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An Optimization Image Watermarking Technique Using Biogeography Based Optimization

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Abstract

Digital watermarking is process of embedding information into a digital signal which is used to know about its authencity or identity of its owners and producers in the same manner as document having a bench mark for visible identification. This paper presents an innovative watermarking scheme based on biogeography based optimization in transform domain. The proposed approach is robust against watermarking attacks. Also, the watermarked image quality is considered. Simulation results also show both robustness and image quality with bbo.

Keywords* - *BBO, DWT, Digital, Image, Watermarking.

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I. INTRODUCTION

The widespread growth of internet has allowed images, audio, videos etc. to become available in digital form. Though this provides an additional way to distribute material to consumers, it has also made it far easier for copies of copyrighted material to be made and distributed. Digital watermarking provides partial solutions to this problem, by embedding a watermark with intellectual property rights into images, videos, audios and other multimedia data by a certain algorithm. Watermarking schemes can be categorized as "visible" and "invisible" Watermarking. From both schemes invisible watermarking is more secure and robust than visible watermarking. Because in this scheme embedding locations are secret and only authorized persons can extract watermark. The watermarked image will look similar with original image.

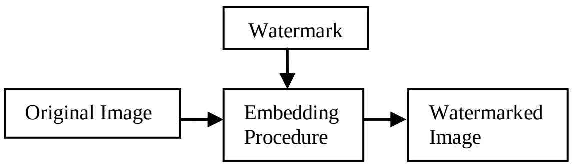

Figure1: Block diagram of Watermarking Algorithm

Watermarking techniques can be classified into different groups, according to domain [2]. Because of medical applications for diagnostic values, it is require to maintain image quality. There are verity of schemes for watermarking based on transform domain technique with DCT [3-5], DWT [6], DFT [7].Improvements in performance can be obtained by several method.

In this paper, proposed watermarking scheme is applied for medical imaging using BBO [8] .The purpose for using BBO is to obtain the optimized embedding bands for hiding the watermark information like GA and PSO. BBO has a way of sharping information between solutions.

This paper is organized as follows: Section II outlines the previous work of watermarking schemes applied on images. In section III a brief description of BBO to obtain the embedded locations for watermark. Section 3.2 describes combination of DWT and BBO, section IV shows the experimental results; and finally, conclusions are presented in section V.

II. Previous Work

Gaurav Bhavnagar et. al. presents a new semi-blind reference watermarking scheme based on discrete wavelet transform and singular value decomposition (SVD) for copyright protection and authenticity[9]. B.Y.Lei,Ing Yann et.al. presents a new singular value decomposition (SVD)and important transform technique in robust digital watermarking due to its different properties from the traditional transforms such as Transform (DCT) and Discrete Wavelet Transform(DWT).In this paper, a new, blind and robust audio watermarking scheme based on SVD–DCT with the synchronization code technique. It embeds a binary watermark into the high-frequency band of the SVD–DCT block blindly. Chaotic sequence is adopted as the synchronization code and inserted into the host signal. Experimental results show audio watermarking that the proposed watermarking method is comparable to, if not, better than SVD based Singular value decomposition method and several selected typical audio watermarking methods, even in the presence of various common signal processing attacks[10]. Byei Jiansheng, Li Sukang et.al. introduces an algorithm of digital watermarking based on Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT). According to the characters of human vision, in this algorithm, information of digital watermarking which has been discrete Cosine transformed, is put into the high frequency band of the image which has been wavelet transformed.The simulation method results show that this algorithm is invisible and has good robustness for some common image processing operations [11]. Say Wei Foo et.al, presents a normalization-based robust transform image watermarking scheme which encompasses singular value decomposition (SVD) and discrete cosine transform (DCT) techniques is proposed. For the proposed scheme, the host image is first normalized to a standard form then divided into non-overlapping image blocks. SVD is applied to each block. By concatenating the first singular values (SV) of adjacent blocks of the normalized image, a SV block produce SVD-DCT blocks by imposing a particular relationship between two pseudo-randomly selected DCT the watermarking schemes must be able to detect the coefficients. An adaptive frequency mask is used to adjust local watermark embedding strength. Watermark extraction involves mainly the inverse process. The watermark extracting method is blind and efficient. Experimental results show that the quality degradation of watermarked image caused by the embedded watermark is visually transparent. Results also show that the proposed scheme is robust against various image processing operations and geometric attacks.[12.] An adaptive Watermarking Approach for medical imaging using Swarm Intelligent. It presents a secure patient medical images and authentication scheme which enhance the security, confidentiality and integrity of medical images transmitted through internet. Experiment results show that watermark which is invisible to human eyes and robust against a wide varity of common attacks enough for tracing colluders [13].

III. Fundamental Concept Of Bbo

BBO is basically a optimization technique that based upon the mathematical model of species. This technique is based upon two concepts [8]. First is migration and other is mutation. Migration is used to migrate the pixels for one part to other like specie that migrate from one island to other island. Second concept is mutation; this is based upon the creation of new pixels with the combination of two pixels.

3.1. Basic steps for biogeography based watermarking;-

[1] Define the island modification probability, mutation probability, and elitism parameter. Island modification probability is similar to crossover probability in GAs. Mutation probability and elitism parameter are the same as in GAs.
[2] Initialize the population (n islands).
[3] Calculate the immigration rate and emigration rate for each island. Good solutions have high emigration rates and low immigration rates. Bad solutions have low emigration rates and high immigration rates.
[4] Probabilistically choose the immigration islands based on the immigration rates. Use roulette wheel selection based on the emigration rates to select the emigrating islands.
[5] Migrate randomly selected SIVs based on the selected islands in the previous step.
[6] Probabilistically perform mutation based on the mutation probability for each island.
[7] Calculate the fitness of each individual island.
[8] If the termination criterion is not met, go to step 3; otherwise, terminate.

For *i*= 1 to NP **do**
Select I_i with probability based on λ_i
If I_i is selected **then**
For *j*=1 to NP **do**

Select I_j with probability based on μ_j
If I_j is selected
Randomly select a SIV *v* from I_j
Replace a random SIV in I_i with *v*
End if
End for
End if
End for

3.2. Following are the steps of biogeography based dwt watermarking:-
The Proposed algorithm can be summarized as follows:

Step 1: Take an original image and other image as a hidden image.

Step 2: Selecting a seed point from cover image. After selecting, then examine their neighboring pixels of seed points based on some predefined criteria and generate appropriate pixels
.

Step 3: **Cover Adjustment**

Before the embedding process takes place it is necessary to apply a pre-processing step on the cover image. This is a very important step to preserve the overall invert ability of the transform. That is, the embedding process may modify a coefficient that corresponds to a saturated pixel color component in such a way that makes it exceed its maximum value. In this case higher values will be clipped and the embedded message bits would then be lost. Hence, the original cover pixels components (H *(i, j, k))* are adjusted according to the formula shown below. It contains the number of bits to be embedded in each coefficient. This adjustment guarantees that the reconstructed pixels from the embedded coefficients would not exceed the maximum value and hence the message will be recovered correctly. Set probability for each region. Probability is like a threshold values. The probability ***Ps*** the region contains exactly ***S*** pixels. ***Ps*** changes from time to time as follows:

$$Ps(t + \Delta t = Ps(t)(1 - \lambda s.\Delta t - \mu s \Delta t) + Ps - 1$$
$$\lambda s - 1 + Ps + 1\mu s + 1\,\Delta t$$

The values of emigration and immigration rates are given

$$\lambda = I\,(1-K/n)$$
$$\mu = E/n$$

Where *I* is the maximum possible immigration rate; *E* is the maximum possible emigration rate; *k* is the number of species of the *k*-th individual; *n* is the maximum number of species.

Step 4 : After the pixel and region placement, DWT transform are take place. The discrete wavelet transform (DWT) is an implementation of the wavelet transform using a discrete set of the wavelet scales and translations obeying some defined rules. This transform decomposes the signal into mutually orthogonal set of wavelets. In this transform two scaling are defined - smoothing and non-smoothing one are constructed from the wavelet coefficients and those filters are recurrently used to obtain data for all the scales. If the total number of data D=2^N is used and signal length is L, first D/2 data at scale L/2^(N-1) are computed, than (D/2)/2 data at scale L/2^(N-2), ... etc up to finally obtaining 2 data at scale L/2. The result of this algorithm is an array of the same length as the input one, where the data are usually sorted from the largest scales to the smallest ones.

Step 5: The Embedding Process: Next, step is the embedding process of the proposed algorithm. Of course, it will convert the secret message into a 1D bit stream. details of this step will depend on the particular message type. The next step that follows the cover adjustment is concerned with applying biogeography Based optimization (BBO) on the cover image. The embedding process stores (*N)* message bits in the least significant bits (LSB) of the cover image. After the embedding process ends the watermarked image is produced by applying the optimization technique.

Step 6: The Extraction Module

The extraction process reverses the embedding operation starting from applying the BBO and dwt on each color plane of the watermarked image, then selecting the embedded coefficients, until extracting the embedded message bits from the *N* LSB's of the integer coefficients. Furthermore, the extracted bits are converted into its original digital form.

IV. Implementation And Results

A proposed watermarking should satisfy the property of imperceptibility, where the watermark that is embedded is not visible nor degrade the quality of host image. Here the histograms before and after adding watermark in host image is shown below.

Fig.1 original image

Fig 2. Hide image

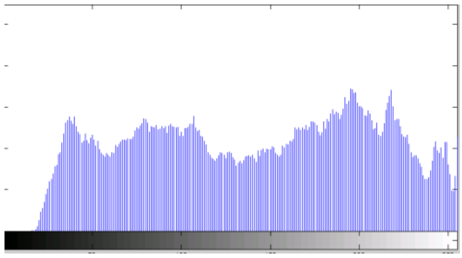

Fig 3. Histogram of original image

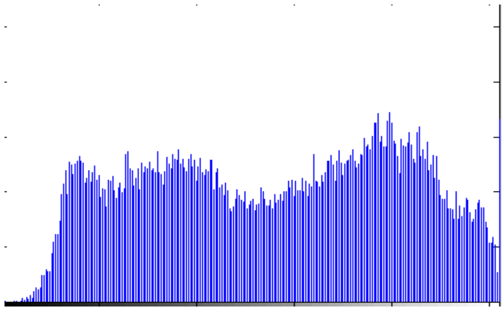

Fig.4 Histogram of Watermarked image

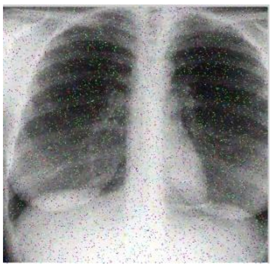

Fig 5. Salt & pepper

Fig 6. Gaussian noise added

Noise added

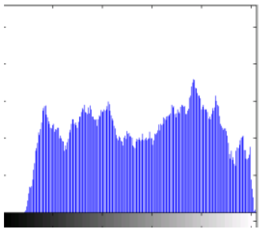

Fig 7. Histogram of Gaussian noise added image

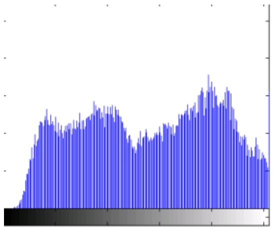

Fig.8. Histogram of Salt & pepper added image

Table 1 The PSNR and MSE values of watermarked image

BBO + DWT		
MEDICAL IMAGE	PSNR	MSE
CHEST	55.2592	0.347
CT SCAN	53.6384	0.3368
MRI	56.478	0.3546
BRAIN	54.9244	0.3449

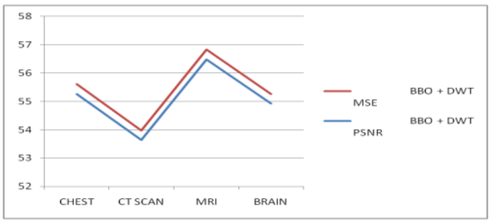

Fig 9. Resultant PSNR and MSE values

We have conducted several experiments to examine the effectiveness of proposed algorithm. We choose the test image Brain, MRI, chest, CT scan and watermark as logo. All the images are 512*512 gray scale images. In order to determine the degradation we apply the PSNR and MSE to measure the distortion produced after the embedding process.

Table2. Results after adding noise

TYPES OF ATTACK						
	Salt and Pepper		**Spackle noise**		**Gaussian noise**	
IMAGE	PSNR	MSE	PSNR	MSE	PSNR	MSE
CHEST	49.733	0.3045	53.2856	0.2131	51.4482	0.28
CT SCAN	48.275	0.2956	51.7227	0.2069	49.9392	0.27
MRI	50.83	0.3112	54.4609	0.2178	52.583	0.29
BRAIN	49.432	0.3026	52.9628	0.2119	51.1365	0.28

Fig 10. PSNR and MSE values of embedded image after adding salt & pepper noise.

As shown in fig 5, 6 and table 2,it confirm the robustness of our proposed watermarking technique with different attacks. Fig 5, 6 shows the histogram of noise added image and it shows that our algorithm can survive under different types of attack. Fig.10 it shows the PSNR and MSE value of watermarked image after adding Salt & Pepper noise. Different attacks are performed on watermarked images and it survived attacks till the usability of the watermarked images is intact.

V. Conclusion

There are several types of algorithms for watermarking. Each type of algorithms has its own advantages and limitations. No method can provide fully perfect solution. Each type of solution has robustness to some type of attacks but is less resilient to some other types of attacks. Main focus of the current research in this field is to make the watermarking algorithms resilient to geometric transformations. In case of practical application, choice of solution type actually depends on the nature of application and requirements. The proposed method uses BBO to optimize the strength of watermark. As the watermark strength is not same, but it is kept adaptive, in this way the watermark is spread in the regions of image which have least effect on imperceptibility of the image. The imperceptibility and robustness of proposed method shows better performance in comparison to other approaches in practice.

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