ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 1, January 2014

HYBRID LIFTING BASED IMAGE COMPRESSION SCHEME USING PARTICLE SWARM OPTIMIZATION ALGORITHM AND ARTIFICAL BEE COLONY ALGORITHM

M.Mohamed Ismail[1], Dr.K.Baskaran[2]

Research scholar , Karpagam university,Coimbatore,India[1]

Associate Professor,Department of Computer Science, Government college of Technology , Coimbatore, India[2]

Abstract : Wavelet transform is one of the compression techniques used for images and multimedia files. This paper proposes a framework for constructing adaptive and hybrid lifting scheme with particle swarm optimization algorithm and Artificial bee colony algorithm. .Particle swarm optimization algorithm is used to find the prediction function P in the lifting scheme and Artificial bee colony algorithm is used to find different update coefficient by local search, atlast optimally choose the best update coefficient to get best quality of compressed image. Particle swarm Optimization technique is used to improve the accuracy of the prediction function used in the lifting scheme where as in the update step we modifying the center pixels with the co-efficient in 8 – different direction with a considerable window size by using local search , we obtain a best directional window with a considerable size using artificial bee colony algorithm to obtain the best reconstructed image, which can be considered as an optimization task. Artificial Bee Colony algorithm which is a recent and successful optimization tool is used to determine the directional window size to produce the best compressed image in terms of both compression ratio and quality.The proposed hybrid lifting scheme is very much useful for image compression compared to the wavelet transforms The proposed work gives better PSNR when compared to existing methods. So, the transmission cost to transmit the encoded data and memory space to store the encoded data can be reduced with help of adaptive and hybrid lifting scheme with PSO and artificial bee colony algorithm.

Keywords : Wavelet transform**,** lifting scheme, prediction function P, update function, Adaptive hybrid lifting scheme , PSO algorithm, ABC Algorithm, image compression

I .INTRODUCTION

Image Compression is an important component of the solutions available for creating image file sizes of manageable and transmittable dimensions. Platform portability and performance are important in the selection of the compression/decompression echnique to be employed.

The discrete wavelet transform (DWT) refers to wavelet transforms for which the wavelets are discretely sampled.A wavelet transform is realized using filter banks which split the image information into frequency sub bands. Due to their inherent property of producing floating point output, classical filter banks cannot in general be used in lossless compression schemes, since the coding cost for the coding of the floating-point wavelet coefficients would be prohibitively large. The lifting scheme has recently attracted much interest. It is away to implement critically sampled filter banks which have integer output.In section II A general lifting scheme is discussed and compared with adaptive and hybrid lifting scheme where the prediction step is performed

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 1, January 2014

using PSO and update step is modified with ABC algorithm section III discusses about the PSO and section IV explains the ABC algorithm . section V explains the proposed algorithm .

II .LIFTING SCHEME

The lifting scheme has recently attracted much interest. It is away to implement critically sampled filter banks which have integer output. An algorithm for decomposing wavelet transforms into lifting steps was described in [11]. The lifting scheme can custom design the filters, needed in the transform algorithms, to the situation at hand. It is processed in space domain, independent of translating and dilating, needless of frequency analysis. In this sense it provides an answer to the algebraic stage of a wavelet construction, also leads to a fast in-place calculation of the wavelet transform, i.e. it does not require auxiliary memory. For different wavelet has different image compress effect, the compressed image quality and the compress rate is not only relational to the length of the filter, but also concerns with the orthogonality, biorthogonality, vanishing moment, regularity and local frequency. In this proposed work, we implement adaptive lifting scheme based wavelet decomposition instead of wavelet decomposition. Then using PSO the accuracy of the prediction function is improved, and with the help of artificial bee colony algorithm, we find the best directional window size to get better compression ratio with considerable quality.

.A. The Lifting Concept

Lifting is a spatial (or time) domain construction of biorthogonal wavelets developed by Sweden. We present here an overview of our interpretation of the lifting concept. Lifting consists of iteration of the following three basic operations (Figure 1)

Split:

Divide the original data into two disjoint subsets. Although any disjoint split is possible, in the standard lifting scheme we split the original data set *x[n]* into *xe[n]* — *x[2n]*, the even indexed points, and *x0[n]* = *x[2n* + 1], the odd indexed points.

Predict:

Generate the wavelet coefficients *d[n]* as the error in predicting *x0[n]* from *xe[n]* using prediction operator *P:*

$d[n]=x0[n]-P(xe[n])$. (1)

Update:

Combine *xe[n]* and *d[n]* to obtain scaling coefficients *c[n]* that represent a coarse approximation to the original signal *x[n]*. This is accomplished by applying an update operator *U* to the wavelet coefficients and adding to *xe[n]*.

$c[n]=xe[n]+U(d[n])$ (2)

These three steps form a *lifting stage.* Iteration of the lifting stage on the output *c[n]* creates the complete set of DWT scaling and wavelet coefficients *Cj[n]* and *dj[n]*.

At each scale, we weight the Cj[n] and dj[n] with ke and k0 respectively, as shown in Figure 2. This normalizes the energy of the underlying scaling and wavelet functions.

The lifting steps are easily inverted, even if P and U are nonlinear, space-varying, or non-invertible. Rearranging (1) and (2), we have

$$xe[n] — c[n] - U(d[n]),$$

$$x0[n] = d[n] + P(xe[n]).$$

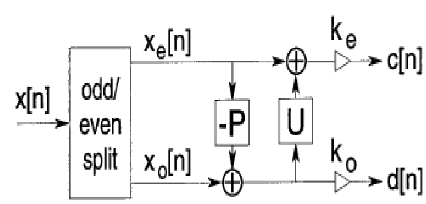


Fig 1 : Lifting stage: Split, Predict, Update. ke and k0 normalize the energy of the underlying scaling and wavelet functions.

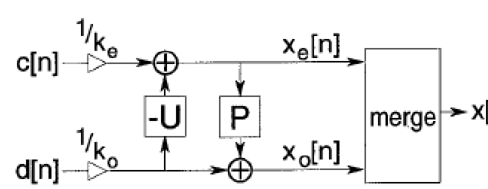


Fig 2 : Typical inverse lifting steps: undo the Update, undo the Predict, and Merge the even and odd samples.

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 1, January 2014

As long as the same P and U are chosen for the forward and inverse transforms, the original signal will be perfectly reconstructed. The inverse lifting stage is shown in Figure 2.

B. ADAPTIVE LIFTING SCHEME

The adaptive LS is a modification of the classical lifting. Figure 3 shows an example of an adaptive ULS followed by a fixed prediction. At each sample n, an update operator is chosen according to a decision function D(x[n], y). The crucial point is that D(x[n], y) depends on y, as in the classical and space-varying lifting, but it also depends on the sample being updated. For this reason a problem arises because the decoder does not dispose of the sample x[n] used by the coder to take the decision. The decoder only knows x0[n], which is an updated version of x[n] through an unknown update filter.

In the standard lifting scheme discussed above, the update operator and the addition are fixed, in the adaptive case, the choice of these operations depends on the information locally available within both the approximation signal and the detail signal. In fact, this choice will be triggered by a so-called decision map.

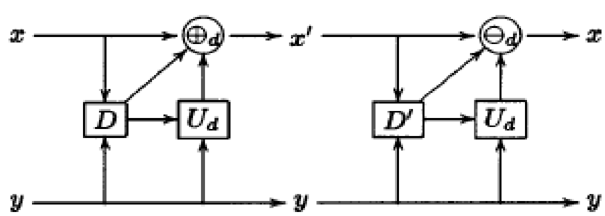


Fig.3. Adaptive update lifting scheme

The 2-D adaptive lifting structure is as follows:

***Update*:** Using coefficienty_h, y_v, y_d, to update *x* :

$x' = U(x, y_h, y_v, y_d)$ (3)

Here, *U* is update operator, in which coefficients are chosen by decidable factor *D* .

***Prediction*:** Using the updated low-frequencyCoefficient*x'*to predicty_h, y_v, y_d:

$y_h' = y_h - p_h(x', y_v, y_d)$ (4)

$y_v' = y_v - p_v(x' - y_d)$ (5)

$y_d' = y_d - p_d(x')$ (6)

Here p_h, p_v, p_d, are the prediction schemes for different frequency bands. The scheme adaptively chooses update operator *U* and prediction operator *P* according to the local feature adjacent to *x*, *yh*, *yv*, and *yd*. This update and prediction scheme ensures perfect reconstruction without recording any overhead information In the standard lifting schemes the update operator U and the addition ⊕ are fixed whereas in the adaptive lifting schemes the choice of these operations depends on the information locally available in the approximation signal x and the detail signal y. In fact, this choice will be triggered by the so called decision map $D: X \times Y \rightarrow D^Z$ where D is the decision set. For every possible decision $d \in D$ of the decision map, we have a different update operator U_d and addition $\oplus_d$ .Thus the analysis step is given by ,

$x'(n) = x(n) \oplus_{d_n} U_{d_n}(y)(n)$ (7)

Where $d_n = D(x, y)(n)$ is the decision at location n. Assuming that the reversibility condition on $\oplus_d$ holds for every possible decision $d \in D$ and it is given by, $x(n) = x'(n) \ominus_{d_n} U_{d_n}(y)(n)$ (8)

Where $\ominus_{d_n}$ denotes the subtraction that inverts $\oplus_d$.The decision $d_n = D(x, y)(n)$ depends on the original signal$x$. However, at synthesis, we do not know but "only" its update x'. In general, this prohibits the computation of d_n and in such cases, perfect reconstruction is out of reach. However, as there exist a number of situations in which it is still possible to recover d_n from an posteriori decision map .

In existing method using wavelet transform is not giving the better quality for more detail texture image, so it gives a way for adaptive hybrid lifting scheme based decomposition.A method of changing prediction functions of the LS for each image is proposed to improve the n ratio, gaining a more accurate prediction of pixels in the image.And Artificial Bee Colony algorithm which is a recent and successful optimization tool is used to determine the best directional

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 1, January 2014

window size to produce the better by local searching process. Then lossless encoding technique is used to get a perfect compressed image. After the encoding process, it is digital form so one can store or transmit the data to long distance.

Finally the image is reconstructed by applying decoding process for compressed data followed by Inverse adaptive lifting scheme.

III PARTICLE SWARM OPTIMIZATION

Particle Swarm Optimization (PSO) is one of the modern heuristic algorithms that can be applied to non linear and non continuous optimization problems. It is a population-based stochastic optimization technique for continuous nonlinear functions. PSO refers to a new family of algorithms that may be used to find the optimal (or near optimal) solutions to numerical and qualitative problems. Particle swarm optimization ties to bird flocking, fish schooling, and swarming theory related to evolutionary computation, and ties to both Genetic Algorithms (GA) and Evolutionary Programming (EP). Unlike GAs and EP, PSO is a simple concept and is very easy to implement.

PSO is initialized with a group ofrandom articles(solutions).The algorithm then searches for optima through a series of iterations. The particle's fitness value is evaluated in each iteration. If it is the best value the particle has achieved, the particle stores the location of that value as pbest (particle best). The location of the best fitness value achieved by any particle during any iteration is stored as gbest (global best).

A. Need for artificial bee colony algorithm

Choosing a global update coefficient does not give better compression ratio and quality, but artificial bee colony algorithm is used to find different update coefficient by local search at last optimally choose the best update coefficient to get best quality of compressed image. In update, modifying the center pixels with the co-efficient in 8 – different direction with a considerable window size and by using local search algorithm, to obtain a best directional window with an considerable size artificial bee colony algorithm.

IV .ARITIFICAL BEE COLONY ALGORITHM

Artificial Bee Colony (ABC) is one of the most recently defined algorithms by Dervis Karaboga in 2005, motivated by the intelligent behavior of honey bees. It is as simple as Particle Swarm Optimization (PSO) and Differential Evolution (DE) algorithms, and uses only common control parameters such as colony size and maximum cycle number. ABC as an optimization tool, provides a population-based search procedure in which individuals called foods positions are modified by the artificial bees with time and the bee's aim is to discover the places of food sources with high nectar amount and finally the one with the highest nectar.

In ABC system, artificial bees fly around in a multidimensional search space and some (employed and onlooker bees) choose food sources depending on the experience of themselves and their nest mates, and adjust their positions. Some (scouts) fly and choose the food sources randomly without using experience. If the nectar amount of a new source is higher than that of the previous one in their memory, they memorize the new position and forget the previous one. Thus, ABC system combines local search methods, carried out by employed and onlooker bees, with global search methods, managed by onlookers and scouts, attempting to balance exploration and exploitation process[1].

To decide whether a solution is exhausted or not, a counter is used to store the number of times that it was exploited. In other words the counter holds the number of the local searches in the neighbourhood of that solution. After a new solution is inserted in the population in a phase, the counter is reset to 0[6

A. Initialization phase

In the initialization phase of the algorithm, an window size is chosen within the maximum boundaries of each pixels.

area=1+floor(maxarea*rand(1));
row=5+floor(r*rand(1));
col=5+floor(c*rand(1));

B .Employed bees' phase

In the employed bees' phase, a local search in the neighbourhood of each directional window, represented by *xi*, is conducted, which is defined by using :

a1=img(row-area,col-area);
b1=img(row,col-area);
c1=img(row+area,col-area);
d1=img(row+area,col+area);

If we get better fitness than before ,then memorize the current one.

```
if(localPSNR>prevPSNR)
   prevPSNR=localPSNR;
   bestimg=reconstimg;
```

After generating a new neighbour solution (*vi*) by local search, the fitness (quality) of new solution is evaluated and the better one is kept in the population. Here the counter is incremented for each local search up to 8 level.

C. Onlooker bees 'phase

In the onlooker bees' phase, a roulette wheel selection scheme is employed to get a best directional window for various size from 1 to M in terms of it fitness value. In roulette wheel selection, each solution is assigned a probability value (Eq. 6.1) proportional to its fitness value:

$$p_i = \frac{fitness_{\ i}}{\sum_{i=1}^{SN} fitness_{\ i}} \qquad (9)$$

After the source is evaluated, a greedy selection is used and the onlooker bee either memorizes the new position by forgetting the old one or keeps the old one. Here the counter is incremented for each local search up to maximum window size M.

D.scout bees' phase

A counter storing the number of non-progressive local searches exceeds the predetermined number (called "limit"), the solution associated with this counter is assumed to be exhausted. When a source (solution) is exhausted, it is abandoned and a new random solution is generated.

V. proposed algorithm

In existing method , decomposing the image using wavelet transform, whereas in proposed method, decomposing the image using wavelet lifting scheme and then apply PSO for prediction process and apply artificial bee colony algorithm in the update process to get a considerable quality.

A.Algorithm steps:

Step 1:Create population of image size and fitness criteria(PSNR)

Step 2:Choose Random pixel p

Step3:Create Random patterns around the Random pixel

Step 4:Apply Prediction function

Step 5:Repeat the above prediction function for all patterns also compute the update process.

Step6 :Reconstruct the image with inverse transform.

Step7:Obtain PSNR for all patterns.

Step 8: Best among them is selected as local best.

Step 9: If local best > global best update the pattern and global best.

Step 10: Repeat step 2-9 for various random pixel about the no. of iterations or until fitness criteria is met.

Artificial bee colony algorithm is used to find different update coefficient by local search, atlast optimally choose the best update coefficient to get best quality of compressed image.

In the update step the center pixels are modified with the co-efficient in 8 – different direction with a considerable window size by using local search.

A best directional window with a considerable size is obtained using artificial bee colony algorithm to obtain the best reconstructed image, which can be considered as an optimization task

Step 1: Scan each pixel in the decomposed image and calculate its present fitness value and compression ratio.

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 1, January 2014

Step 2: Call direction finding algorithm to predict 'a' and 'b' co-efficient of all 8- direction combination.

	D1		V1	D2	
		D1	V1		
H1	H1	H1	X	H2	H2
	D3	D3	V2	D4	
D3			V3		D4

Fig 4 Directional coefficient for center pixel 'x'

Step 3: Calculate update weight by using Update lifting formula for each direction prediction and find MSE and compression ratio for all combination.

Step 4: Memorize the best individual MSE, CR and its direction using ABC local search.

Step 5: Iterate K from (0 to M).here we going to predict and update the best value for different range of window size.

Step 6: Using ABC local search, memorize the best window size in terms of its MSE and CR for each reference pixel.

VI .EXPERIMENTAL RESULTS

The proposed PSO and ABC based hybrid lifting Method is simulated and verified and is compared with normal lifting. The images such as Camera man, Lena,peppers and Rice etc of size 512 x 512 are tested. The Reconstructed images are shown in figure 5 and figure 6. The results are tabulated for various images in Table (1),(2) and Fig7 Shows the performance graph.

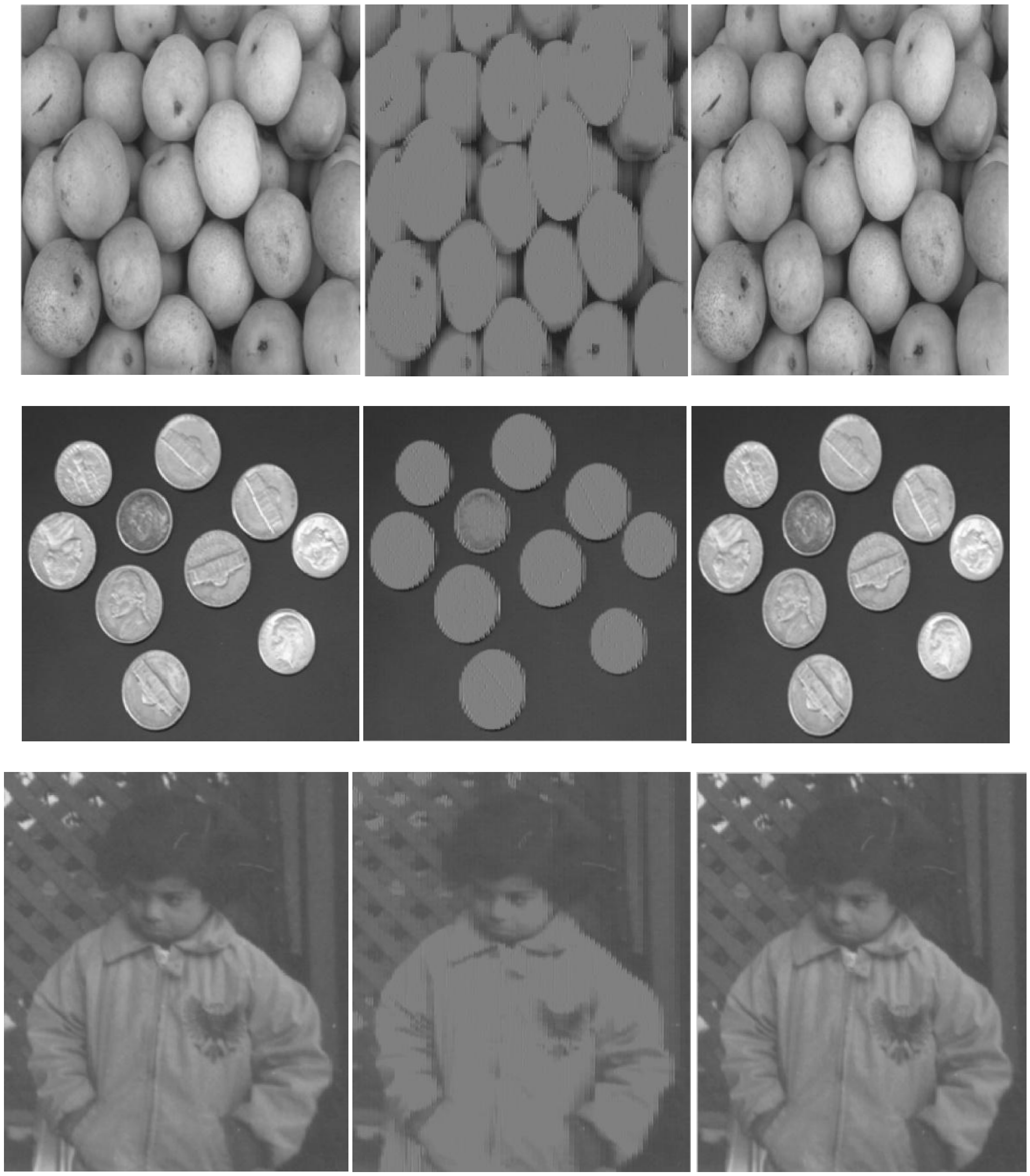
(a) (b) (c)

Figure 5 . Reconstructed Images with wavelet transform and lifting with ABC

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 1, January 2014

(a) Original Image
(b) Output of normal lifting scheme
(c) Output of hybrid Lifting Scheme with PSO and ABC



(a) **(b)** **(c)**

Figure 6 . Reconstructed Images with wavelet transform and lifting with ABC

(a) Original Image
(b) Output of normal lifting scheme
(c) Output of hybrid Lifting Scheme with PSO and ABC

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

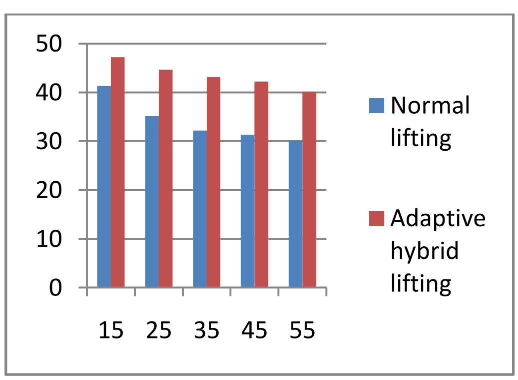
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 1, January 2014

Table 1: PSNR values for normal lifting and Adaptive hybrid lifting for Lena Image

	Normal lifting			Adaptive hybrid lifting		
	PSNR	Encoding time	Decoding time	PSNR	Encoding time	Decoding time
15	41.35	3.125	0.458	47.25	2.845	0.28
25	35.18	4.876	0.499	44.66	4.381	0.37
35	32.18	4.987	0.845	43.27	4.431	0.29
45	31.34	7.980	0.896	42.25	3.641	0.132
55	30.16	7.995	0.965	40.19	3.591	0.129

Table 2: PSNR values for normal lifting and Adaptive hybrid lifting for Peppers image

CR	Normal lifting			Adaptive hybrid lifting		
	PSNR	Encoding time	Decoding time	PSNR	Encoding time	Decoding time
15	32.85	6.673	0.76	43.00	5.175	0.37
25	30.93	8.972	0.86	41.84	5.326	0.53
35	29.97	8.979	0.87	40.93	5.519	0.63
45	28.34	7.546	0.93	32.78	3.662	0.71
55	27.52	7.776	0.99	30.53	3.716	0.84



PSNR

CR

Figure 7.: Plot of PSNR vs CR for normal lifting and Adaptive hybrid lifting for Lena Image

VII CONCLUSION AND FUTURE ENHANCEMENTS

In this paper PSO and ABC algorithm are applied to prediction process and update process. Therefore PSO improves the accuracy of the prediction function where a ABC algorithm finds the best directional window of lifting scheme to give better PSNR. From the experimental result, it is concluded that proposed hybrid method give improved quality compare to existing method. It gives the way to reduce data to represent the image and decrease in transmission bandwidth. So, the transmission cost and memory cost is reduced with help of proposed method.

In future work, Artificial bee colony algorithm can be implemented in the thresholding process to reduces the number of coefficient representing the image by optimally choosing the thresholding value to get more better compression and quality.

REFERENCES

[1] B. Akay and D. Karaboga, Parameter tuning for the artificial bee colony algorithm, ICCCI 2009 (R. Kowalczyk N.T. Nguyen and S.-M. Chen, eds.), LNAI, vol. 5796, 2009, pp. 608–619.
[2] J. Chen, M. Yang, Y. Zhang, and X. Shi, Ecg compression by optimized quantization of wavelet coefficients, ICIC 2006, LNCIS, vol. 345, Springer-Verlag Berlin Heidelberg, 2006, p. 809814.
[3] R.R. Coifman and M.V. Wickerhauser, Entropy-based algorithms for best basis selection, IEEE Transactions on InformationTheory 38 (1992), no. 2, 713–718.
[4] V. U Kale and N. N. Khalsa, Performance evaluation of various wavelets for image compression of natural and artificial images,International Journal of Computer Science and Communication1 (2010), no. 1, 179–184.
[5] D. Karaboga, An idea based on honey bee swarm for numericaloptimization, Tech. Report TR06, Erciyes University, Engineering Faculty, Computer Engineering Department, 2005.
[6] D. Karaboga and B. Akay, A survey: Algorithms simulating bee swarm intelligence, Artificial Intelligence Review 31 (2009),no. 1, 68–55.
[7] A modified artificial bee colony (abc) algorithm forconstrained optimization problems, Applied Soft Computing (InPress).
[8] Z. Wang, A. C. Bovik, H. R. Sheikh, and E. P. Simoncelli, Imagequality assessment: From error measurement to structural similarity,IEEE Transactios on Image Processing 13 (2004), no. 1,600
[9] Z. Ye and Ye Y. Mohamadian, H., Digital image waveletcompression enhancement via particle swarm optimization, 2009IEEE Int. Conf. on Control and Automation (Chrisrchurch, NewZeland), 2009, pp. 2287–2292
.[10]W. Trappe and K. J. R. Liu, "Adaptivity in the lifting scheme," in 33th Conference on Information Sciences and Systems, Baltimore, March 1999, pp. 950-
[11]R. Claypoole, G. Davis, W. Sweldens, and R. Baraniuk, "Nonlinear wavelet transforms for image coding via lifting," submitted to IEEE Transactions on Image Processing 1999.Published in international journal

BIOGRAPHIES

M.Mohamed Ismail was born on 03.05.1965 now residing at vellore ,TamilNadu,India.He is Working as Associate Prof ,Dept of Computer Science at Mazharul Uloom College,Ambur -635 802 from 04.10.1989 to till date.He completed his M.Sc physics in 1987 with first class from Bharathidasan University, Trichy, PGDCA in 1988 with first class from Bharathidasan University,Trichy, M.Sc (Info Technology) in 2000 with first class from Alagappa University,Karaikudi. M.Phil (Computer Science) in 2006 with first class from Alagappa University,Karaikudi.At present doing Part time Ph.D at Karpagam University,Coimbatore .He has attended orientation and refresher courses for computer lecturer at various universities in Tamil nadu,and have research papers published in international journals.

Dr.K.Baskaran now residing at Coimbatore,tamilnadu,India.He is working as Associate Prof at Government college of Technology,Coimbatore.He Completed his B.E. degree from Annamalai University and M.E degree from Bharathiyar University,Coimbatore and Ph.D from Anna University,Chennai and have published many papers in national and international journals and guiding many Ph.D scholars at present.