IMAGE WATERMARKING TECHNIQUE BASED ON CHAOS AND FOURIER TRANSFORM

[1]VIVEK GUPTA
[1]*Department of Science, HLM Group of Institutions, Delhi- Meerut Road*

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ABSTRACT

In this paper , We propose a new method for image watermarking technique based on chaotic fourier transform. Image watermarking technique has become an interesting field of research for the protection of copy right of data. Logistic or chaotic maps have been used in the proposed technique. Chaotic maps are used to generate the random phase masks and this phase masks are known as chaotic random phase masks. Chaotic maps have been used in watermarked encoding and decoding process.The watermark encoding method in the proposed technique is based on the double random phase encoding method. Chaotic maps used to generate the CRPM. Numerical simulations have been performed on a matlab platform to verify the validity of the proposed technique. In simulation's results, we have discussed input image , host image , the first CRPM, the second CRPM.

Keywords: *Image watermarked encoding and decoding , Chaotic maps/Logistic maps ,CRPM (Chaotic random phase mask) , Chaotic Fourier transform*

INTRODUCTION

Image Watermarking

The image watermarking is a data security method in which an image (cover image) is embedded with in another image which is known as the host image such that the host image does not suffer from several degradation [1]. If $Q_c(\xi,\eta)$ is the cover image in the frequency domain then the watermarked image can be defined as [13]

$$Q_n(\xi,\eta) = Q_c(\xi,\eta) + \alpha H_N(\xi,\eta) \tag{1}$$

where $H_N(\xi,\eta)$ is the normalized host image and can be expressed as

$$H_N(\xi,\eta) = \frac{H_{n0}(\xi,\eta) - H_{\min}}{H_{\max} - H_{\min}} \tag{2}$$

The H_{min} and H_{max} are the minimum and maximum amplitudes of the host image, respectively. The value of the H_N lies between 0 and 1. The cover image is also normalized and its value also lies between 0 and 1. α is the constant-level weighting factor(attenuator) which represents a constant superposition of the holographic watermark over the entire cover image. A value of α depends on the weight selection criterion and the correlation detection procedure. The large value of α will distort the cover image over the entire image plane, resulting in the degradation of the watermarked image for visual inspection. A small value of α represents the low-bit coding, which is vulnerable to deliberate attacks for which the mark information can easily be removed from the watermarked image. The host image should be normalized because holographic watermarking can be achieved by superposing the hologram onto the cover image using various weighting factors such that visual inspection will not recognize the holographically water- marked image containing the mark information. To do this, the amplitude of the non-zero order hologram must be normalized [13]. The most important requirements for watermarking are robustness and imperceptibility.

Chaotic map (Logistic map)

Chaotic maps are those maps which can generate a large number of uncorrelated, random like and deterministic signal with a small perturbation of the parameters. The chaos term is used to describe the complex behavior of simple and well-behaved systems. Chaotic behavior looks as casual, erratic and almost random. Chaotic maps possess several attractive properties [16]. A small difference in the initial value or system parameters leads to a vast change of the chaotic sequence. Keeping the chaotic parameters and initial condition as the secret key, the chaotic signal can be reproduced easily. These properties of the chaotic maps make it suitable for secure communication and robust watermarking systems. Chaos-based image encryption and watermarking techniques rely on the complex dynamics of nonlinear systems or maps which are deterministic but simple [18]..The chaotic map used is the logistic map [22,25–27]. It is defined by

$$f(x) = p.x.(1-x) \tag{3}$$

This function is bounded for $0 < p < 4$. The iterative form of this function is

$$x_{n+1} = p.x_n.(1-x_n) \tag{4}$$

With x_0 as the initial value. This is known as the seed value for the chaotic function. These chaotic maps are very sensitive to their initial conditions, in the sense that two chaotic sequence generated from different initial conditions are uncorre- lated statistically. These chaotic maps are used to generate random phase masks which are known as chaotic random phase mask (CRPMs). The logistic map is one-dimensional chaotic maps. One-dimensional chaotic system has the advantage of high-level efficiency and simplicity

IMAGE WATERMARKING USING DOUBLE RANDOM PHASE ENCODING METHOD

Image watermarking

There are various methods of securing data. Image watermarking is one of them which is used for securing data. The image watermarking is a data security method in which an image (cover image) is embedded with in another image which is known as the host image such that the host image does not suffer from several degradation In the image watermark encoding technique, the information is encoded in such a fashion that, even if it is viewed or recorded, only the application of the correct key will reveal the original information i.e. the information is transferred into another form such that the original information cannot be read without the appropriate knowledge referred to as key of the watermark encoded data. Hence, the confidentiality and authenticity of the information is preserved by using watermarking techniques. Image watermark decoding technique is the inverse process of the image watermark encoding technique. In the watermark decoding technique, the watermark encoded data is transferred back into the original information.

Methodology

The proposed watermarked encoding and decoding technique uses FT and chaotic maps.The watermarked encoding and the decoding processes in the proposed technique are based on the double random phase encoding method. The CRPMs used in the watermarked encoding process is generated by using two different seed values of logistic map. The watermarked encoding and the decoding process are shown in Figs. 1 and 2, respectively. Let $f(x,y)$ be the input image. In the watermarked encoding technique, the input image is multiplied by the first CRPM at the input plane. This CRPM is represented by the phase function $\exp\{i\pi[C(x,y)]\}$, where $C(x,y)$ is the random number sequences generated by using the logistic map seed values at the input plane. The FT operation is performed over it. The distribution obtained is then multiplied by the second CRPM at

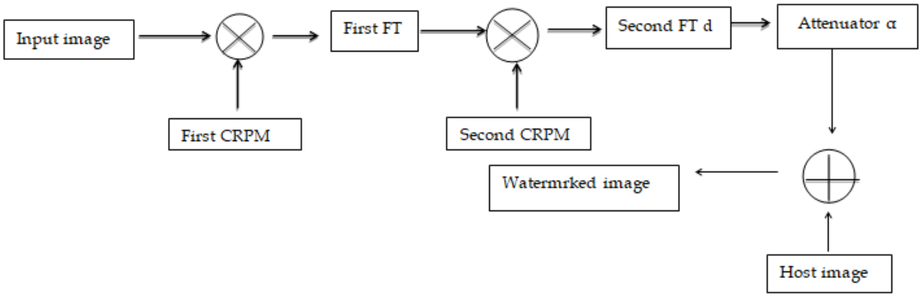

Fig. 6 Block diagram for watermarked encoding process

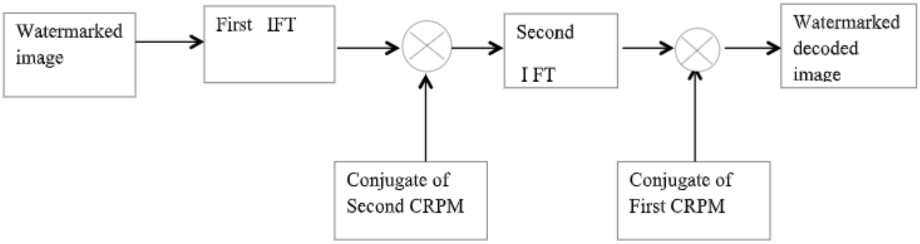

Fig. 7 Block diagram for watermarked decoding process

The FT plane. This CRPM is mathematically expressed as the phase function $\exp\{i\pi[C(u,v)]\}$, where $C(u,v)$ are the random number sequences generated by using the logistic map ,with different seed value at the FT plane. Then it goes into the inverse Fourier transform (IFT) operation. The distribution obtained at the output plane of the IGT is given by

$$Q_c(\xi,\eta) = IFT\{\exp\{i\pi[C(u,v)]\}FT\{f(x,y)\times\exp\{i\pi[C(x,y)]\}\}\} \tag{15}$$

where (x,y) and (u,v) are the input and the output coordinates of the FT system and (ξ,η) is the output coordinate of the IFT system. Then the watermarked image with the weighting parameters α is obtained which is expressed as

$$Q_n(\xi,\eta) = Q_c(\xi,\eta) + \alpha H_N(\xi,\eta) \tag{16}$$

where $H_N(\xi,\eta)$ is the normalized host image. The watermarked decoding process is the inverse of the watermark encoding process. To decode the water- marked image $Q_w(\xi,\eta)$, the FT operation is performed over it and then multiplied by the conjugate of the second CRPM. On the output obtained, IFT operation is performed over it and then multiplied by the conjugate of the first CRPM. The watermarked decoded image is then obtained and it can be expressed as

$$f^d = \alpha f(x,y) + \exp\{-i\pi[C(x,y)]\}FT\{\exp\{-i\pi[C(u,v)]\}FT\{Q_w(\xi,\eta)\}\} \tag{17}$$

The superscript d denotes the watermarked decoding process.

Results

Numerical simulations have been performed on a Matlab platform to verify the validity of the proposed technique. The input image and the host image are shown in Fig. 8 and Fig. 9 ,respectively. The size of the input image and the host images is 100_100 pixels. The chaotic maps that is used in the proposed technique are the logistic map. The first and second CRPM is generated by using the logistic map with the seed value x = 0.241 are shown in Fig. 10 and Fig. 11 respectively. The watermarked encoded image and watermarked encoded image are shown in Fig. 12 and Fig. 13 respectively. The value of the weight factor a used in the technique is 0.05.

Fig 8: The input image

Fig 9. The host image

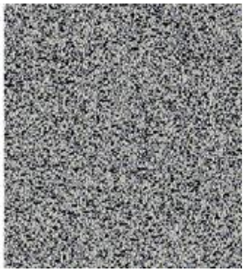

Fig.10 The first CRPM

Fig. 11 The Second CRPM

Fig 12: The watermarked encoded image

Fig 12: The watermark decoded image

DISCUSSION AND CONCLUSION

The image watermarking technique has been proposed using double random phase encoding method. The watermarking will be carried out for 2- dimensional (spatial image plane) images. Two CRPMs with different seed values and host image have been used to watermark the input image. The CRPMs have been generated using Logistic map.These CRPM convert the image into stationary white noise. Using two CRPMs., numbers of the keys have been increased which increase the security level. Two Fourier transform have been used.Computer Simulation has been performed on MATLAB platform. MATLAB program has been written to generate the 2-dimensional CRPM. MATLAB program has also been written for double random phase encoding method using FT

The two random functions are in the spatial and the frequency domain respectively with an uniform probability in [0,1]. The original image multiplied by the first RPM is converted into non-stationary white noise but not encrypted. The complex is filtered through a phase filter having a transfer function which is called the second RPM. The encrypted image is a stationary white noise.

Conjugate of the second RPM is essential key for successful decryption. The method is robust to blind deconvolution.

SCOPE FOR FUTURE STUDIES

1. Random phase mask can be generated using chaotic map. Chaotic maps are very sensitive to initial conditions. Small change in initial condition may change the results of chaotic maps.
2. Other linear canonical transform e.g fractional fourier transform, gyrator transform and Hartely transform may be used to increase the numbers of key for security level
3. Instead of single image, multiple image watermarking can be performed using multiple images.
4. Proposed work can be implemented for encryption technique.

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