Multi Image Watermarking Using Lagrangian Support Vector Regression

C.M.Namratha, S. Kareemulla

***Abstract*—Watermarking has been used widely for passing the confidential information over Internet, a good watermark will be imperceptible, robust over the various geometric and non-geometric attacks. The watermark shouldn't be easily extracted by the hacker, to achieve this several watermarking methodologies were developed for different domains namely spatial ,frequency and wavelet domains using DCT,DWT and fourier transforms. Here we perform wavelet domain watermarking using Lagrangian Support Vector Regression method. Lagrangian coefficient is to find the minimum point in a line, which uses support vector machine and regression concept for data classification. Arnold Transform is used for image scrambling of the watermark image. The advantage of Arnold transform is the frequency response is same even after scrambling.. We purpose a multi watermarking in the host cell using LSVR for a colour image, which showed good PSNR value. We see that LSVR supports multi image watermarking techniques**

Keywords— Support Vector Machine, PSNR, Lagrangian support Vector Regression

I. INTRODUCTION

The information is transmitted over media internet; it is difficult to protect the secured information, due to the unauthorized access of secured data. There will be several attacks to steal the data. Water marking is a process of embedding/inserting secret information into a host cell. Watermarking, is advantageous compared to cryptographic methods, in cryptography the secret /authenticated data lies with the secret key. If the secret key is decrypted by the attackers, then we cannot stop the reproduction [1] whereas in watermarking the secret information lies within the host cell.

Watermarking is of two types: Blind Watermarking and Non-Blind watermarking. In blind watermarking, the watermark embedded is required for extraction, and in Non-Blind watermarking scheme, there is no need of embedded watermark image for extraction purpose.

The host cell size must be obviously larger than watermark image. The watermarking scheme should satisfy the following properties:

Robustness: The watermark shouldn't be easily extracted, by having partial knowledge.

Unobtrusiveness: 'The watermark should be completely invisible, it shouldn't interfere with the undergoing work' [1].

Imperceptibility: The watermark shouldn't be visible to human eye, perceived by special handling [2].

C.M.Namratha,P G Scholar (DEC): Department of Electronics & Communication, MVJ College of Engineering,Bangalore, India (nammu.math@gmail.com)

S. Kareemulla, Assistant Professor: Department of Electronics & Communication, MVJ College of Engineering,Bangalore, India (kareemulla434@gmail.com)

Regression is the methodology of detecting input and output relationship using mathematical formulation. Regression comes under machine learning, which prediction is given by a computer without explicit programming. Minimization is the problem in machine learning.

Support Vector Regression deals with data classification and analyzing the data, the problem with SVR was the size and speed limitation of datasets, and the algorithm complexity increases for quadratic programming and even the memory requirements increases to overcome with SVR, Lagrangian Support Vector Regression was developed.

'The main advantage of LSVR is that optimization is not required, it can start from any point [3]. Solution is obtained by taking inverse of matrix of order, which is equal to input samples at the starting of iteration, rather than solving quadratic optimization problem' [3]. Minimization problem is overcome with high generalization property.

The wavelet domain is preferred here as each pixel information can be examined, by sub sampling, and due to multi resolution property of DWT , DWT is prefered here.

According to the latest research Lagrangian support vector regression (LSVR), provided high robustness, imperceptibility, high generalization. We propose LSVR in wavelet domain, i.e. DWT [12.] for multi watermarking in the host image.

II. LITERATURE SURVEY

There are several techniques for watermarking; Several Papers were published in watermarking in different domains using different methods.

In 1997, I.J.Cox et al presented watermarking in multimedia, using spread spectrum in spatial domain [1].

In 2002, P. Moulin et al presented a thesis regarding data-hiding capacity, or for maximum reliable transmission [4].

In 2003, Chin-Chen Chang et al, gave an idea for 'embedding the watermark, using the human visual effects of host cell, and for generating secret key for watermark retrieval along with extracted image feature' [5].

In 2004, G. Tang et al, developed a blind watermarking scheme on neural network, using chaotic maps [6], where robustness was achieved at higher rates.

In 2009, X.B. Wen et al, proposed a blind watermarking in wavelet domain using probabilitstic neural network[7], this technique showed good results, against several attacks such as additive Wide Gaussian Noise[AWGN], Median filtering, Cropping, Gauss filtering and JPEG.

In 2001, O.L. Mangasarian et al published the thesis on lagrangian support vector machine [8]. The idea of lagrangian coefficients in vector machine came into application.

In 2005, C.H. Li et al, gave a watermarking technique using support vector regression (SVM) to watermark, which showed high robustness, perception and had high security [9].

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R. Mehta et al came up with lagrangian support vector regression using fuzzy entropy for gray image in DCT domain [10] showed robustness and imperceptible.

In 2010, S. Balasundram et al, published paper on LSVR [3] to demonstrate the practical application of LSVR using real time- applications.

In 2013, S. Balasundram et al, came up with a new idea of lagrangian twin support vector regression, 'the inverse of matrices obtained by performing matrix subtraction of the identity matrix by a scalar multiple of inverse' [11].

In 2015, R. Mehta et al, proposed 'Lagrangian Support Vector Regression, in wavelet domain, which shows imperceptibility, robustness and showed high PSNR values in spite of several attacks' [12].

III. PROPOSED WORK

We propose three different watermarks of size (32X32) into colour image (Lena) of size (512 X 512). The procedure for watermarks insertion and extraction shown below. While sub sampling the color image it is divided into Red, Blue and Green plans. We add the 3 different watermarks in 3 different RGB planes of the host (Lena) image and obtain three watermarks after watermark extraction.

Watermark insertion and Watermark extraction shown below :

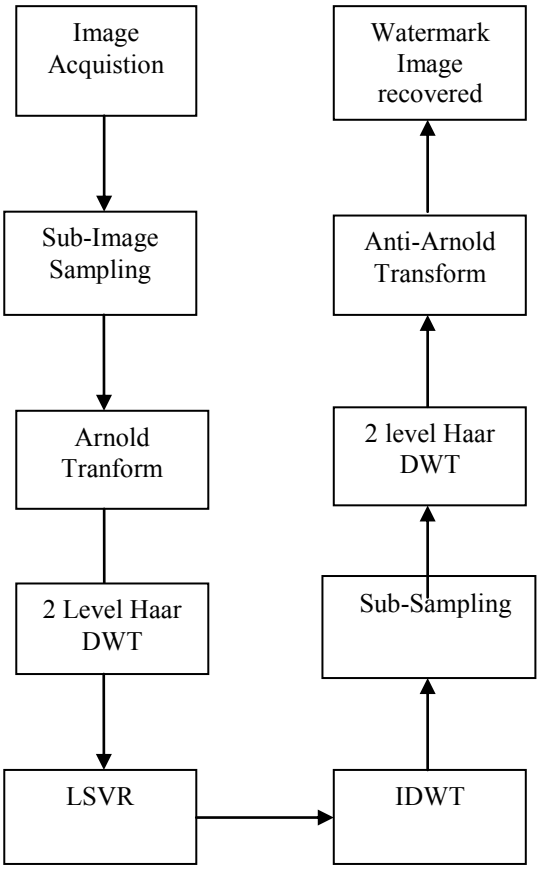


Fig. 1: Block Diagram of watermarking process- Insertion and Extraction of watermarks

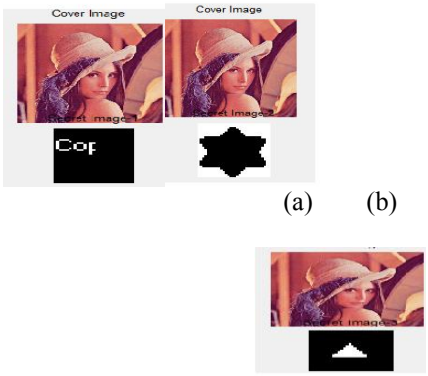
Watermark Insertion:

1) The Colour Image of size 512x512 is host image and 3 watermarks are of size 32X32 each.
2) Apply Arnold Transform to each of the watermark image for scrambling.
3) Perform sub sampling to host image, i.e. by dividing into four parts, 'LL,LH,HL,HH'[12], representing average, vertical horizontal and diagonal respectively.
4) Apply DWT to each subsample, to obtain lower frequency component, as information lies in lower set forming data set[DS] from each lower frequency component.
5) For LSVR insertion, we use even samples to embed the watermark, and odd samples to train LSVR.
6) LSVR embedded images in each four different bands is obtained, thus the 3 watermarks are embedded using LSVR.

Watermark Extraction:

1) For watermark extraction, apply Inverse Discrete Wavelet Transform to obtain the sub-sampled images in DWT.
2) LSVR extraction step is same as LSVR insertion, after which a watermark recovered image is obtained.
3) The scrambled watermark is applied Arnold transform to obtain original watermarks.

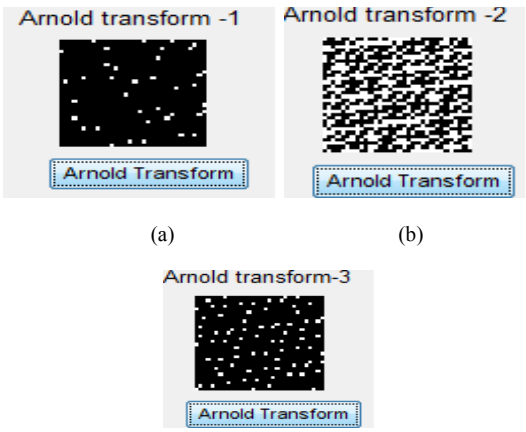
IV. RESULTS AND TABULATION



(a) (b)

(c)

Fig. 2: (a) Orginal Lena color Image with 3 different watermarks



(a) (b)

(c)

Fig . 3 . (a) Arnold Transform for the 3 watermarks

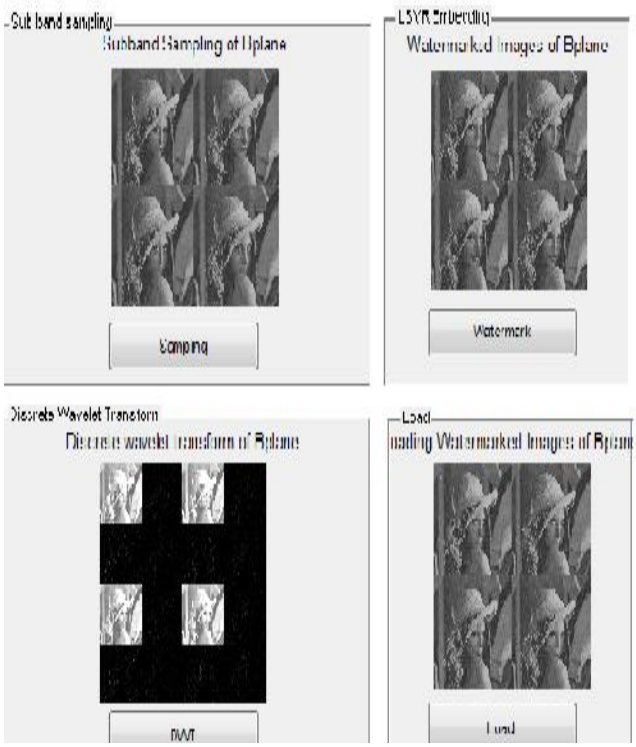


Fig . 4. (a) Sub Sampling of Lena Color Image for different R, G, B planes. Here for B plane DWT and watermark Insertion shown

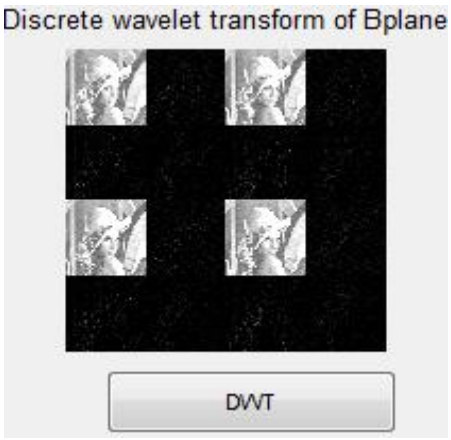


Fig.4: (b) DWT for B- Plane (watermark extraction process)

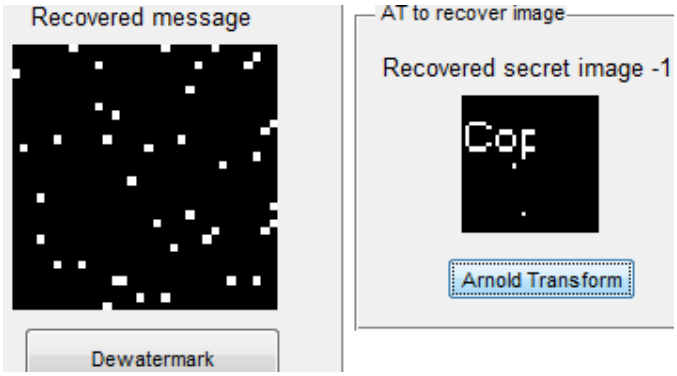
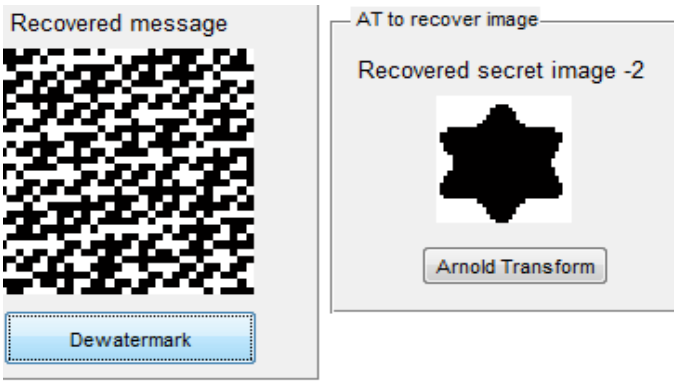
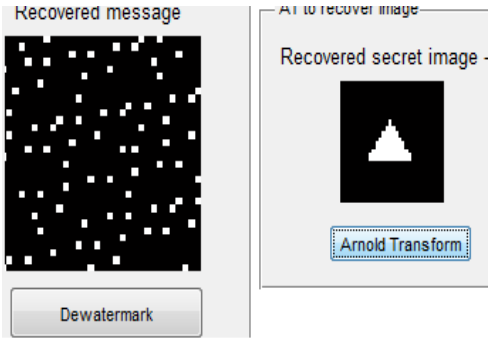


Fig . 5 : (a) Recovered Watermark 1 along with scrambled and original image



(b) Recovered Watermark 2



(c) Recovered Watermark 3

Table 1 . PSNR values for 3 watermarks

WATERMARK	PSNR
	76.448
	75.4345
	76.3171

The 3 different watermarks were inserted into the Lena colour image, results showed the successful transmission. The watermarks showed an excellent PSNR value, which is clear that the multi watermarking showed good response using LSVR. The watermarks are robust to different attacks and the PSNR degradation doesn't occur with large difference. BER can also be tabulated.

V. CONCLUSION

Here the objective was to use a huger size of watermark for host Lena colour image, but the LSVR didn't support the large size of watermark image, thus a multi – image watermarking idea was developed were at a time we can perform the 3 different watermark insertion, the PSNR values showed the excellent transmission of the multi watermarking in the host image. Thus the addition of different noises, BER values can be confined to further work.

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