Implementation of Honey Bees Foraging Optimization for Image Stegnography

Sunil Khullar[1], Dharminder Kumar[2],Mankiran Kaur[3]
[1, 2] Assistant Professor, Department of Computer Engg, Rayat Technology Campus, S.B.S. Nagar, Punjab
[3]Assistant Professor, Department of Computer Engg, Quest Group of Institutions Mohali, Punjab
[1]sunilkhullar222@yahoo.co.in, [2]dkdropar@gmail.com, [3]mankiranquest@gmail.com

***ABSTRACT*: Honey Bee Foraging Optimization is a swarm based meta-heuristic algorithm introduced, and simulates the foraging behavior of honey bees. Steganography is the art of hiding the fact that communication is taking place, by hiding information in other information. Many different carrier file formats can be used, but digital images are the most popular because of their frequency on the Internet. This paper intends to give an overview of image steganography & Honey Bee Foraging Optimization (HBFO). It attempts to identify a good steganographic algorithm based on Honey Bee Foraging Optimization (HBFO).**

***Keywords*: Honey Bee Optimization, Image Steganography**

INTRODUCTION

Artificial Bee Colony (ABC) algorithm is a swarm based meta-heuristic algorithm introduced by Karaboga in 2005, and simulates the foraging behavior of honey bees. The ABC algorithm has three phases: employed bee, onlooker bee and scout bee. In the employed bee and the onlooker bee phases, the bees exploit the sources by local searches in the neighborhood of the solutions selected based on deterministic selection in the employed bee phase and the probabilistic selection in the onlooker bee phase. In the scout bee phase which is an analogy of abandoning exhausted food sources in the foraging process. The solutions that are not beneficial anymore for search process are abandoned and new solutions are inserted instead of them to explore new regions in the search space. The algorithm has a well-balanced exploration and exploitation ability and the performance of ABC is analyzed in 2007 .The ABC algorithm is developed by inspecting the behaviours of the real bees on finding food source, which is called the nectar and sharing the information of food sources to the bees in the nest. Each of them plays different role in the process: the employed bee stays on a food source and provides the neighborhood of the source in its memory, the onlooker gets the information of food sources from the employed bees in the hive and select one of the food source to gather the nectar and the scout is responsible for finding new food, the new nectar sources. Steganography is the art of hiding the fact that communication is taking place, by hiding information in other information. Almost all digital file formats can be used for steganography. Images are the most popular cover objects used for steganography. In the domain of digital images many different image file formats exist, most of them for specific applications. Image steganography techniques can be divided into two groups: those in the Image Domain and those in the Transform Domain. Image – also known as spatial – domain techniques embed messages in the intensity of the pixels directly, while for transform – also known as frequency – domain, images are first transformed and then the message is embedded in the image. Image domain techniques encompass bit-wise methods that apply bit insertion and noise manipulation and are sometimes characterized as "simple systems".

Honey Bees Foraging Optimization Algorithm

The process of the Honey Bee Foraging Optimization algorithm is presented as follows:
It is assumed that there is only one artificial employed bee for each food source. In other words, the number of employed bees in the colony is equal to the number of food sources around the hive. The main steps of the algorithm are given below:

Initialization Phase

REPEAT
EmployedBeesPhase
OnlookerBeesPhase
ScoutBeesPhase
Memorize the best solution achieved so far
***UNTIL** (Termination condition is satisfied)*
At the first step, a randomly distributed initial population (food source positions) is generated. Provided that the nectar amount of the new one is higher than that of the previous source. The bee memorizes the new source position and forgets the old one. Otherwise it keeps the position of the one in its memory. As in the case of the employed bee, it produces a modification on the source position in its memory and checks its nectar amount providing that its nectar is higher than that of the previous one.

PARAMETERS

n: number of scout bees
m: number of sites selected out of *n* visited sites

e: number of best sites out of *m* selected sites
nep: number of bees recruited for best *e* sites
nsp: number of bees recruited for other (*m*-*e*) selected sites
ngh: initial size of patches which includes site and its neighborhood and stopping criterion

1. Initialize population with random solutions. (*n* scout bees are placed randomly in the search space.)
2. Evaluate fitness of the population.
3. While (stopping criterion not meet)
   //Forming new population.
4. Select sites for neighbourhood search. (Bee that have the highest fitnesses are chosen as "selected "and sites visited by them are chosen for neighbourhood search.)
5. Recruit bees for selected sites (more bees for best *e* sites) and evaluate fitnesses.
6. Select the fittest bee from each patch. (For each patch, only the bee with the highest fitness will be selected to form the next bee population.)
7. Assign remaining bees to search randomly and evaluate their fitnesses.
8. End While

STEGNOGRAPHY TECHNIQUES

Image steganography techniques can be divided into two groups: those in the Image Domain and those in the Transform Domain.

i. Image Domain

Least Significant Bit :
Least significant bit (LSB) insertion is a common, simple approach to embedding information in a cover image. The least significant bit (in other words, the 8th bit) of some or all of the bytes inside an image is changed to a bit of the secret message. When using a 24-bit image, a bit of each of the red, green and blue colour components can be used, since they are each represented by a byte. In other words, one can store 3 bits in each pixel. An 800 × 600 pixel image, can thus store a total amount of 1,440,000 bits or 180,000 bytes of embedded data.

ii. Transform Domain

To changes in its colour. This fact is exploited by the JPEG compression by down sampling the colour data to reduce the size of the file. The colour components (U and V) are halved in horizontal and vertical directions, thus decreasing the file size by a factor of 2. The next step is the actual transformation of the image. For JPEG, the Discrete Cosine Transform (DCT) is used, but similar transforms are for example the Discrete Fourier Transform (DFT). These mathematical transforms convert the pixels in such a way as to give the effect of "spreading" the location of the pixel values over part of the image. The DCT transforms a signal from an image representation into a frequency representation, by grouping the pixels into 8 × 8 pixel blocks and transforming the pixel blocks into 64 DCT coefficients each. A modification of a single DCT coefficient will affect all 64 image pixels in that block. The next step is the quantization phase of the compression. Here another biological property of the human eye is exploited: The human eye is fairly good at spotting small differences in brightness over a relatively large area, but not so good as to distinguish between different strengths in high frequency brightness This means that the strength of higher frequencies can be diminished, without changing the appearance of the image. JPEG does this by dividing all the values in a block by a quantization coefficient. The results are rounded to integer values and the coefficients are encoded using Huffman coding to further reduce the size.

1. Proposed Research Work

Since Bee colonies are very efficient in exploiting the richest food sources based on scouts that communicate information about new food sources by means of a so-called waggle dance. Some human artifacts also fall into the domain of swarm intelligence, notably some multi-robot systems, and also certain computer programs that are written to tackle optimization and data analysis problems. The research work suggests hiding information in other information (all digital image) file formats using HBFO i.e. image stegnography by applying Honey Bee Foraging Optimization Algorithms. Further performance of designed algorithm can be evaluated by comparing with those of other Stegnograph techniques using image quality measurement parameters. The parameters are:

A. Mean-Squared Error

The mean-squared error (MSE) between two images is:

$$MSE = \frac{\sum_{M,N}[I_1(m,n) - I_2(m,n)]^2}{M * N}$$

M and *N* are the number of rows and columns in the input images, respectively.

B. Peak Signal-to-Noise Ratio

Peak Signal-to-Noise Ratio (PSNR) avoids this problem by scaling the MSE according to the image range

$$PSNR = 10\ log_{10}\left(\frac{R^2}{MSE}\right)$$

PSNR is measured in decibels (dB).

CONCLUSIONS

A Color images Quantization is necessary if the display on which a specific image is presented works with less colors than the original image. The earlier research work suggests that images quantized with Honey Bee Foraging Optimization technique gives good results; way that lead to image stegnography using HBFO. Be case frequency of digital images usage on the Internet is high, a good HBFO algorithm in terms of time & complexity for image stegnography can break many barriers in internet usage.

REFERENCES

[1] Freisleben B., Schrader A., "An evolutionary approach to color image quantization", Proceedings of IEEE International Conference on Evolutionary Computation, 459-464, 1997.

[2] Jamil, T., "Steganography: The art of hiding information is plain sight", IEEE Potentials, 18:01, 1999

[3] Silman, J., "Steganography and Steganalysis : An Overview", SANS Institute, 2001

[4] Provos, N. & Honeyman, P., "Hide and Seek: An introduction to steganography", IEEE Security and Privacy Journal, 2003

[5] Wang, H & Wang, S, "Cyber warfare: Steganography vs. Steganalysis", Communications of the ACM, 47:10, October 2004

[6] Pham DT, Ghanbarzadeh A, Koc E, Otri S, Rahim S and Zaidi M, "The Bees Algorithm". Technical Note, Manufacturing Engineering Centre, Cardiff University, UK, 2005.

[7] Karaboga.D, "An idea based on honey bee swarm for numerical Optimization". Technical Report TR06, Erciyes University, Engineering Faculty, Computer Engineering Department, 2005.

[8] Marco Dorigo and Mauro Birattari, Swarm intelligence. Scholarpedia, 2(9):1462,(2007).

[9] Rafael Parpinelli and Heitor S. Lopes, "Theory and New Applications of Swarm Intelligence " ISBN 978-953-51-0364- 6, DOI: 10.5772/1405 March 16, 2012.

[10] Rachel Hager, "An Introduction toImage Processing with MatLab".