



# Analysis of Adaptive Lossless Image Compression using Hybrid Particle Swarm Optimization Spider Monkey Optimization (PSOSMO) Algorithm

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## Abstract:

The compression of image is actually plays an important role to compress the data in case of digital images. Mainly image compression is used to reduce the redundancy. It is done such that overall memory requirement and processing requirement and less time should be taken for transmitting the data from one place to other place. Image compression reduces the size in bytes without compromising the quality of the image. Spider Monkey Optimization (SMO) and Particle Swarm Optimization (PSO) are the two algorithms which are used for the image compression.

**Keywords:** SMO, PSOSMO, CCTV

## I. INTRODUCTION

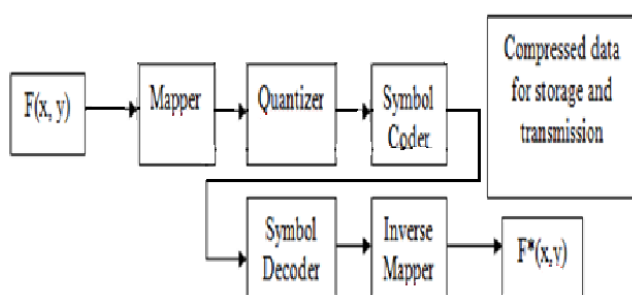
The compression of image is actually plays an important role to compress the data in case of digital images. Mainly image compression is used to reduce the redundancy. It is done such that overall memory requirement and processing by using these algorithms, some of the important parameters such as Peak Signal To Noise Ratio (PSNR), Compression Ratio (CR), Bits per Pixels (BPP), Mean Squared Error (MSE) is to be calculated. After calculating these parameters, it may be concluded that PSNR, CR, BPP is more in PSOSMO algorithm in case of test images. This hybrid algorithm is compared to PSO, while MSE is less in PSOSMO algorithm than PSO. In this thesis work, Spider Monkey Optimization algorithm has been implemented successfully over PSO for the image compression. memory requirement and processing requirement and less time should be taken for transmitting the data from one place to other place. Image compression reduces the size in bytes without compromising the quality of the image. There are plenty of the applications which require large no. of images to produce. That means large amount of storage space requirement and large amount of processing required. If certain image compression technique is followed then naturally space requirement will be reduced and also processing time requirements will be reduced [1],[2]. Now a day's CCTV camera takes 24\*7 moving videos and records them. Under such situations large memory will be required. Which can in results reduces the functionality and increases the cost. If some compression agent is incorporated then memory space requirement will be reduced and in results decreases the memory space requirements. Image compression is to compress the image so that amount of required space and processing can be reduced. Image compression is done with various techniques. Each technique has different abilities to compress the images. As the compression amount in each technique is different. Some algorithms which perform the compression of image in different ways: some are lossless and keeps same information as the original image. While

compressing the image, some other losses the information. These compression methods are designed for some specific kinds of images. Some methods are not good for other types of images. Many algorithms change some parameter for finding the better results of image compression. Some formats match with many images which are better than others and that depending on what type of images and obtain good looking. The image compression techniques are mainly classified into types of categories: Lossless image compression and Lossy image compression. Ajay Kumar Boyat, Parth Khare[1] discussed that it is attempt to combine the effects of block least mean square algorithm (BLMS) to maximizes the Peak Signal to Noise Ratio (PSNR), along with singular valued decomposition (SVD), so as to achieve results that bring us closer to aim of perfect reconstruction. The results show that the combination of these methods provides efficiency and easy computations. Ali A.Al-Azza, Amaar A. Al-Jodah[2] had proposed a paper is to introduced that Spider Monkey Optimization is an optimization technique for the electromagnetic study and the Community of antenna theory. Spider monkey optimization technique gives the foraging behavior of spider monkeys. This optimization process is used to study the linear array factor array factor and designed for E-shaped patch antenna in wireless system. Amandeep kaur, Monika Goyal [3] the medical imaging methods can be used to detect the diseases. The problem is to store the medical images by the physicians encounter. This storage occupy more area for storing images long time as there is need to keep the record of numerous patients. So there is need to compress the image can be suited in an area of medical images including X-Rays, ultrasound images, Brain MRI, CT images and so on. Ammar A. Al-Jodah, Frances J. Harackiewicz [4] had proposed a paper that spider monkey optimization shows the behavior of spider monkeys and it is the new intelligence swarm technique. Different examples are represented to show the efficiency of SMO and result obtained by other popular optimization technique. Bhaskar Mishra, Bhanu Partap Singh[6]studied that every day a large amount of information

is to be stored. Processed, and digitally transmitted. Compression of image allows Picture Archiving and Communication (PACS) to detract the size of files on the basis of their storage necessities while maintains the information is to be relevant. This algorithm represents various compression methods as it is applicable for various fields of image processing. Chunjan Ouyang, Xia Li [7] uses a best Wavelet packet based on image compression for PSO. PSO technique is used to find out the best wavelet packet. A mean squared error is obtained from the fitness function and entropy is compared with the threshold compression algorithm. Dianxun Shuai, Bin Zhang [9] represents a new (GPM) initiated particle model which creates coding for lossless compression. The basic algorithm provides the properties of GPM which is to be discussed in the compression method. GPM has many advantages in terms of lossless compression based on the properties and easy implementation of hardware. Gaurav Gupta and Parul Thakur [10] studied that image compression plays an important role in case of data compression that encodes the original image within few bits. The size of data is reduced in data compression method and reduces the redundancy. So data can be transmitted in an efficient form and it should be stored properly. G. Scarmana [11] this gives the effect of Portable Network Graphics (PNG) based on lossless image compression and gives the floating point elevation values for 16 bit DEM. The portable network graphics is a general purpose method for patient free image format and it is universally supported lossless compression.

## II. IMAGE COMPRESSION MODEL

Compression is process of coding that will reduce the total number of bits needed to represent information effectively. By human visual system, Image is a two dimensional signal processed. Image data plays a vital role in many applications such as Remote sensing Military, Industrial quality control. Compression is an art and science of decreasing the amount of information required to signify the image. It is the most successful and useful technology in the field of digital images. The reduce size represents to allows more images to be showed in a given quantity of disk space. The block diagram of image compression model shows that the mapper transforms the image  $f(x,y)$  to reduce the spatial and temporal redundancy. Quantizer reduces the output accuracy in pre-established criterion area. The symbol encoder creates variable length code to form a compressed data for storage and transmission. Decoder has two blocks such as inverse mapper and symbol decoder, which perform in reverse order to recover the original image from the compressed image.



**Figure.1. functional Block Diagram of General Image Compression Model.**

The above diagram shows that the image compression takes an original data and generates compressed data as compared to

original data having less number of bits. This is done by the process of decompression. Decompression is the reverse process that takes the compressed data and generates or reconstructs the data as shown in figure 1.

## III. IMAGE COMPRESSION TECHNIQUES

**A. Lossless image compression:** In this technique, the reconstructed image is same as the input image. In this lossless technique, first image will be broken down into pixels. Each pixel will be treated independently. In first step first next pixel value is predicted. In second step, the difference between the predicted and actual value of the next value will be encoded. There are various methods for encoding like

1. Huffman Encoding
2. Run length Encoding
3. Incremental Encoding

### B. Lossy compression technique

Lossy compression techniques provides higher compression ratio as compare to lossless compression technique. In this technique, the image compressed is not same as to the original image. Some amount of information is lost in this technique.

1. Vector Quantization
2. Wavelet Compression
3. Transformation Coding

### Problem Formulation

Image compression is measured in terms of their compression ratio i.e. mainly compression ratio is defined as the ratio of total number of bits in the original image and number of bits in its compressed form of representation. Compression ratio increases when more of noise is added to the data. In this paper, we have to receive data online, save more time and space utilization. Dictionary based image compression techniques are the most popular form of lossless data compression. But this paper explained how dynamic dictionary is generated in the forward move. Code is generated for each string which is coming from dictionary. It also explained how it is used in the next block of data and it takes less bandwidth and less time. This paper is only for textual data. Mainly four parts of textual substitution data: fixed length code, fixed length phrases, variable length phrases, variable length code word. Dictionary based compression technique is equivalent to compress the textual data. In image file, it has large number of redundancy and it will be very helpful for image compressing.

### Characteristics which judge the compression algorithm

The quality of image describes the fidelity of image compression scheme for the data source image. Following parameters which judge the performance of compression algorithm:

- Peak Signal To Noise Ratio (PSNR)
- Compression Ratio (CR)
- Mean Square Error (MSE)
- Bits Per Pixel (BPP)

## IV. PROPOSED METHOD

### A. Particles Swarm Optimization

Particle Swarm Optimization is an extremely simple algorithm that occupying the space in nature between evolutionary searches and it is very effective for a wide range of functions which is to be optimized by the optimization technique. PSO

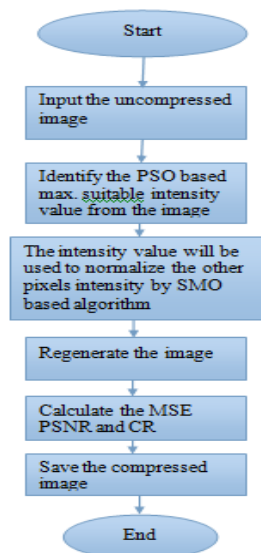
has some computation problems which seem to lie between genetic algorithm and evolutionary programming. It is the modern heuristic algorithm that can be applied to the non linear and non continuous optimization problems. The main goal of this optimization is the simulation of social behavior. It includes artificial life like bird flocking, fish schooling and has some common features of evolutionary computation. PSO is like a genetic algorithm in which population is initiated with a group of random potential solutions. Early testing found that the implementation is very effective with several kinds of problems.

## B. Spider Monkey Optimization

Spider Monkey Optimization a population based method. The social behavior of spider monkey is an example of fission-fusion system. Spider monkeys are living in a large community called unit-group or parent group. In order to minimize foraging competition among group individuals, spider monkeys divide themselves into subgroups. The subgroups members start to search for food and communicate together within and outside the subgroups in order to share information about food quantity and place. The parent group members search for food (forage) or hunt by dividing themselves in sub-groups (fission) in different direction then at night they return to join the parent group (fusion) to share food and do other activities. Spider monkeys are travelling in different direction to search for food. They interact and communicate with each other using a particular call by emitting voice like a horse's whinny. Each individual has its identified voice so that other members of the group can distinguish who is calling.

## V. ALGORITHM

Step1 input the image from the local source.  
 Step2 identify the most suitable particle for its intensity value from total image.  
 Step3 normalize the all frequencies based on SMO for the image ,such that all frequencies can be reduced to the level of that intensity value which is found using PSO.  
 Step4 image intensity reduction will in result reduces the memory space requirement.  
 Step5 calculate the compression ratio value.  
 Step6 calculate the MSE value.  
 Step7 calculate the PSNR value.  
 Step8 store the image into the local disk memory.



## VI. RESULTS

In thesis work the hybrid approach of SMO (spider monkey optimization) and PSO (particle swarm optimization) is to be considered. This hybrid approach will subdivide the total image into multiple grids and considers intensity value and tries to reduce the intensities values of each grid pixel so that relative memory occupation can be reduced.

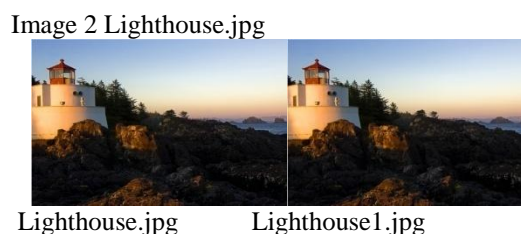


**Figure.2. Lossless image compression (a) Original image (b) Compressed image**

**Table No.1**

Image Name	Original Image Size(bytes)	Compressed Size(bytes)	Percentage Reduction
Desert.jpg	2359296	1519518	64%
Lighthouse.jpg	2367900	1515456	64%

Figure 3(a) and 3(b) shows the original and compressed image of lighthouse.jpg. The hybrid algorithms also applied on this image.



**Figure.3. Lossless image compression (a) Original image (b) Compressed image**

The table 1 shows the comparison between sizes of original and compressed images with Hybrid PSOSMO Approach for image compression. For comparison, the two jpg images Desert.jpg and Lighthouse.jpg having size in bytes are compared. In both cases of images, the compressed size is reduced by 64%.

**Table.2. comparison between quality factors**

Image Name	MSE	PSNR	C.R.	B.P.P.
Desert.jpg	254.83	24.10	4.7659	0.4238
Lighthouse.jpg	254.83	24.1022	4.7253	0.4141

The table 2 shows the quality factor between both images. However table no.3 shows comparison between PSO and hybrid PSOSMO approach for image compression on the basis of quality factors such as PSNR, MSE, CR, and BPP. It is clear from the table that the proposed hybrid technique has higher PSNR value as compared to PSO technique means the reconstructed image quality is very close to the original image.

**Table.3. Comparison of PSO and PSOSMO**

Proposed Algorithm	Name of Image	PSNR	MSE	C.R.	B.P.P.
PSO	Desert.jpg	17.8924 Db	388.8242	3.2904	0.8617
PSOSMO	Desert.jpg	24.1022179 Db	254.83	4.7659	0.4238
PSO	Lighthouse.jpg	19.8924	388.8242	3.2253	0.86
PSOSMO	Lighthouse.jpg	24.1022	254.85	4.7253	0.4141

Compression ratio is of higher amount in case of this technique. There is an improvement of 64%. That is BPP has been improved by around 49%. The error is decreased as MSE factor is decreased by using proposed technique. The CR value is high means more data of a image is compressed in terms of bytes. The compression ratio for both images Desert and lighthouse are same. For hybrid technique the BPP rate is less because the less information stored per pixel of reconstructed image as compared to original image. The error is decreased as MSE factor is decreased by using proposed technique. The CR value is high means more data of a image is compressed in terms of bytes. The compression ratio for both images Desert and Lighthouse are approximately same. For hybrid PSOSMO technique the BPP rate is less because the less information stored per pixel of reconstructed image as compared to original image.

**Table . 4. Comparison of SMO and PSOSMO**

Proposed Algorithm	Name of Image	PSNR	MSE	C.R.	B.P.P.
SMO	Desert.jpg	17.8924 b	388.8 242	3.59 04	0.861 7
PSOSMO	Desert.jpg	24.1022 Db	254.8 3	4.76 59	0.423 8
SMO	Lighthouse.jpg	19.89	388.8 3	3.5	0.86
PSOSMO	Lighthouse.jpg	24.1022	254.8 3	4.72 53	0.422 3

It is clear from above discussion that the proposed hybrid PSOSMO technique has PSNR value as compared to PSO, SMO techniques so the image quality of reconstructed image becomes better in comparison with original image. By using proposed technique, MSE is reduced by 38% and 32% as compared to PSO and SMO respectively. Compression ratio is increased by 42% and 24% as compared to previous techniques. By using proposed hybrid PSOSMO technique, BPP has been improved by 29% as compared to both PSO and SMO techniques. BPP has been improved by 48%. as compared to both PSO and SMO techniques.

## VII. CONCLUSION

The thesis represents a new hybrid algorithm for image compression and gives the improvement of different parameters. Two algorithms are used in this thesis work i.e. Spider Monkey Optimization (SMO) and Particle Swarm Optimization (PSO). These two algorithms are implemented for compressing the image. Some qualitative parameters such as Compression Ratio (CR), Peak Signal to Noise Ratio

(PSNR), Mean Square Error (MSE), Bits Per Pixel (BPP) are calculated in this hybrid algorithm. After calculating these parameters, it may be concluded that PSNR, Compression Ratio (CR), Bits per Pixel is more in PSOSMO algorithm as compared to PSO, while MSE is less in PSOSMO algorithm than PSO. In this thesis work, Spider Monkey Optimization (SMO) has been successfully implemented over PSO for compressing the image.

## VIII. FUTURE WORK

As this hybrid algorithm is implemented in general types of images for their compression. The image compression is better than the previous technique. But in future this technique should be studied for satellite imaging so that the average transfer data can be reduced.

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