CHAPTER X

CONCLUSIONS

The central contribution of this research is a new set of optimized IFS algorithm [23] that extends ideas from statistical and numerical pattern search. This novel idea has been implemented and tested using MATLAB successfully. While comparing with existing Normal IFS algorithm, the proposed algorithms achieve very good performance in terms of speed and quality. The overall reduction in the search space is found between 30 to 40% in the images taken for the experimentation using RBRS strategy and the ideas outlined in this work can be explored further to improve the quality of existing fractal image compression algorithms.

Different types of IFS based fractal image compression algorithms using RBRS strategy that reduce the overall search time have been considered. The attained results are significant and can be compared with the Normal IFS method in terms of compression speed and quality. A novel Bit-weight based classification/sorting and Transformation selection algorithms provide good results for the chosen images of varying amount of details. The overall search space reduction [45] idea is implemented successfully in all proposed algorithms that provide faster compression and good decoded image quality.

Another important factor that influences the performance of the proposed methods is the choice of decomposition strategy. The constant block size decomposition method used in conventional IFS algorithm takes more time since it creates more number of blocks than the proposed variable block size method. Thus, the search time was increased while performing the block matching operation. To reduce this complexity, a quadtree decomposition strategy has been used to reduce the search space by creating the blocks of variable sizes. The other significant improvement in this work is calculating Bit-weight for the image blocks. The numerical values are very easy to compare instead of comparing image blocks by pixel-by-pixel during matching operation carriedout for domain blocks to range blocks.
An efficient IFS coding algorithms namely the Bit-weight based image block
classification / sorting and Transformation selection algorithms can be treated as different
approach in this research. The procedure explained in this work helps to understand the
significance of these algorithms. Usually, the geometric transformations performed
during block matching operation in conventional method takes more time for which a
proposed Bit-weight based Transformation selection algorithm provides optimal solution.
This is because the appropriate transformation is selected in a shorter time during the
block matching operation and better performance is provided when compared to Normal
IFS algorithm.

The efficiency of the proposed algorithm has been tested with low and high-
resolution images of varying details in IFS coding process. The results of these
algorithms confirm better prospects in the field of fractal image compression. The main
aim is to find the solution to improve the performance [64] of the fractal image
compression in terms of compression speed and decoded image quality. The proposed
Bit-weight based approach is not only applicable for image compression but also for
extension of pattern recognition or pattern matching operations.

The effectiveness of the Genetic Algorithm depends upon two factors such as the
amount of self-similarity present in the image and the proper selection of the parameter
values. A perfectly matched domain block suitable for a range block exists during block
matching operation. It is observed that the number of transformations used in the Normal
IFS algorithm has significant effect on the overall performance of an encoding operation.
But, it has very negligible effect on Genetic Algorithm based approach, since the
transformation selection is a random process. Even though GA based approach consumes
more time due to the limitations of MATLAB data types, it is suitable to tackle the
encoding complexity. This GA based image compression technique can be extended to
general data compression also.
The proposed Neural Network based approach is capable of achieving very fast compression time irrespective of images of any size with varying details. The encoding scheme presented in this work provides efficient performance for still image compression. Though the performance measurement in terms of quality of a decoded image in PSNR is poorer when compared to the Normal IFS method, it is good in terms of compression time. In general, the comparative study reveals that the Neural Network based implementations provide good performance in terms of compression time but PSNR values indicate poor quality of a decoded image.

The suitability of Bit-weight based image block classification and sorting algorithm is checked in a prerecorded video streaming application. The Normal IFS and Bit-weight based block classification and sorting algorithms have been implemented on a sample video clip obtained from http://ise.stanford.edu/video/suzie.qcif.gz. It is observed that the size of the codebook is not increased much during the processing of sequence of video frames. The whole video can be coded using the seed blocks of the first frame itself since much variation in gray levels are not available for the blocks in a continuous scene. The idea may be enhanced further to perform these operations in a lesser time than the presented ones and only the suitability of the Bit-weight based algorithm is explored in this thesis.

10.1 Scope for Further Research

The principal objectives of this work is to present the alternative methodologies for fractal image compression that form the core technology. The most important problem dealt in this thesis is the generation of the efficient IFS code using the RBRS mechanism and geometric transformations for effective implementation of the proposed algorithms. Trying different error calculations between child and parent or domain and range blocks other than the Root Mean Square Error (RMSE) estimation can also be explored. In addition, image enhancement operations [20] can be done on decoded image
to get additional image quality. Still, the measures used in this work for block matching operation may be explored further to improve the compression time.

The performance of these algorithms can be examined by using other partitioning schemes such as Horizontal-Vertical (HV), triangular and mixed partitioning etc. These decomposition schemes combined with other search techniques such as simulated annealing, tabu search etc. may provide lesser search time during block matching operation. Instead of using a conventional block matching operation, the Fuzzy Logic may be used to find a range block for a domain block to reduce the IFS coding time.

In the encoding process of Bit-weight based model, the image blocks are to be arranged in some order to select the set of range blocks for the block matching operation after calculating the bit weight. Any sorting method that performs comparatively in quicker time for sorting the range blocks, if chosen, will yield further reduction in compression time.

In Neural Networks based implementation, the network is trained by using image blocks. If Neural Networks are combined with Bit-weight based block classification and sorting method, bit total of an image block can be used to train the network. This bitwise operation of combined mechanism will be more suitable for effective block matching operation for the improved encoding process. Since the transformations have not been applied in Neural Network based approach that can be explored further to improve the overall performance. The proposed fractal video compression (Chapter 8) is not a supreme method for video streaming applications. Only suitability of the Bit-weight sorting algorithm is tested here.

However, there is lot of scope for improvement for combining the Neural Networks and Bit-weight based image classification and sorting algorithm which will definitely add more possibilities in further exploration. An investigation on the
effectiveness of the RBRS mechanism used for reducing search space in compression operation has been explored in this thesis.

Using appropriate filtering technique one can use the wavelets to develop the rules for deterministic fractals which in turn used to analyze the scaling property. The wavelet transform provides an efficient representation of images that cause reduction in storage requirement. Most of the wavelet coefficients of an image would be nearly zero and the image thus obtained would be well approximated with a small number of large wavelet coefficients. This idea will provide better compression time and ratio since wavelets provide a lot of scope in this area.

In addition to the conventional applications, medical imaging is one of the few areas of image processing that has received a sufficiently broad commercial appeal today, which can be identified as a potential research area. Other tasks outlined in this section may also be tried in the mentioned framework.