custom_b.jpg')); %load in image two
```

```
[I,J,K]=size(a); % save dimentionions of both images
% both images used as input are the same size
```

```
a=dec2bin(a,8); % change a into binary 8 bits
b=dec2bin(b,8); % change b into binary 8 bits
```

```
a=a(:,1:4); % keep the 4 high bits MSB most sig bits
b=b(:,1:4); % keep the 4 high bits LSB least sig bits
a_flip=flipplr(a); % flip the matrix left-right
b_flip=flipplr(b); % flip the matrix left-right
```

```
a_a=[a,a_flip]; % make a palindrome matrix of just a
b_b=[b,b_flip]; % make a palindrome matrix of just b
a_b=[a,b_flip]; % make a emordnilap matrix a with a
%watermark of b
```

```
a_a=bin2dec(a_a); % change a_a from binary to decimal
b_b=bin2dec(b_b); % change a_a from binary to decimal
a_b=bin2dec(a_b); % change a_b from binary to decimal
```

```
a_a=reshape(a_a,I,J,K); % reshape to look like a picture
b_b=reshape(b_b,I,J,K); % reshape to look like a picture
a_b=reshape(a_b,I,J,K); % reshape to look like a picture
```

```
watermark_flip_display(a_a) % show orginal & flipped same
pause % pause
watermark_flip_display(b_b) % show orginal & flipped same
pause % pause
watermark_flip_display(a_b) % orginal & flipped different
```

Step by Step description of process for making Palindrome watermark

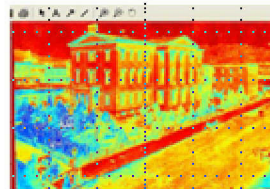
IR Image of House
Data Decimal & Binary

53 = 00110101
78 = 01001110
100 = 01100100
75 = 01001011
47 = 00101111
7 = 00000111
11 = 00001011
52 = 00110100
38 = 00100110
5 = 00000101

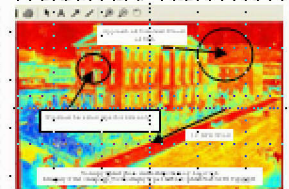
Annotation Watermark
Data Decimal & Binary

23 = 00010111
78 = 01001110
100 = 01100100
17 = 00010001
10 = 00001010
38 = 00100110
11 = 00001011
21 = 00010101
92 = 01011100
68 = 01000100

A Sample of Data from Each Image

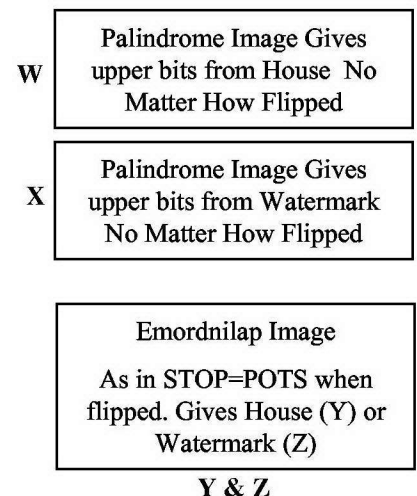
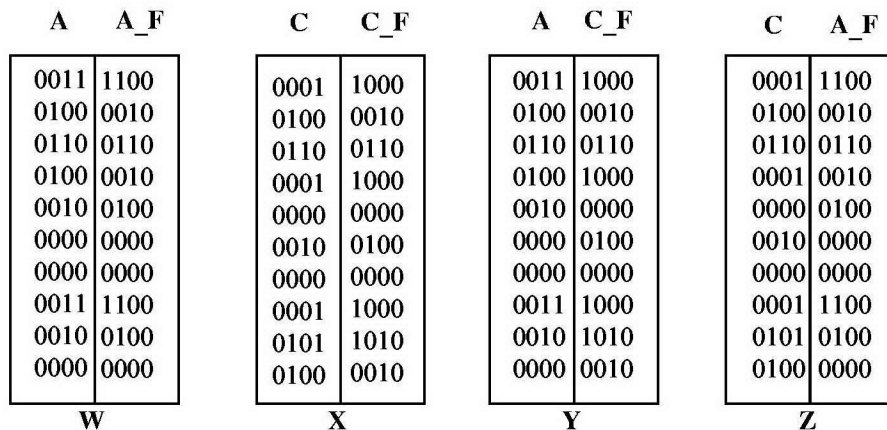
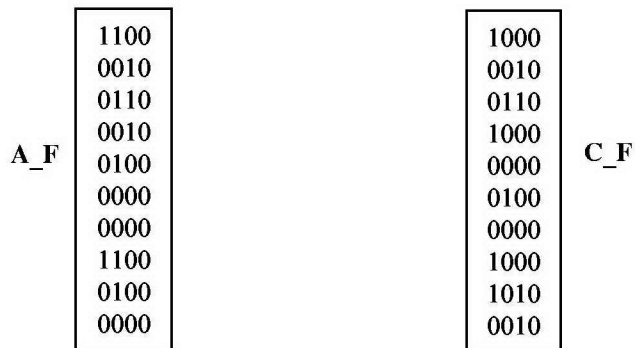
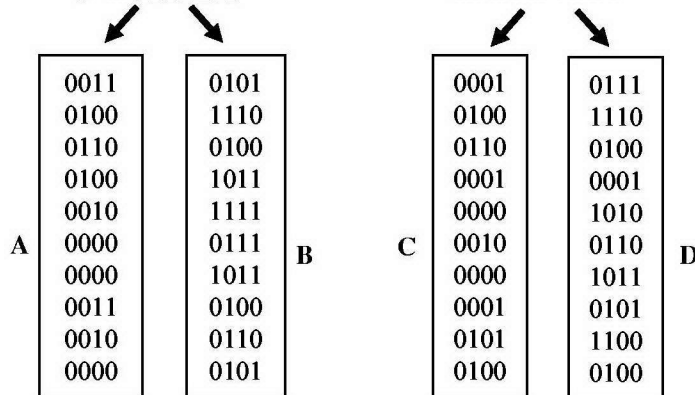


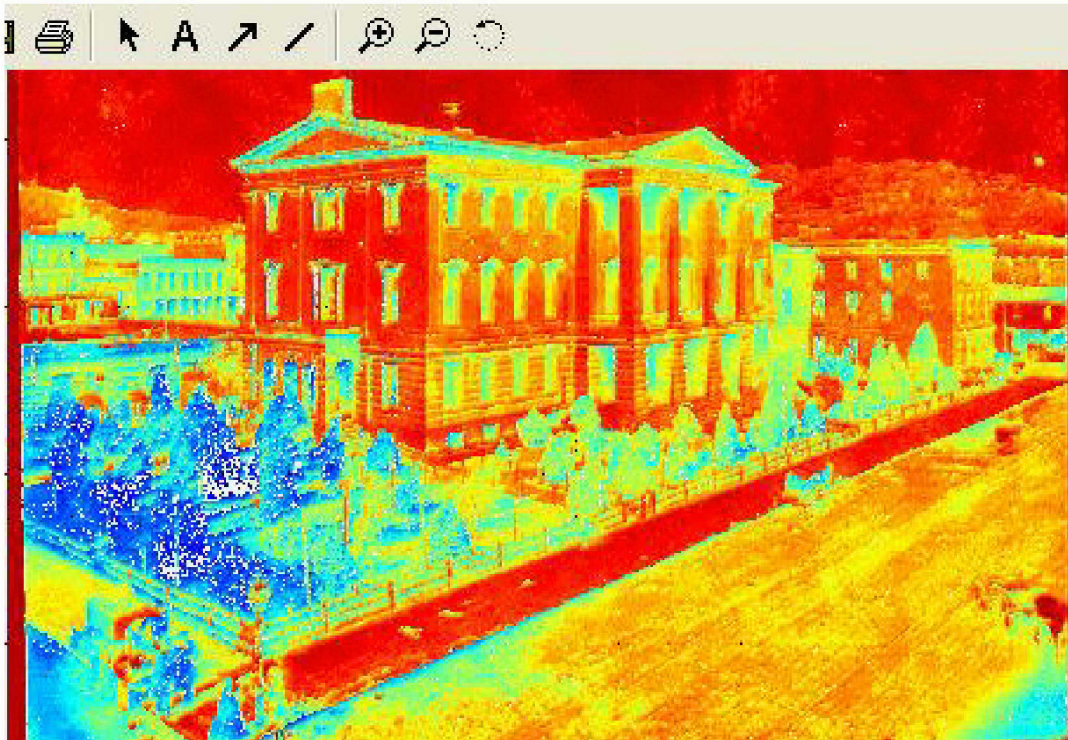
Cover image
Custom House



Annotation Watermark

Some Data Points From "House" and From
"Watermark Annotation written on Image
of House" See enlargements next page





IR Image Number one: Cover Image

Original Photograph: non copyrighted Located at [http://memory.loc.gov/cgi-bin/ query/ r?pp/ils: @filreq\(\(@field\(NUMBER+@band\(cph+3a28019\)\)+@field\(COLLID+lawhou\)\)](http://memory.loc.gov/cgi-bin/query/r?pp/ils:@filreq((@field(NUMBER+@band(cph+3a28019))+@field(COLLID+lawhou)))



IR Image Number two : Annotation Watermark

Watermark showing some of the conditions that occurred during a simulated cloud release of SF6 in low wind conditions. Also note the photograph credit at the bottom of the photograph