NORMALIZATION CROSS CORRELATION VALUE OF ROTATIONAL ATTACK ON DIGITAL IMAGE WATERMARKING BY USING SVD-DCT

Vikas Chaubey[1], Komal Goyal[2], Amita Garg[3]

[1]*Asst. Professor, Computer Science Department, MVN University, Haryana, India*
[2]*Asst. Professor, Mathematics Department, MVN University, Haryana, India*
[3]*Research Scholar, Mathematics Department, Sharda University, Uttar Pradesh, India*

Abstract

The WWW (World Wide Web) is a superb sales and distribution medium for digital image assets, but official document compliance and important data can be a call to prove or justify it. Present days, digital image, audio and video used all over world with or without agreement. In digital image watermarking answer let you add extra layer of protection (added logo) to your digital image. By using Singular Value Decomposition - Discrete Cosine Transfer we are finding Normalization Cross Correlation coefficient value of attacking (rotational attack) on digital image watermarking. The Normalization Cross Correlation coefficient value depended on step size of digital image. If you change the value of step size than our results are different.

***Keywords*: *SVD, DCT, Orthogonal Matrix, NCC, Watermarking*.**

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1. INTRODUCTION

Maximum collection of data is transfer in digital format now than ever and the growth in this field will not plane in the likely further day. Digital collection of data is susceptible [1][2] to having same creator at the same quality as the original signal. Other word input signal is same as output signal. Watermarking is possible to work on digital image, audio and video it is a pattern of bits inserted into identifies the file's copyright collection of data. Digital image watermarking is derived from the weakly visible marks stamped on structural notepaper. Dissimilarly printed digital watermarks, which are planned to be somewhat visible(usually the actual light compass stamp watermarking this report), digital image watermarking are designed to be full proof invisible or in the case of audio clips, video clips and inaudible clips.Digital Images that are misused can that are leaked or misused can upset sale and distribution marketing efforts, brand image. Other person one click on your digital effect can be separate from your invisible information so guarding brand and logical property.

2. DISCRETE COSINE TRANSFORM

Discrete Cosine Transform (**DCT**) is a new method for converting digital signal into elementary frequency components. It is maximums used in digital image compression/decomposition. It is easy method to calculate the Discrete Cosine Transform and to compress/de-compressdigital image[2][3]. It is widely used for image compression because of its high energy packing capabilities. Discrete Cosine Transform has many useful properties and involves only real components.

Discrete Cosine Transform of a 1D sequence of length N can be given as

$$C(u) = W(u) \times \sum_{x=0}^{N-1} f(x) \cos\left(\frac{\pi(2x+1)u}{2N}\right)$$

For u= 0,1,2….,N-1.

$$W(u) = \left\{ \frac{1}{\sqrt{N}} \text{ for } u = 0; \sqrt{\frac{2}{N}} \text{ for } u \neq 0 \right\}$$

When $u = 0, C(0) = \frac{1}{\sqrt{N}} \sum_{x=0}^{N-1} f(x)$. This is called DC component. For other value of u, the components obtained are called AC coefficients. The inverse DCT is given below

$$f(x) = \sum_{u=0}^{N-1} W(u) \times C(u) \times \cos\left(\frac{\pi(2x+1)u}{2N}\right)$$

The two dimensions DCT is an extension of 1-D DCT. It is given as

$$\mathrm{C}(\mathrm{u},\mathrm{v}) = \mathrm{W}(\mathrm{u})\ \mathrm{W}(\mathrm{v}) \sum_{x=0}^{N-1}\sum_{y=0}^{N-1} f(x,y).cos\left(\frac{\pi(2x+1)u}{2N}\right)cos\left(\frac{\pi(2y+1)v}{2N}\right)$$

For u,v=0,1,2…..,N-1. $W(u)$ and $W(v)$ can be calculated as in the case of one dimension. The inverse transformation is given as

$$f(x,y)=\sum_{x=0}^{N-1}\sum_{y=0}^{N-1}W(u)W(v)C(u,v)cos\left(\frac{\pi(2x+1)u}{2N}\right)cos\left(\frac{\pi(2y+1)v}{2N}\right)$$

For x,y=0,1,2……N-1. The DCT is helpful in removing the redundant data from an image. The energy compaction efficiency of the DCT is higher than that of FFT in general. The DCT is separable similar to FFT[9][10]. Since the transforms for rows and columns are identical, the DCT can be called as a symmetric transformation and can be expressed as

$$g = A \times F \times A$$

where the symmetric transformation of matrix A is specified as

$$a_{i,j} = W(j)\sum_{j=0}^{N-1} cos\left(\frac{(2j+1)i}{2N}\right)$$

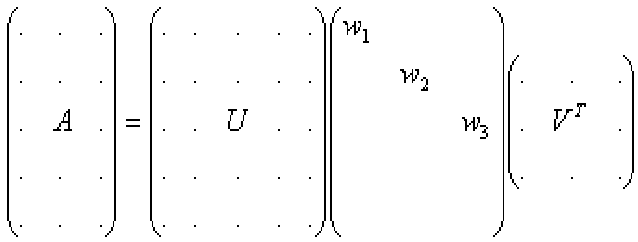
Here F is given image. The inverse DCT(IDCT) is given as

$$F = A^{-1} \times T \times A^{-1}$$
$$= A^T \times T \times A^T$$

The DCT can also be extended to higher dimensions.

3. SINGULAR VALUE DECOMPOSITION

The singular value decomposition of $M \times N$ matrix A is its representation as $A = U\ D\ V^T$, where U is an orthogonal $M \times M$ matrix, V - orthogonal $N \times N$ matrix. The diagonal elements of matrix D are non-negative numbers in descending order, all off-diagonal elements are zeros.



The matrix D consists mainly of zeros, so we only need the first min(M,N) columns of matrix$U$ to obtain matrix *A[4][5]*.Similarly, only the first min(M,N) rows of matrix V^T affect the product. These columns and rows are called left and right singular vectors.

The expression $A = U\ W\ V^T$, is known as SVD(Singular value decomposition).

To decompose ‘A’ we require two orthogonal matrix “U” and ‘V’ and one diagonal matrix ‘D’ which is formed by square roots of eigen values of ‘$A^T A'$.

We need two equations to solve it :

$$(a) A^T A = V D^T D V^T$$

$$(b) CV = UD.$$

We can understand it in better way using an example:

Let ‘A’ is any matrix,$A = \begin{bmatrix} 5 & 5 \\ -1 & 7 \end{bmatrix}$

Step I: Compute $A^T A$ and find itseigen values.

$$A^T A = \begin{bmatrix} 5 & -1 \\ 5 & 7 \end{bmatrix}\begin{bmatrix} 5 & 5 \\ -1 & 7 \end{bmatrix} = \begin{bmatrix} 26 & 18 \\ 18 & 74 \end{bmatrix}$$

Eigen values of $A^T A$,

$$\text{Det } (A^T A - \lambda I) = Det\begin{bmatrix} 26-\lambda & 18 \\ 18 & 74-\lambda \end{bmatrix}$$
$$=\lambda^2 - 100\lambda + 1600$$
$$=(\lambda - 20)(\lambda - 80)$$

Therefore, eigen values are $\lambda = 20{,}80$

Step II: To find eigen vectors of corresponding eigen values to get V which is equal to $[V_1, V_2]$.

Eigen vector of $(A^T A - 20I)X = \begin{bmatrix} 6 & 18 \\ 18 & 54 \end{bmatrix}\begin{pmatrix} x \\ y \end{pmatrix}$

$$V_1 = \begin{pmatrix} \frac{-3}{\sqrt{10}} \\ \frac{1}{\sqrt{10}} \end{pmatrix}$$

Similarly, $A^T A - 80I = \begin{bmatrix} -54 & 18 \\ 18 & -6 \end{bmatrix}\begin{pmatrix} x \\ y \end{pmatrix}$

$$V_2 = \begin{pmatrix} \frac{1}{\sqrt{10}} \\ \frac{3}{\sqrt{10}} \end{pmatrix}$$

Therefore,$V = \begin{bmatrix} \frac{-3}{\sqrt{10}} & \frac{1}{\sqrt{10}} \\ \frac{1}{\sqrt{10}} & \frac{3}{\sqrt{10}} \end{bmatrix}$ ....……………….. (i)

Step III: To find $D = \sqrt{eigenvalues}$.

Therefore $D = \begin{bmatrix} \sqrt{20} & 0 \\ 0 & \sqrt{80} \end{bmatrix} = \begin{bmatrix} 2\sqrt{5} & 0 \\ 0 & 4\sqrt{5} \end{bmatrix}$ ……………………………………….. (ii)

Step IV: From (b) , we have ,

$$AV = \begin{bmatrix} 5 & 5 \\ -1 & 7 \end{bmatrix}\begin{bmatrix} \frac{-3}{\sqrt{10}} & \frac{1}{\sqrt{10}} \\ \frac{1}{\sqrt{10}} & \frac{3}{\sqrt{10}} \end{bmatrix} = U\begin{bmatrix} 2\sqrt{5} & 0 \\ 0 & 4\sqrt{5} \end{bmatrix}$$

From this we get,

$$U = \begin{bmatrix} \frac{-1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{bmatrix} \text{……………………………... (iii)}$$

Thus, we get 'U' 'D' and 'D' to decompose any matrix 'A'.
If a matrix 'A' has a matrix of eigenvectors 'P' that is not invertible (for example, the matrix $\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$, has the noninvertible system of eigenvectors $\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$, then 'A' does not have an eigen decomposition.

The singular value decomposition has many useful properties [8]. For example, it can be used to: solve underdetermined and over determined systems of linear equations, matrix inversion and pseudo inversion, matrix condition number calculation, vector system orthogonalization and orthogonal complement calculation.

4. RESULTS AND DISCUSSION

4.1 NCC between Original Watermark and Extracted Watermark

(i) To calculate the normalized cross correlation coefficient between the original and extracted watermark we use the concept
of mathematical formula.
(ii) First we take the multiplication between the original and extracted value for each element in the matrix.
(iii) Then we normalize these values by dividing the value of (w*w) . Where w is the original watermark.

Mathematically

r = r + (w*W_h)

c = c + (R*R)

NCC = r/c

Where r = 0; initially
c = 0; initially
w = original watermark
W_h = extracted watermark from CH frequency sub band in resolution level
(l =1).

As the same watermark is extracted from level 1 in CH frequency sub band so the value obtained is NCC = 1.

4.2 NCC Coefficient Calculation in case of Rotating Attack

(i) Rotating attack is performed on watermarked image by rotating the watermarked image to 2 degree in anticlockwise direction.
(ii) The similarity between the watermarked image and attacked watermarked image is found by calculating the correlation over entire dimension of the attacked image.
(iii) The same procedure is applied as above.

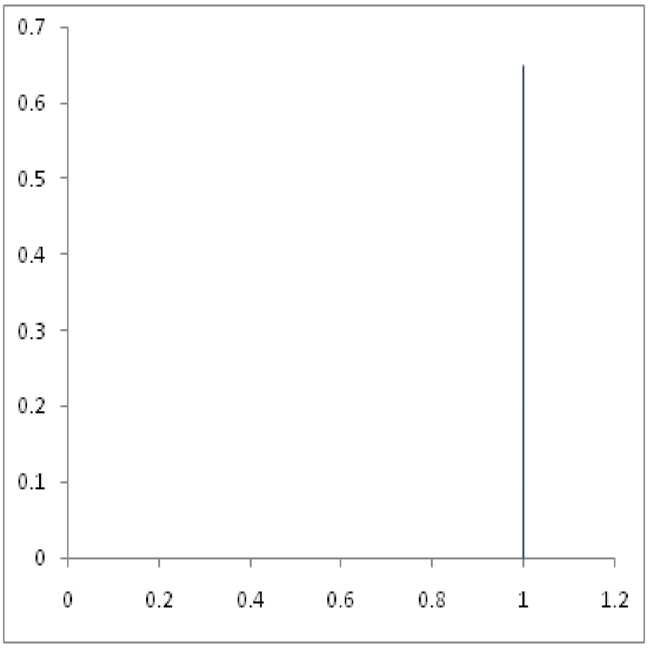
Taking x3 = x3 + (w * W_h_r)

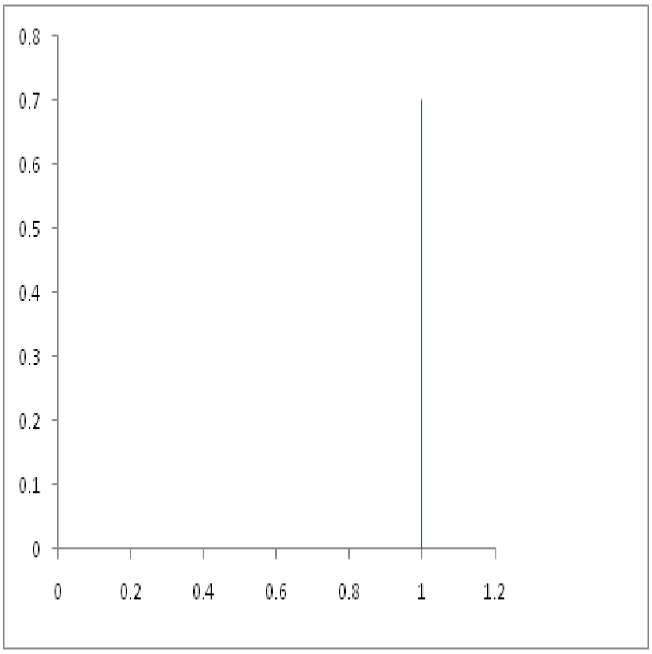
y3 = y3 + (w * w)

P3 = (x3/y3)

Where x3 = 0; initially
y3 = 0; initially
P3 = correlation coefficient
w = original watermark
W_h_r = watermark extracted from rotated image

The value of correlation coefficient found in this case of rotated back is p1 = 0.6779 for step size of 15. the correlation value is less which shows that the watermarking scheme is not more robust for rotating attack also.





The value of correlation coefficient found in this case of rotated back is p1 = 0.7044 for step size of 15. the correlation value is less which shows that the watermarking scheme is something robust for rotating attack from before.

5. CONCLUSIONS AND FUTURE WORK

The correlation coefficient in the two different bit configuration 32*32 and 64*64. Both time you consider different value but these value are near by the 1.and also if you change the step size of image than also possible that you get different results on various step size of image. Digital Image processing operations can be applied both in the spatial domain as well as the frequency domain. The reason for performing these operations in the frequency domain is the speed and simplicity of operation in this domain.Digital Image Transforms are used to convert information from the spatial domain to the frequency domain and vice versa. Discrete Cosine Transform and Singular Value Decomposition both are together performing best result on digital image by the help of Normalization Cross Correlation Coefficient (NCCC). Limitation of this is we are not going to closer of 1 because if we are not getting closer value of 1 than you are not robust for rotating from before.

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BIOGRAPHIES

He received M. Tech and B. Tech. Currently, he is working as an Assistant Professor in Computer Science Department at MVN University, Palwal. His areas of interest include Operating System, Computer Network and Object Oriented Programming, Digital Image Processing.

Komal Goyal received the M.Sc. degree in Mathematics in 2010. She is pursuing Ph.D. from Jaypee University, Noida. She is working as an Assistant Professor in a reputed University. She is mainly indulged in research of Fixed point theory and fractals. She has published two research papers in international Journals.

Amita Garg received M.Sc. and M.Ed. degree from Dayalbagh Educational Institute. She is pursuing Ph.D. from Sharda University under the supervision of Dr. A. H. Siddiqi (Ex- Pro- vice chancellor of AMU). Her research area is inverse problems related to Partial differential equations. She has published two research papers in international Journals.