Chapter 6

Conclusion and scope for future work

6.1 Conclusion

In this work, we have presented fast and low memory image coding algorithms based on lifting wavelet transforms. The memory requirement and the computational complexity of the proposed coders are very low as compared with that of SPIHT coder. However, they show computational complexities slightly higher than NLS. Further, the compression efficiency and visual quality of the three proposed coders are almost same and at par with that of SPIHT and NLS.

The improved performance of the proposed coders are accomplished due to the following important features of our algorithm, (i) the lifting wavelet transform scheme lowers the number of arithmetic operations (ii) the listless implementation structure further reduce the amount of memory and improves the speed of coder. Thus due to the low computational complexity and low memory requirement at various bitrates in the range of 0.125bpp to 2bpp, the proposed coders are suitable for resource constrained devices such as portable cameras, PDAs, movable biomedical instruments like EEG, ECG, EMG and real time interactive multimedia communication for heterogeneous networks, allowing their implementation both in hardware and in software.
All these coders provide progressive transmission, scalability and good PSNR value at low bitrates, so that the proposed coders may be good candidate for multimedia applications such as image storage and progressive web browsing. The error resiliency analysis of the proposed ER-MELS algorithm is discussed in chapter 5. It is observable that the algorithm gives the 2~8 dB gain in the presence of channel errors, which make it useful for transmission of image over heterogeneous networks.

6.2Directions for the future work

The proposed listless image coders could play a key role in the new generation of multimedia applications. The concept behind the low memory coders can be extended for colour images and videos. Some suggestions for future work are as follows.

**Memory reduction in the implementation:** We have reduced the markers requirement significantly from 16 to 4 for listless implementation of embedded SPIHT coder. In our third coder (MELS), we have not used any marker to record the state of pixels and using only four markers to record the state of trees/sets. Further reduction may be possible by reducing the marker requirement to process the zero trees for coding the wavelet coefficients. Further work may also be possible to reduce the memory requirement to store the decomposed integer wavelet coefficients of the image.

**Complexity:** A research work conducted by Pearlman [30] showed a very significant complexity reduction of SPIHT over JPEG 2000. The proposed coders in the present thesis are found to have lower complexity than the SPIHT coder, therefore the methods are very attractive for software implementation. Applying extra arithmetic coding to the bitstreams of
proposed coders would increase the complexity, but result may in improved performance. The issue of complexity-performance needs to be investigated and compared among the state of the art embedded wavelet image coding algorithms.

**Adding robustness for transmission in error prone heterogeneous network:** The proposed ER-MELS coder provide better error protection by packetizing the trees, but need more protection against the channel errors for those part of the bitstream which are more important.