Chapter VII

Conclusions
7.1 General discussion

The goal of the research work presented in this thesis has been to design various image coding techniques using a set of orthogonal polynomials transform coefficients to achieve better compression ratio with good quality of reconstructed picture that preserve texture and edge in the reconstructed picture.

Firstly, an orthogonal polynomials framework for 2-D monochrome image compression has been proposed. The proposed scheme uses the statistical design of experiments approach to separate out the spatial variation within the image region due to discriminable low level features from the spatial variation due to unexplained sources called noise. The process of separation during polynomials transform coding is based on the statistical hypothesis testing procedures. The resulting truncated transform coefficients are subjected to bit allocation using variable length code.

Secondly, a new integer image coding technique based on orthogonal polynomials has been designed. The proposed transformation has been applied on the image region under analysis to obtain the transform coefficients. These coefficients are threshold coded using scalar quantization and bit allocation as in JPEG baseline system. The proposed coding scheme has good performance. But at the same time produces artifacts at low level primitives.

Thirdly, texture preserving image coder using orthogonal polynomials has been proposed. The proposed scheme is based on the model that represents textures using points spread operator relating to a linear system. In this proposed scheme, the encoder first identifies textured regions, which are then analyzed to produce the model features. These are later transmitted to the decoder that produces a synthetic texture based on these features through the synthesis stage. With this technique, the texture regions are preserved in the reconstructed image.
Next, in order to preserve the edges in the reconstructed image, a new image coding scheme based on orthogonal polynomials is presented. The proposed algorithm captures the locations of important edges with an edge detection step at the encoder. This edge information is transmitted and are effectively removed from the images during the forward transform coding and reinserted at the decoder during the inverse transform. The proposed method well preserves the object boundaries with improved performance when compared to the existing method simultaneously achieving the compression.

Finally, a new low bit rate coding scheme based on the same set of orthogonal polynomials is devised. This scheme employs the adaptive decision of appropriate down sampling directions /ratios and quantization steps in order to achieve higher coding quality with low bit rates with the consideration of local visual significance. The full resolution image can be restored from the orthogonal polynomials based transform coefficients of the down sampled pixels so that the spatial interpolation required otherwise is avoided. The experiments have demonstrated better PSNR improvement over the existing techniques before the critical bit rate.

7.2 Summary
The contribution in this thesis work is summarized below:

1. A new framework for image compression based on orthogonal polynomials has been proposed. The framework is based on the statistical design of experiments approach and the compression process is a two-stage statistical hypothesis testing procedure.
2. A new image coding technique with scalar quantization, called transform coding technique with orthogonal polynomials has been proposed, inline with JPEG baseline system.
3. A new texture preserving image coder with the same set of orthogonal polynomials is proposed.
4. A new edge preserving image coding technique using orthogonal polynomials has been proposed.
5. A new low bit rate coding scheme with down sampling based on orthogonal polynomials has been proposed.
7.3 Future directions

The proposed transform coding uses the Huffman coding and VLC which have been proposed for DCT coefficients by JPEG. A detailed study on the proposed transform coefficients which can replace the DCT coefficients based VLC tables and Huffman codes is expected to give better compression ratio.

The proposed image coding techniques are carried out for monochrome images. It can be extended for color images and videos.