

## **Abstract**

Compression of digital images has been considered as a major area of research for the last two decades and a number of image compression standards have been developed for different applications. The important roles of a compression algorithm are to reduce bandwidth requirement for transmission and memory requirements for storage of all forms of data. In the contemporary multimedia communication world, large memories as well as more than ever before new technologies are available providing high-speed digital communications. Image compression is still of great importance because along with the advances in technologies there is increasing demand for image communication as well as higher quality image printing and display.

In this work, the focus is on some key new technologies for image compression with significant attention on the application of Neural Network (NN) for image compression. This work at the outset dwells with presentation of image compression codecs. Emphasis is given on Discrete Cosine Transform (DCT) based JPEG technique and subband coding using multilevel Wavelet Transform (WT). Looking through the shortcomings like blocking artifacts associated with DCT at low bit rates and computational as well as memory complexity associated with DWT, the present work concentrates on developing a new technology using Artificial Neural Network (ANN).

Wavelet coders, apart from offering superior compression ratios have another useful feature namely, resolution scalability i.e. multiresolution representation. The above feature can also result through eigen value extraction and Principal Component Analysis (PCA) of image. Though K-L transform is considered as an optimal statistical method for principal

component extraction, it is restricted from image compression applications owing to the computational complexity associated with its derivation. Over the years, researchers have proposed different NN models for Principal Component Extraction (PCE). The main deficiency of these models lies in the network leading to instability with inappropriate learning rate as well as slow convergence.

In this work an Adaptive Recursive Least Square (ARLS) algorithm based training of auto-associative Neural Network and its application for principal component extraction leading to image compression is proposed. Noticeable improvement is achieved by using variable gain parameter in comparison to fixed gain parameter or the learning rate used in Least Mean Square (LMS) based algorithms. Moreover, ARLS algorithm removes accuracy speed trade-off.

In the present work a Multi-Level Principal Component Extraction (MLPCE) algorithm suitable for subband decomposition and multiresolution representation is presented. Proposed MLPCE algorithm works on image blocks but still results in performance compatible to WT.

In this work a morphological dilation based embedded zero-tree coding algorithm is implemented leading to good progressive coding. Further, attempt is made for a new encoding which combines fractal analysis based block interpolation and optimal subband bit allocation strategy.

The main contribution of this work is the implementation of MLPCE algorithm for low memory image compression using context modelling. This compresses an image without the need to buffer the complete transformed coefficients of the image. The memory requirement of the MLPCE approach are order of magnitude lower than other algorithms proposed up to date, which would require buffering of the entire image. This limited low memory implementation is a key in enabling widespread commercial use of image coding.

The general conclusion that emerges out of this work are on the basis of the performance and capabilities of auto-associative Neural Network and ARLS and MLPCE algorithm for image compression applications.