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Biogeography for Watermarking Medical Images

A.Umaamaheshvari[1], K.Prabhakaran[2], K.Thanushkodi[3]
[1](Assistant Professor/ECE/SSEC), [2](P.G. Student/KSOU), [3](Director/ACET)

Abstract: With the evolution of internet and multimedia digital watermarking is gaining momentum. In day to day life for unwanted messages few people are affected .So watermarking is essential in every part of multimedia. In the paper we are proposing a new method of watermarking based on optimization technique. Performance improvement is got from biogeography algorithm. Threshold values and embedding strength forms the important parameters for improving the visual quality of watermarked images. Independent watermark is constructed and distributed separately based on biogeography algorithm.

Keywords: *biogeography, digital watermarking, Independent watermark, multimedia, threshold value*

I. INTRODUCTION

Internet being an open source has become popular. In open source the transmitted data is corrupted, altered or stolen. Enforcing the copyright protection is a serious issue. Many methods are available for watermarking of images both in frequency domain and spatial domain. Cox et al.[1] proposed discrete cosine transform. Dugad et al.[2] proposed the discrete wavelet transform. Shieh et al .[3]proposed genetic watermarking based on transform domain. El-Khamy et al.[4] introduced the watermarking based on human visual system and wavelet based data fusion. Umaamaheshvari et al.[5] proposed a hybrid watermarking method based on daubauche 2 wavelet. Huang et al[6] worked with DCT and GA.

Many of the techniques got unsatisfactory values towards fidelity and robustness. Spatial domain techniques are having poor values. Biogeography based genetic algorithm[7] mimics the process of natural evolution. The important ROI and NROI can be classified and optimized for achieving a best solution. Appropriate locations of the cover image are identified to insert the watermark. The locations are called as populations in genetic algorithm. In biogeography algorithm deals with the distribution of species in a particular location called habitat. Habitat suitability index is a measure for the species about the temperature, rainfall, humidity, vegetation and land area. Suitability index variables are independent variables of the habitat that characterize habitability.

High HSI = more number of species and static.

Low HSI = less number of species and not static

Low HIS are more dynamic in their species distribution than high HSI habitats . Here low HSI denotes the low frequency components and high HSI denotes the high frequency components in an image.

Section II describes the concept of Bandlet Section III deals with Biogeography algorithm and its applicability in image watermarking. Section IV deals with the proposed method. Section V discusses with results and conclusions.

II. BANDLET TRANSFORM

In 2005 pennac and mallet[8] proposed a new method called bandeltization. The advantage is along the geometric flow image regularity is obtained. Redundancy is removed from the warped wavelet transform. Standard orthogonal wavelet transform is used for second generation. In a region Ωi where the geometric flow is vertically parallel. The scaling function is given by

Ui[k1,k2] ={f[n1,n2],ϕj,jki[Ψj,k2[n2-ci[n1]]}

Where Ui[k1,k2] is input and ϕj,jki is scaling function. The scaling function does not take the advantage because of geometric image regularity. The change os basis with a 1D DWT along the parameter k1,which computes inner products with discrete bandlet scales 2i>2j:

{f[n1,n2],Ψl,k1[n1] Ψj,k2[n2-ci[n1]]} (1)

When filters (h,g) applied to Ui[k1,k2] along the variable k1,with k2 as fixed we get1D wavelet transform. The bandeletization when applied to warped wavelet coefficients:

Ui[k1,k2] ={f[n1,n2], Ψj,k1[n1-ci[n2]]ϕj,k2[n2]} (2)

to compute the bandlet coefficients at scales 2i >2j:

f[n1,n2],Ψj,k1[n1-ci[n2]]Ψl,p2[n2]]} (3) within each region bandletization is computed and it avoids overlapping and does not create any boundary problems. It does not affect the image at all since the work is done in the warped coefficients only.

III. BIOGEPGRAPHY OPTIMIZATION

In this part we discuss how optimization is done using biogeography in discrete domain.

3.1*Migration*

Consider a problem to have a candidate solutions as vector of integers. Good solutions are considered to be habitats with a high HSI. Poor solutions are considered to be low HSI. HSI is the fitness function. Fitness function is based on peak signal to noise ratio and normalized correlation coefficient.

Fitness value = PSNR+ α NC (4)

Fitness value = α NC + PSNR (5)

In equation (4) the fitness value increases with α value rather than PSNR.

3.2. Fitness function

*D*efines how to fit the chromosomes in the search space.

3.3.Selection and crossover

It is based on the survival of the fittest mechanism.based on the high fitness value chromosomes are selected for generating more offspring.

3.4Mutation

The offspring are subjected to mutation i.e a bit is flipped by changing 0 to 1 and 1 to 0 with a small probability.

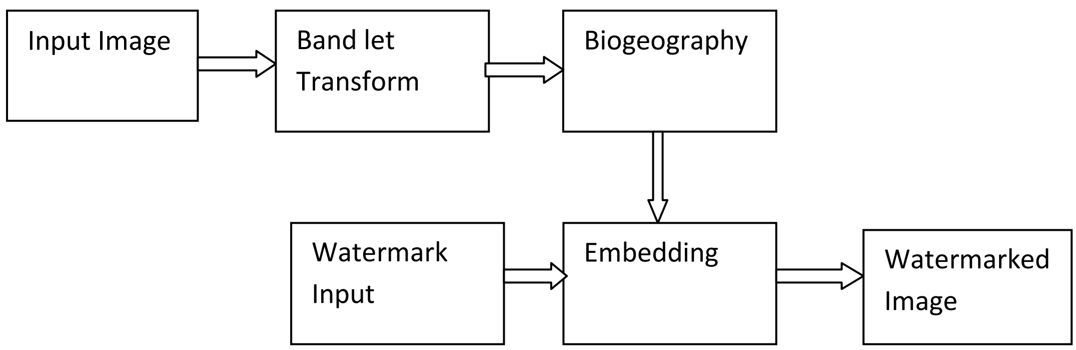


Figure 3.1 Block Diagram of the Proposed Method

3.5 Embedding algorithm

i)Start the process by getting the original file

ii)Accept the threshold percentage from the user.

iii)Choose the suitability index where to embed the watermark. Here watermark embedding is divided into lower and higher fields.

$L^* = L+a^*W_A$ (6)

W_A is coefficient of watermark A.L* is low coefficient of DWT .

High frequency coefficient and mid frequency coefficient forms the best segmentation by building the quadtrees.

The optimal geometric flow is computed and bandeletization is done to get bandlet coefficient.

$H^*= H +a^*W_B$ (7)

W_B is the coefficient of the watermark.H is bandlet coefficient and H* is a bandlet coefficient which embed the watermark.

iv)Initialize the first generation by reading the characters from the input file

v)Initialize generation count to zero,N to 0

vi)do crossover operation with best suitable index value and increment the count

vii)then Mutation() is performed

viii)finally Fitness() function is calculated

ix)Sort the obtained values.

x)Copy the first ten values of the present generation to the next generation

xi)Go to step 6 if generation count is less than maxgen

xii)Add the values of final generation to final key text file.

xiii)End process

3.6 Extraction algorithm
Generally the extraction process is the inverse process of embedding
i)accept the input image file.
ii)In low frequency we use direct method as $W_A' = (L'-L)/a$ (8)
In the high frequency we need bandletization to extract the watermark
$W_B' = (H'-H)/a$ (9)

IV. CONCLUSION

This section deals with the comparative study of the various inputs and the corresponding outputs. The output of the proposed method is compared with other methods.The screen shots are shown below for CT image.

TABLE I PERFORMANCE VALUES FOR CT IMAGES

PSNR	MSE	SSIM
64.0309	0.0257	0.9124
48.5227	0.9137	0.9058
56.1408	0.1581	0.9157
44.6947	2.2060	0.8905
48.0655	1.0152	0.9016

TABLE II PERFORMANCE VALUES FOR MRI IMAGES

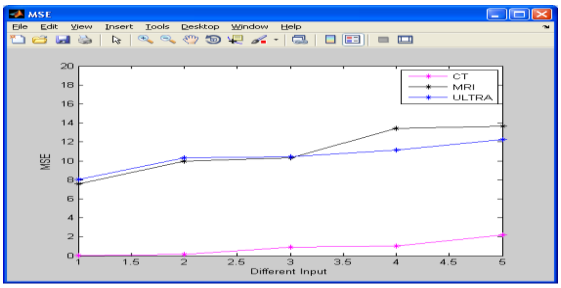
PSNR	MSE	SSIM
36.8532	13.4203	0.8878
38.1485	9.9593	0.9098
36.7808	13.6457	0.9141
37.9888	10.3323	0.8880
39.3461	7.5591	0.9092

TABLE III PERFORMANCE VALUES FOR ULTRA IMAGES

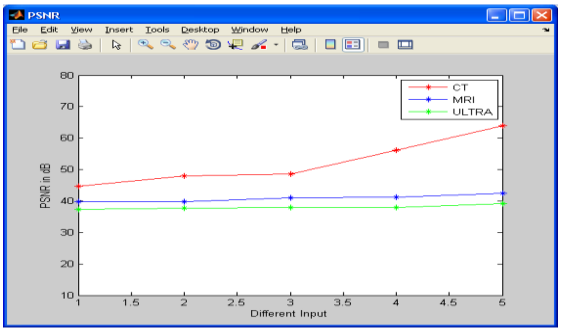
PSNR	MSE	SSIM
37.2461	12.2595	0.9023
37.9901	10.3293	0.8939
37.9476	10.4309	0.9236
39.0785	8.0395	0.9311
37.6604	11.1439	0.9193

TABLE IV COMPARISON OF PROPOSED METHOD WITH OTHER EXISTING METHODS

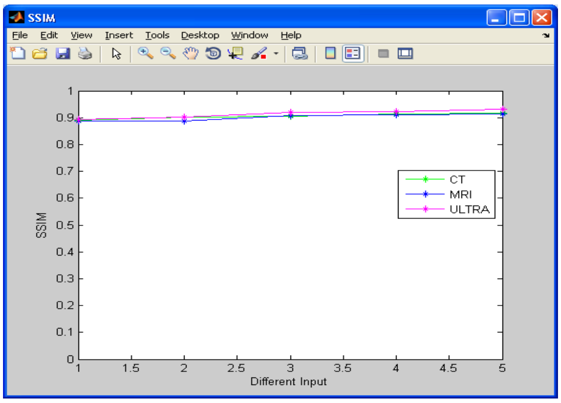
Proposed method		Dugad method		Dugad DMT1		GA dugad method	
CT Images	64.03	Lena	41.33	Lena	41.18	Lena	46.07
MRI	39.34	Baboo n	34.67	Baboo n	34.95	Baboo n	41.87
ULTR A	39.07	Pepper	39.25	Pepper	38.94	Pepper	44.48



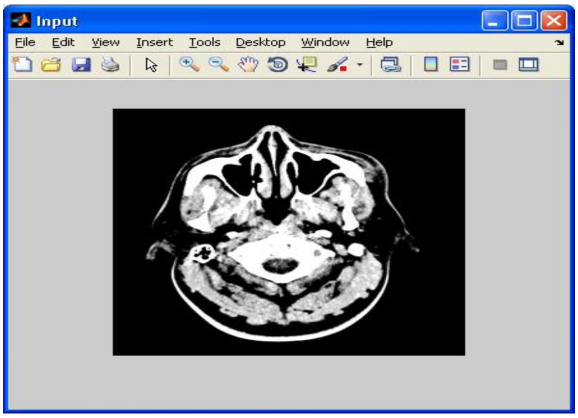
Graph 1: Different Input images vs MSE

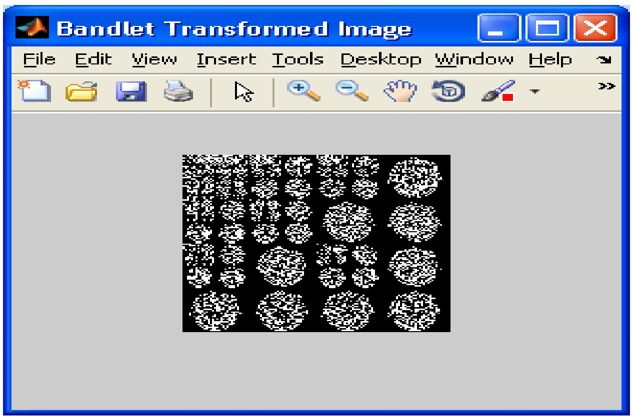


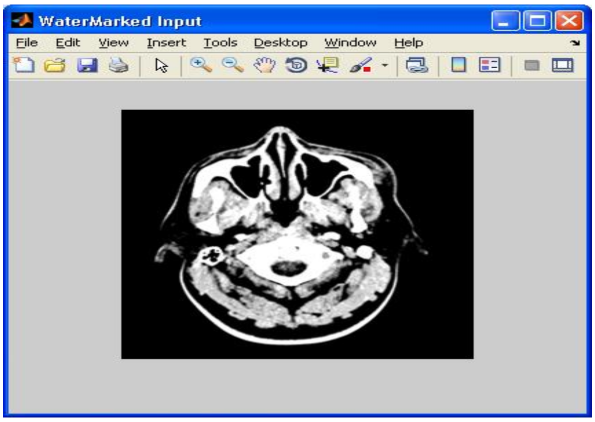
Graph 2: Different Input Images vs PSNR



Graph 2: Different Input Images vs SSIM







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