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Image Compression Using Different Optimization Algorithms: A Review

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Abstract

Image compression is most essential requirement for efficient utilization of storage space and transmission bandwidth. Image compression technique involves reducing the size of the image without degrading the quality of the image. Currently many image compression algorithms are used to deal with increasing amount of data involved but still finding the alternative solution is the area of research as shown in Fig 1.

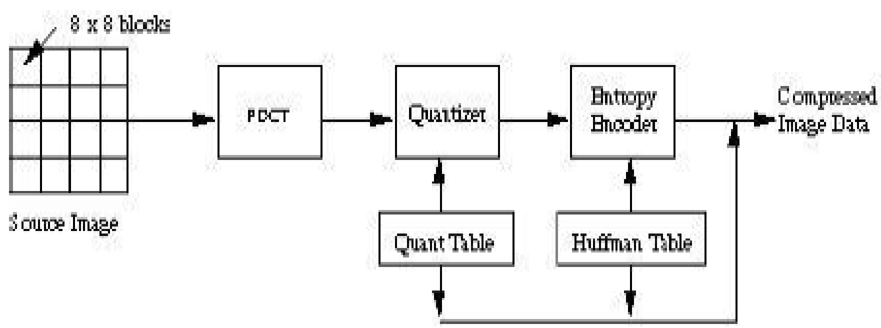

Fig 1 Image Compression

1. Introduction

This paper reviews some of the Meta heuristic optimization algorithms used for image compression. These algorithms are based on swarm intelligence. Swarm intelligence is a relatively new area that deals with the study of behavior among many entities or objects interacting within the natural or artificial systems. In past few years Swarm Intelligence based algorithms have been applied to a wide variety of problems in combinatorial and continuous optimization, telecommunications, swarm robotics, networking, image processing etc. This paper provides an insight of many optimization techniques used for image compression like Ant Colony Optimization (ACO) algorithm , Harmony Search Algorithm (HSA) and Artificial Bee Colony algorithm, Particle Swarm Optimization (PSO) and Genetic Algorithm (GA). Ant Colony Optimization algorithm is inspired by the behavior among real ant's while searching for the food source. Harmony Search Algorithm is inspired by the harmony improvisation process followed while playing musicas shown in Fig2.

2. Literature Review

2.1 Image Comprission

Image coding and compression techniques have become a highly active research area over the past decades [1]. The main purpose of image compression is reducing the redundancy in images in order to store or transmit data in an efficient form [2]. One common characteristic in most images is that neighboring pixels are highly correlated and consequently contain a lot of redundant information. To find an image representation in which pixels are less-correlated, various image compression schemes that utilize image transformations can be used. There are two compression techniques that are used for image compression (Lossless and Lossy compression [3]). When the reconstructed image after compression becomes numerically identical to the original image, it is called lossless image compression. Conversely, when the reconstructed image after compression becomes more distorted compared to the original image, it is called lossy image compression. To perform compression, a linear transformation is first applied to make the pixels of the image less-correlated. Then, the quantization process is performed to the coefficients that result from the transform. Discrete Cosine Transformation (DCT) [4] is the most easily and widely used transform in image compression schemes. It has excellent compaction for highly correlated data.it provides a good tradeoff between information packing ability and computational complexity. JPEG-based compression [5] is the well-known algorithm that uses the DCT and achieves high compression with less data loss. In addition, video compression MPEG [6] is one of the best algorithms to compress videos in with low bit-rate and high quality. In image watermarking

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field [7], a lot of researches use the DCT to achieve better results. Image processing using parallel computation [8] is proposed in many techniques [9] that depend on multicore systems instead of a single processor system to overcome the high computation complexity. For example, the method in [10] proposed a parallel technique for image segmentation using CPU and GPU. In [11-12], parallel processing techniques are used in video compression. In [13-15], different image compression methods that use CPU and GPU parallel computing were presented. Different optimization techniques were applied for image segmentation and image compression [16-17].

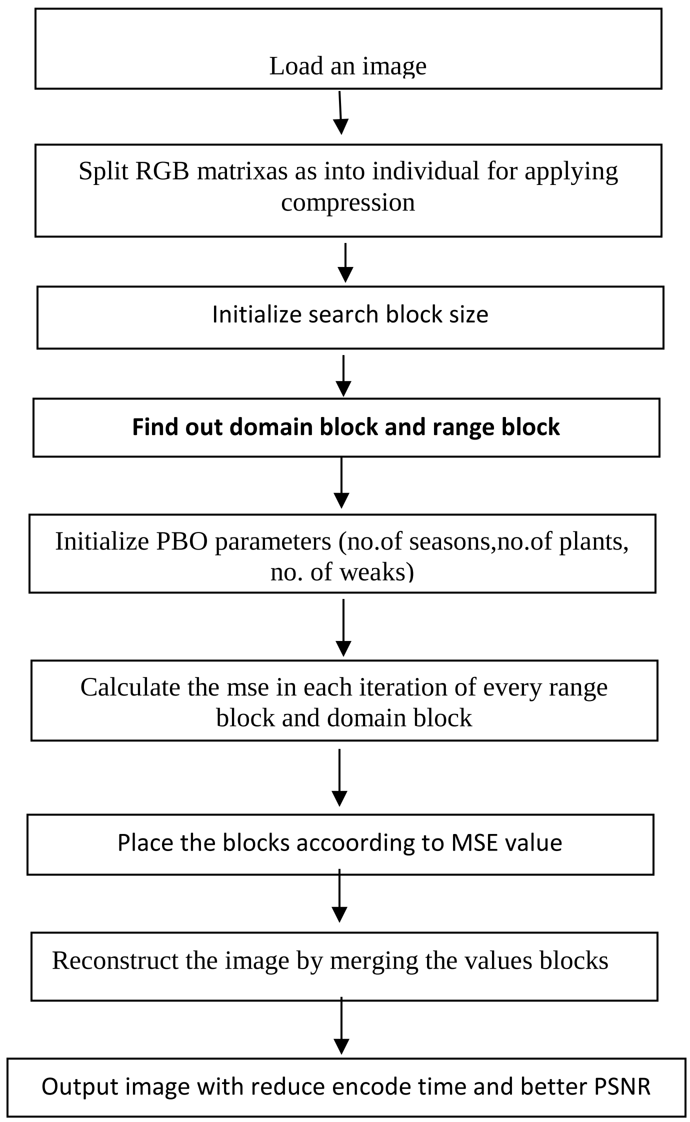

Fig 2: Algorithm level design of fractal image compression using pollination based optimization.

A new image compression technique using 3D-DCT is proposed. The proposed technique utilizes a modified quantization table and a method for converting a 3D image cube into a 1D array. The proposed algorithm provides better coding efficiency in the run length coding step. In order to improve the performance of the image compression algorithm, a 2D-DWT based classification is used [18] to determine the type of the image. The resultant 2D image is converted into 3D cubes of sizes that are determined based on the image type (low or high detail). The 3D-DCT is then applied on the constructed cubes. A parallel implementation of the proposed algorithm is used to improve the computation time in two ways: the first one utilizes computation parallelization process using SPMD (Single Program Multiple Data) and the other method utilizes graphics processor unit (GPU) programming with CUDA language. The performance of proposed algorithm is evaluated using some of the most commonly used test images in the compression literature. Test results demonstrate that the proposed algorithm outperforms several compression methods in terms of Peak-Signal-to-Noise Ratio (PSNR) and compression bit rate.

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2.1.1 3D-DCT Based Techniques

3D-DCT has been used in many techniques. Some of these techniques focus on integral images [19-20], where image elements are placed along the third dimension before applying the 3D-DCT.

This is commonly used in video compression [21-22], in which, the temporal domain is used as the third dimension. In visual tracking [23], 3D-DCT is frequently used to represent the object appearance model that is robust to variations in illumination, pose, etc. Furthermore, 3D-DCT is used in many image processing applications, such as video watermarking, denoising, and fingerprinting [24-26]. 3D-DCT sequential coding is used for specific classes of images like medical images [27]. In [28], 3D spiral JPEG image compression is used, where it uses spiral scanning to format the multi-dimensional constellation, in order to get a more effective compression scheme [29]. For hyperspectral space images, different techniques are proposed, as in [29,30-31]. In video compression, 3D-DCT is used by taking the two-dimensional frames and the temporal dimension (the sequence of frames) as the basis .

The main goal of the proposed compression algorithm is to achieve a high compression ratio with minimum information loss. In the following subsections, the main steps of the proposed 3D-DCT based compression technique are described.

2.1.2 3D Cube Formation

A 2D input image is first mapped into a set of 3D data cubes. This is done by grouping NxN blocks. These blocks are processed from left-to-right and top-to-bottom. Eight NxN blocks are used to construct a 3D data cube. In our technique, we used two cube-dimensions: 8x8x8 cubes and 4x4x4 cubes, depending on the image characters.

2.2 Image Classification

When the correlation between the pixels (The similarity between blocks [32]) is high, DCT coefficients get smaller and, consequently, it yields a better compression. Images can be classified into two types:

high-detail and low-detail images. The similarity ratio in the low-detail images is more than that in high–detail images. Based on that, we suggest that the 8x8x8 cube size would be more suitable for low details images because it has high similarity ratio, while the 4x4x4 cube size would be more suitable for the high details images because of its low similarity ratio. In the proposed algorithm, an image classifier is used to determine the type of the image. Such image classifier decreases the dimension of the image by using Discrete Wavelet Transform (DWT) and then uses the details images to determine its type and to decide the appropriate cube size. The result of 2D-DWT is decomposed into four quadrants: LL: The upper left quadrant represents the approximated version of the original at half the resolution. HL/LH: The lower left and the upper right blocks. The LH block contains the vertical edges. In contrast, the HL blocks shows the horizontal edges.

HH: The lower right quadrant. We can interpret this block as the area where we find diagonal edges of the original image. The GxG image (512 x512 or any other size) is decomposed by 1-level 2D-DWT, then take the inverse DWT with only the LH sub-band (it is chosen experimentally based on the vertical edges of image) and the other sub bands are set to zero. We take the 2D-DFT (Discrete Fourier Transform) [33] to compute the mean of the inversed image. The computed mean is compared to a certain threshold T (decided experimentally). If it is lower than T, then the image is a low detail image. Otherwise it is a high detail image. The performance of the algorithm is evaluated in terms of image quality and compression ratio. To evaluate the image quality in image compression systems, reliable quality measures should be used. A set of objective image quality measures for image compression systems were investigated in [34] and emphasized the correlation between these measures and the subjective image quality measures. The most commonly used measures are the PSNR and the Compression Ratio (CR)Because of compression, the decompressed images

may exhibit various kinds of distortion artifacts such as blocking, blurring and ringing [35]. The human visual sensitivity to several types of artifacts is very different. The blocking artifacts are usually the most significant among them, especially at low bit rate compression.

1. Optimization algorithms for image comprission

3.1 The genetic algorithm (GA)

John Holland and his collaborators in the 1960s and 1970s (Holland, 1975; De Jong, 1975) presented a model or abstraction of biological evolution based on Charles Darwin's theory of natural selection [36-39]. Holland was probably the first to use the crossover and recombination, mutation, and selection in the study of adaptive and artificial systems. These genetic operators form the essential part of the genetic algorithm as a problem-solving strategy. Since then, many variants of genetic algorithms have been developed and applied to a wide range of optimization problems, from graph coloring to pattern recognition, from discrete systems (such as the travelling salesman problem) to continuous systems (e.g., the efficient design of airfoil in aerospace engineering), and from financial markets to multi-objective engineering optimization[40- 45].

3.2 Ant Colony Optimization

Marco Dorigo in (1992) presented Ant Colony Optimization(ACO) algorithm to generate the appropriate solutions for discrete optimization problems, continuous optimization problems and some real world problems like Travelling Salesman problem, routing and load balancing. It mimics the foraging behavior of real ant colonies. There are many variants of ACO namely Ant System, Elitist Ant Colony System, Max-Min Ant System, Rank Based Ant System etc. ACO simulates the foraging behavior of the real ants in which they establish shortest path between the food source and the nest. While searching for the food source the ant randomly moves in the area surrounding its nest. While carrying the food source towards the nest they drop achemical pheromone over the ground. Ants can smell pheromone and evaluate its quantity. Thus larger quantity of pheromone is concentrated on the shortest path and pheromone deposited on the longest path begins to evaporate. The path chosen by the ant contains large amount of pheromone concentration. Thus after acquiring the food source the ant leaves pheromone trial based on the quality and quantity of the food source. This pheromone trial helps other ants to find the shortest path for the food source. The indirect exchange of information through pheromone between the ants is known as stigmergy[46-48].

3.3 Particle Swarm Optimization

Kennedy and Eberhert in (1995) presented evolutionary computation algorithm which was developed by Kennedy and Eberhert in 1995. It simulates the behavior of bird flocking together to seek the food source. While searching for the food source the birds communicate with each other and reach target within minimal duration of time. The population of PSO is initialized with random solutions called particles. Eachparticle has a capability to freely fly through the search space with some velocity which can be dynamically adjusted during search process[50-52].

3.4 Harmony Search Algorithm

Zong Woo Geem et al. in (2001) presented Harmony Search Algorithm (HSA) was developed[53-54], can be applied to solve many optimization problems like water distribution networks, ground water modeling, vehicle routing and many more. Harmony Search is music based metaheuristic optimization algorithm. When playing the music the or chestrator always tries establishing harmony by improvisation process. This harmony in the music is analogous to finding the optimality in an optimization process. The optimal solution to any problem corresponds to best solution with given constraints and parameters. The harmony depends on the aesthetics quality of music which is determined through pitch (frequency), timbre (sound quality) and amplitude (loudness) of musical instrument. Perfect harmony is achieved by adjusting the pitch which changes the frequency[55-57].

3.5 Artificial Bee Colony Algorithm

Dervis Karaboga et al. in (2005) presented Artificial Bee Colony ,(ABC) algorithm is swarm intelligence based optimization algorithm developed It mimics the intelligent foraging behavior of the honey bees. ABC can be used for optimizing a large set of numerical test functions. Three main components of the ABC algorithm are food sources, employed foragers and unemployed foragers. The food source is selected by the bee based on some properties like the amount of nectar, closeness to hive, taste of nectar and effort required for extracting. Employed forager is the bee which exploits the food source and provides other bees with rich set of information like distance, direction and profitability of the food source. Unemployed forager is the bee which searches for the food source. They are of two types i.e. scouts and onlookers. The scouts search the food source randomly while the onlookers search for the food source based on information provided by the employed forager. The exchange of the information takes place in the dancing area and the related dance is called as the waggle dance. There is higher probability of selecting the most profitable food sources by the onlooker bees[58-62].

3.6 The improved PSO algorithm

Chen et al. (2005) presented a new method called the improved PSO algorithm to construct a high-quality codebook for image compression. Previously used algorithm LBG results were provided to initialize the global best particle for improved the convergence of PSO. The image encoding and decoding were implemented in this work. The proposed method was reliable and reconstructed images obtained by this method gets a high-quality image while compared to the other method of image compressions like VQ and LBG [63-64].

3.7 Particle Swarm Optimization

Muruganandham et al. (2010) proposed the PSO (Particle Swarm Optimization) method for fast fractal image compression (FIC) system. In FIC at low bitrate with the acceptable quality of the encoded image was achieved with the longer encoding time. The longer encoding time was reduced by using PSO algorithm. The PSO was proposed for the MSE depend on the stopping situation among the domain and range block. PSO increased the speed of the fractal encoder and better image quality of medical image preserved [65-66].

3.8 The fractal image compression (FIC)

Uma et al. (2011)-proposed the comparison among various image compression techniques. The fractal image compression (FIC) provided great robustness beside the salt and pepper noise. The computational cost of the FIC algorithm was high, so the optimization method can be used to reduce encoding with the good quality of the reconstructed image. Different optimization methods were studied with the FIC, ACO provided the best results while compared with the PSO and GA. The robustness of the reconstructed image depends on the PSNR value and encoding time. The optimization method improved the PSNR value and reduced the encoding time [67-68].

3.9 The Huffman coding

Jiang et al. (2012) provided an improved vector quantization, and wavelet transforms for the medical images compression. The Huffman coding was proposed for high and low-frequency components. The improved VQ applied to the wavelet transform, which provided a better visual quality compress image and high compression ratio. The parameters like PSNR, MSE, and NCC considered as the evaluation type for the compressed image [69-70].

2. Various Algorithms Used for the Vector Quantization

Mittal et al. (2013) presented a survey on the various algorithms used for the vector quantization (VQ) process. The algorithm from all provided the less noise produced good image quality. In VQ process, the codebook selection is a major phase, which can be formularized by various algorithms. In this study, the LBG (Linde-Buzo-Grey) algorithm, ENN (Equitzs-Nearest-Neighbor) algorithm, BPNN (Back Propagation Neural Network) and FBPNN (Fast Back Propagation Neural Network) were discussed. The quantitative comparison also observed for different algorithms in vector quantization. Among all above-said algorithms, the BPNN and FBPNN provided better image quality than the LBG and ENN. The size of the codebook was also small in case of BPNN and FBPNN [71-72].
Sathappan (2013) proposed the vector quantization scheme for the low bit rate image compression system. In this method, a residual codebook is produced by the Weighted Mahalanobis Distance and Modified Fuzzy Possibilistic C-Means with Repulsion. This residual codebook removed the noise from the reconstructed images and improved the quality of the images. The proposed method provided the highest PSNR value than the other image compression technique [73-74].
Snayal et al. (2013) developed an efficient VQ scheme in which a stochastic optimization algorithm called BFO (Bacterial Foraging optimization) proposed for the image compression method. In this study, the codebook design process was obtained by the fuzzy logic membership based algorithm, and determine the free parameters for the fuzzy sets. These parameters are further used for the optimization process. An improved BFO algorithm was applied to the codebook by which compression ratio and PSNR value increase. The improved results provided the robustness to the image compression system [75-76].
Abouali (2014) proposed a vector quantization (VQ) algorithm for the compression of the image. The VQ algorithm contains three phases initial, iterative, and final. The starting phase was covered with the max-min algorithm. An adaptive LBG algorithm was used for the iterative phase, and finalization frees the codebook from noise. The iterative algorithm locates the codebook points to line up across the boundary of the object in the image. The results reflect that the image features remain stable in the high compression ratio. The proposed algorithm also implemented the codebook bins for better improvement in the quality of the area [77-78].
Guo et al. (2014) proposed the VQ method for the image segmentation. The image divided into the sub-block and each sub-block contains vectors which were cluster by the VQ method. In this scheme, the self-organizing map (SOM) neural network was adopted for the VQ realization. The adaptive search algorithm was proposed for estimating the optimal codebook size by using a minimization ratio of the matrix. The computational complexity of the proposed method was quite high in SOM as well as in adaptive algorithm case. The computation time also increased with the proposed method because the SOM and adaptive algorithm structure are in parallel [79-80].
Li et al. (2014) presented a multivariate vector quantization (MVQ) for the compression of hyperspectral imagery (HSI). In HIS the pixel spectra are taken as the linear combination of two codewords from the codebook and indexed maps, their corresponding components are coded and compressed. The fuzzy C-mean (FCM) scheme was proposed for designing the codebook, in which the number of cluster data and codeword selected for the codebooks. The proposed algorithm tested on the real dataset, which provided better performance than the conventional VQ and other algorithms used for the compression of HIS [81-82].
S. Mirjalili (2015) proposed a nature-inspired algorithm called Ant Lion Optimization (ALO) algorithm for the benchmark function optimal solution. The ALO follows the hunting steps of ant lion. There are five main steps of hunting of ant lion like the random walk of ants, building traps, entrapment of ants in traps, catching preys, and re-building traps. These steps were followed in the optimization algorithm and provided an optimal solution as per the position of ant lion. The benchmark functions, truss structure and ship propellers were examined by the ALO and provided the efficient design [83-84].
Pantsaena et al. (2015) presented the codebook selection scheme by using the splitting codebook method. The quality of compressed image improved with the splitting codebook selection method. The image quality of the proposed method compared with the random codebook image quality, which provided better image quality while low bit rate achieved. The splitting codebook method provided good image quality at a lower bit rate. The LBG method used for the vector quantization process and codebook design was selected by the split method. The PSNR term was considered for the performance evaluation of the compressed image [85-86].

3. A hybrid Image Compression Approach

By Roy et al. (2015)-proposed a hybrid image compression approach by combining Vector Quantization (VQ) and Discrete Cosine Transform (DCT). The initialization phase, a codebook is generated with the help of 10 different images using VQ. The DCT technique performs the final codebook generation. The generated codebook can compress any image. Selected codewords are used to compress the selected image, and based on these codewords compressed image was obtained. The decompression of image also performed by this method in which the original image was reconstructed from the compressed image. The proposed method was tested on the standard images and compared with the VQ method. The higher value of PSNR was provided by the hybrid algorithm while compared with the standard VQ algorithm [87-89].
Omari et al. (2015) proposed a new technique of image compression based on the minimization of rational numbers in nominator and denominator form. Mapped image converted into the RGB form, and then fractal quotient was analyzed. The Genetic Algorithm is used to enhance the search for close fraction, which further minimizes to an efficient quotient. The implemented method provided the high compression ratio, so image quality was enhanced [90-91]
Chiranjeevi et al. (2016) used a metaheuristic optimization algorithm called Cuckoo Search (CS) for optimizing the codebook of LBG using levy flight function. The Gaussian distribution function replaced by Mantegna's method. The CS algorithm obeys the levy flight distribution function, which takes 25% and 75% of convergence time for the local and global codebook. The CS optimized codebook has a greater value of PSNR and provided improved fitness value than previously used algorithms like LBG, PSO-LGB, HBMO-LBG. The computation time of the proposed algorithm was also less than the other algorithm [92-94].
Chiranjeevi et al. (2016) proposed the BAT optimization algorithm with LBG for VQ image compression. In this work, the BAT algorithm coupled with the LBG for the better quality codebook of VQ image compression. The BAT optimization is proposed to optimize the initial parameters of the LBG then the efficient quality image was reconstructed with the help of codebook. The proposed method provided good PSNR value and regularly zooming attributes via loudness of bats and adjusting the pulse emission rate. The observed results of BAT-LBG

were greater than the PSO-LBG, FA-LBG, and convergence speed is 1.841 times. There was no significant difference observed in the BAT-LBG while compared to the PSO [95-96].

Kekre et al. (2016) presented a hybrid scheme using VQ and hybrid wavelet transform image compression method. Kronecker product of different transform was used to generate the hybrid wavelet transform. The image converted into the transform domain by hybrid wavelet transform and low-frequency components were retained to obtained better compression of the image. The VQ method applied to the low-frequency components for increasing the image compression ratio significantly. The implementation of VQ on the transformed images and 16 or 32 small size codebooks were generated. The better performance was achieved by using KFCG and KMCG algorithms. The image compression ratio was 192, and lowest distortion provided by the KFCG hybrid wavelet transform method [97-99].

Chiranjeevi et al. (2016) proposed modified firefly algorithm (MFA) of VQ for image compression. In MFA the movement of brighter fireflies was in the direction of brightness in its place of random move. The codebook was generated with the help LBG method. The MFA optimization algorithm used to provide the initial command for LBG. The results show that MFA-LBG algorithm provided a better-reconstructed image than the FA-LBG and LBG algorithms. The convergence time of MFA is also less than the FA [100-102].

Valsesia et al. (2016) proposed universal spectral vector quantization method for the multispectral image compression. In this approach theory of universal spectral quantization used for the vector quantization. The universal spectral theory used in the distributed context of coding. It reduces the encoding rate of the quantizer by the side information. The image was reconstructed using the total weight minimization because the side information saved in the form of weight [103].

Agustsson et al. (2017) proposed the end to end method for the image compression and neural network. The continuous relaxation [104-105]in this studies the challenges against the image compression and neural network training were discussed. The soft to hard annealing method provided the transfer of soft relaxation of sample entropy on the actual image compression. The proposed method optimized the rate of distortion between the net loss and entropy [106-107].

Wang et al. (2017) presented a new technique of VQ compression by using the K-means algorithm for clustering the features. The K-mean algorithm is used to design the codebook section of VQ. The feature classification and efficient grouping method were proposed in this study. The two-level classifier, edge classifier and contrast classifier were used to divide the vector section into the 16 categories. Each category vector is sorted depend on their normal value and divides into the groups. The size of the group is the same and the centroid of the vector are estimated on the initial value of codebooks. We obtained the design of VQ codebook fast in nature and convergence speed increases by the proposed method [108-110].

Rishav Chatterjee (2017) proposed the vector quantization algorithm and k-means algorithm for the image compression. The image was divided into the blocks by using VQ method. The LBG method and wavelet transform method used for the vector quantization process. The quality measure parameters distortion and reconstruction ratio were considered for the image compression analysis — the better quality compressed image estimated by the proposed method [111-112].

Natu et al. (2017) proposed a hybrid approach for color image compression by combining wavelet transform and vector quantization (VQ) method. The hybrid wavelet transform was used for the image compression by which the high compression ratio achieved. The out of the wavelet transform is a compress error image. For the improvement of compression ratio, the VQ technology applied to the compress error image. A small codebook size of 32 bits was generated with VQ which provide high compression ratio. The error image also contains the distortion which can be removed by the vector quantization (VQ) approach. The obtained error image added to the transform error image, which provided the better-reconstructed image. The proposed work provided 10% less distortion than the previous work [113-115].

Nag et al. (2019) proposed an improved differential evolution (IDE) optimization algorithm for the LBG generating codebook[116]. In this work, the IDE algorithm was combined with the LBG. The output of the IDE provided as the input to the LBG which produced efficient codebook. Previously used a differential algorithm doesn't have efficient control scaling factor and boundary limits. The IDE modifies the scaling factor and boundary control methods. The IDE-LBG method provided optimal VQ codebook. The computational time of the proposed method is less and high PSNR value achieved — the excellent quality of the reconstructed image obtained by IDE-LBG algorithm. The implemented method was provided better results while compared with the other method like IPSO-LBG, FA-LBG, and BA-LBG [117-118].

Kumar et al. (2019) presented a BAT optimization algorithm combined with LBG (Linde Buzo Grey) in the codebook design for the vector quantization (VQ). The dynamic BAT-LBG algorithm provided efficient results in the codebook selection while compared to VQ method, JPEG loss-less method, and static BAT-LBG method. The performance analysis depended on the PSNR, compression ration, and MSE. The proposed algorithm applied was not only for the codebook design even for the size selection of the codebook. The quality of the reconstructed images was good, which compress by the BAT-LBG algorithm [119-122].

4. Summary of Literature Review

Author	Year	Technique	Advantages	Limitations
Kumar et al.	2019	BAT-LBG for the VQ image compression	Small size codebook achieved, high compression ratio and MSE	NA

Omari et al.	2015	Genetic algorithm (GA) for image compression	The high value of PSNR obtained so image quality enhance	Iterative process
Chen et al.	2005	PSO-LBG for codebook design	Reliable reconstructed image	NA
Chiranjeevi et al.	2016	Cuckoo search (CS-LBG)	Improved convergence time, high PSNR and MSE	NA
Nag et al.	2019	Improved Differential Evolution (IDE) with LBG	Better quality image reconstructed via optimal codebook selection	NA
Chiranjeevi et al.	2016	BAT-LBG algorithm for VQ image compression	Better PSNR value achieved with VQ codebook selection	No significant difference between PSO and BAT
Uma et al.	2011	Comparison study of various FIC methods like BAT-LBG, PSO-LBG and CS-LBG	Better PSNR provided better image reconstruction	NA
Abouali	2014	Optimization for codebook noise removal	The high value of PSNR and reliable reconstructed image obtained	NA
Roy et al.	2015	A hybrid method of VQ-DCT for image compression	Image encoding and decoding both work followed	NA
Kekre et al.	2016	VQ-wavelet transformed method like KFCG and KMCG	192 image compression ratio achieved and low distortion	Only passes Low-frequency components
Guo et al.	2014	VQ with SON neural network	Computational time increased	NA
Sanyal et al.	2013	VQ with BFO and Fuzzy logic	Robustness to the image	NA
Chiranjeevi et al.	2016	MFA-VQ with LBG	High PSNR value	NA
Li et al.	2014	MVQ with HSI	Better performance than VQ	NA
Seyedali Mirjalili	2015	ALO (Ant Lion Optimization)	Tested on benchmark function and provide fast convergence results	NA
Natu et al.	2017	Wavelet transform with VQ	High image compression ratio with less distortion	NA
Valsesia et al.	2016	Universal spectral vector quantization	Using side information for weight minimization	NA
Agustsson et al.	2017	End to end method for image compression and neural network training	High compression ratio	NA
Wang et al.	2017	VQ by K-mean algorithm	Codebook convergence time is fast	NA
Pantsaena et al.	2015	Spilt codebook selection technique for vector quantization	Improved compression ratio and quality of the compress image	NA
Mittal et al.	2013	Comparison among LBG, ENN, BPNN and FBPPNN	BPNN provided the better quality compress image and improved compression ratio	NA
Sathappan	2013	Residual codebook generated by the Modified Fuzzy Possibilistic C-Means with Repulsion and Weighted Mahalanobis Distance.	The quality of the compress image improved by the residual codebook slection	Only reduces the bit rate
Rishav Chatterjee	2017	vector quantization and K-means algorithm	Reduced noise and improved reconstruction ratio	NA
Jiang et al.	2012	Wavelet transform and improved vector quantization	High PSNR value compressed image computed	NA

5. Conclusion

This paper presents a complete review for image compression methods based optimization techniques. Different optimization algorithms were proposed for the improvement of PSNR and MSE. Vector quantization with LBG method used for the partition of the image segments. The obtained results from the review indicates that ALO optimization with the LBG provide better results for image compression. In the other hand ALO provide better performance in compared with other techniques.

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