Abstract

Nowadays several applications require efficient storage and transmission of digital images. The key obstacle in these applications lie in the vast amount of data that is required to be stored for a digital image. Hence, the need for image compression is growing steadily over the years. There are quite a good number of image compression techniques available to date. As an innovative approach, *fractal* geometry has found potential applications in image compression due to its inherent power in expressing self-similarity.

This thesis aims at addressing some of the potent shortcomings of the *fractal image compression.* The extension of fractal based approach for compressing color images and video sequences are also presented. In fractal image compression, an image is divided into non-overlapping *range* blocks and overlapping *domain* blocks. The main idea is to search a *fitting* domain block from the domain pool for every range block. The major bottleneck of fractal encoding is that this searching process is inherently time intensive. In the present work a *randomized* method of searching the domain block for every range block has been implemented. A detailed analysis of this approach also has been presented. The randomized approach is found to be giving substantial amount of speed-up in the encoding process. Another issue in fractal image compression is the convergence of the decoder. A graph-theoretic approach for studying the convergence of the fractal decoder has been presented. From this analysis, a fast linear decoding algorithm has been developed. Finally, a novel concept of *relative fractal coding* has been proposed which is found to be effective in coding color images and video sequences. In this encoding technique, given the fractal code of a reference image, the relative fractal code of any other image (of the same size) is generated. This relative code combined with the code of the reference image produces the complete fractal code of the target image. More the similarity in the images, less is the size of the relative code. In the relative code, the same range-domain mappings of the reference image are used. Only the transformation of brightness values are changed, if required. In case of color image, there are *spectral* redundancy between the color components. Hence, one of the component can be fractally coded, and it can be used for relative coding of the other two. The relative fractal

coding is found to be more effective in case of video sequences due to substantial *temporal* redundancy between the successive video frames. The first frame of a group of frames is fractally coded whereas others are relatively coded. The relative fractal coding technique results in substantial speed-up along with high compression ratio.