

Steganography Using Particle Swarm Optimization-A Review

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Abstract

Steganography is a technique of hiding the data in images. It is derived from Greek word that means “Covered”. Secret messages are embedded into the cover image to hide its existence from the hackers. While hiding the data in the image, there are two main things that we should keep in mind are maintaining the quality and security of image. There are no of points where we can hide the data in the cover image. Finding these optimal points for hiding the data is quite difficult work to do. So we require an efficient method for finding an optimal solution. For that we can use no. of optimization algorithm, Particle Swarm optimization is one of them which can be used for finding an optimal matrix for hiding the data. In this paper we are going to review some techniques of steganography for hiding the data and PSO algorithm for optimization.

**Keywords:** Particle Swarm optimization, Least Significant Bit, Steganography.

Introduction

Steganography is the art and science of hiding the existence of data. The techniques used in steganography make it difficult to detect that there is a hidden message inside an Image file. In this way we are hiding the message as well as hiding it. All the digital file formats can be used as cover images but the image and audio files are more suitable because of their high degree of redundancy<sup>[12]</sup>. Images in which we hide the secret data are known as “Stego-Images”.

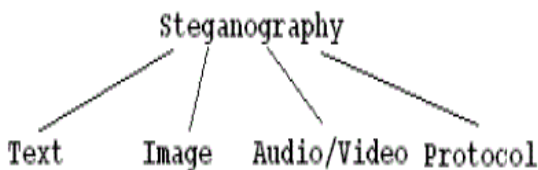


Fig.1 Steganographic Category<sup>[12]</sup>

The main motive of steganography is to keep the data safe from the notice of hackers. There are two fundamental characteristics which must be used in Image steganography, these are: Quality of an image and Security of image. While hiding the data we have maintained these two characteristics.

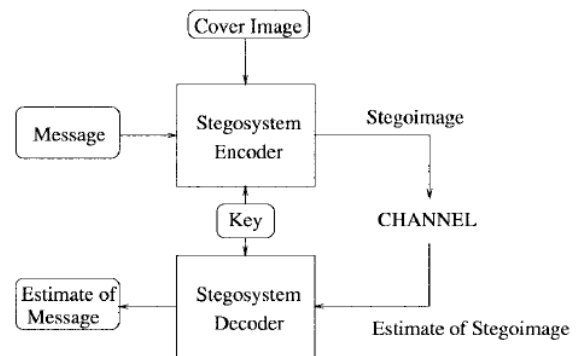


Fig.2 Steganographic system<sup>[13]</sup>

There are no of approaches for hiding the data in images<sup>[1]</sup>.

- 1) Least Significant Bit
- 2) Masking and Filtering
- 3) Transform Techniques

**Least Significant Bit (LSB)** As the name suggest this technique involves hiding the data into the least significant bits of the cover image to hide the existence of the message. It is the simplest technique used in data hiding. As the change in amplitude will be very small so it becomes difficult to identify the change and it achieves high capacity. In this technique we can insert single message bits in last bit of single byte. For increasing the capacity upto 4 bits, it is implemented only to bitmap and wave file.<sup>[6]</sup>

**Masking and filtering** In this technique two signals are embedded into each other in such a way that

only one signal is perceptible by human eye<sup>[9]</sup>. It can be applied only to 24-bits and gray scale images. In this data is hidden in the similar manner as in paper watermarks.

**Transform Domain Techniques** This includes transforming spatial domain into frequency using discrete fourier transform, discrete cosine transform and discrete wavelet transform. In this transform coefficients are mixed with the secret signal such that information hiding becomes transparent to human eye. Transformation techniques are mainly of three types<sup>[9]</sup>.

- 1) Fast Fourier Transform(FFT)
- 2) Discrete Cosine Transform(DCT)
- 3) Discrete Wavelet Transform(DWT)

### Literature Review

In this section we are presenting some research work done in the field of steganography and PSO.

Ching-Sheng Hsu et al<sup>[2]</sup> use the Least Significant Technique of data hiding. The secret message is embedded into the last bits of the cover image to protect it from unauthorized users. For maintaining the quality we have to keep in mind the two main issues that are quality and security. For this researcher uses optimization matrix that helps in finding the optimal points where we can hide the data. For obtaining optimal matrix they use optimization algorithm here they use ACO (Ant Colony Optimization).

Chi-Kwong Chan et al<sup>[3]</sup> This paper presents simple LSB substitution. Optimal pixel adjustment process is applied to the stego-image that is obtained by the LSB method. It helps in improving the complexity of the stego-image. The worst mean square error between the cover and stego-image is calculated and the results obtained show a significant improvement than previous work done.

Saeid Fazli et al<sup>[4]</sup> novel method is presented to embed the message into the cover image so that hacker will not notice the existence of the data. This uses the basic concept of the LSB method and in order to improve the quality and security of the image, the cover image is split into  $n$  blocks of  $8 \times 8$  pixels and message into  $n$  partitions. For finding the optimal solutions or optimal matrix we use Particle Swarm Optimization (PSO) Algorithm. The results show that this method is better than the JPEG and Quantization Table Modification method.

Lin Lu et al<sup>[5]</sup> presents hierarchical structure poly-particle swarm optimization (HSPPSO) approach using the hierarchical concept. In the bottom layer of this structure, parallel optimization is performed on the poly-particle swarms that increases the searching domain and in the top layer, every particle in the bottom layer is considered as single particle swarm. The best position found by the particle in the lower layer is considered as

the best position of the single particle in the top layer. The optimization result of top layer is used by the lower layer. The results show that HSPPSO performs better than PSO.

Jasril et al.<sup>[6]</sup> Least Significant Bit method is among one of the techniques of steganography that is most commonly used for hiding the data because of simplicity. It is implemented by inserting message bits in the last bit of every single byte of carrier file. In this paper author modifying four bits of carrier that helps in increasing the capacity of message to be hidden into the carrier file. In this research, steganography modifying 4-bits LSB was implemented to Bitmap and Wave file.

Guanghui Zeng et al<sup>[7]</sup> proposes a cooperative line search particle swarm optimization (CLS-PSO) algorithm by combining the basic PSO with local line search technique. The performance of this hybrid algorithm is evaluated using four nonlinear optimization problems. The results show that CLS-PSO is better than basic PSO.

Ranjit V. Bobate et al<sup>[8]</sup> The main purpose of this research is to develop a data hiding technique that is secure and optimal in 24 bit true color image. This helps to embed a large amount of secret message bits as well as maintaining the quality of the image. The method embeds secret bits in the next LSBs of some pixels of the cover image.

K.B. Raja et al.<sup>[9]</sup> This paper presents image steganography that combines the two techniques of steganography that are Least Significant Bit (LSB), Discrete Cosine Transform. Along these compression techniques are used on raw images to increase the security of the payload. Firstly LSB algorithm is used to insert the bits into the cover image that results to make the stego-image. This stego-image is transformed from spatial domain to the frequency domain using DCT. After that compression algorithms are used to enhance the security. The approach of combining the LSB, DCT and compression techniques helps to transfer data securely with low BER (Bit Error Rate) and MSE (Mean Square Error).

Jalal A. Nasiri et al.<sup>[10]</sup> This paper presents a technique for detecting the lips in the color images using PSO. PSO is used to find optimized solution. The main motive behind this method is that lip has high values of Cr and low values of Cb. The results show that we have achieved 92% correction rate as compared to previous approach and 11% increase in lip detection.

S. M. Masud Karim et al.<sup>[11]</sup> This paper introduces different approach that enhances the existing LSB technique to improve its security. This new approach hides the secret message into the cover image and a secret key encrypts the information that is hidden in the image to protect it from the notice of hackers. Normally

information is hidden into the specific positions of LSB of image but in this it is hidden into the different position depending on the secret key. For measuring the quality Peak Signal-to-Noise Ratio (PSNR). The results show that it is better than normal approach.

### Conclusion

The main purpose of this paper is to review the techniques of steganography and optimization algorithm. We had reviewed the techniques of embedding the secret data into the image so as to keep the data safe from intruder and PSO algorithm for finding the optimal points. In future we will construct an algorithm which will first find the optimal pixels which are suitable for hiding the text in the image so that it enhances its quality and security.

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