Chapter 8
Conclusion and Future Works

8.1 Conclusion

In this research, we have proposed the medical data compression using wavelet and S-transform. Using wavelet-based lossless image compression we have proposed (i) wavelet based compression of CT image, (ii) Compression of MR images using DWT by comparing RGB and YCbCr color spaces, (iii) wavelet based medical image compression using ROI and (iv) ECG signal compression and denoising with time frequency filtering using S-transform.

Lossless compression for CT medical images has been investigated by examining dependencies among wavelet coefficients to improve the compression rate. In the proposed lossless medical image compression experimental results indicate that the particular wavelet used in image decomposition has crucial impact on both the quality of the reconstructed image and the data compression rate. The biorthogonal wavelet Bior4.4 is the best performer in almost all cases. The effect of image resolution on the compression rate is more noticeable than the effect of the number of decomposition levels and wavelet shape. We have analyzed that the higher the resolution of the original image, the better the compression performance but the wavelet suitable for compression of a specific class of images (medical images) may not be suitable for other image classes.
Comparing with RGB and YCbCr color spaces with the proposed compression of MR images using DWT, we have found superior performance of the proposed technique when working in the YCbCr domain. Similarly it is observed that, the PSNR and bpp in YCbCr color space has increased. Hence quality of reconstructed image is better.

In the next technique, research on DWT based medical image compression/decompression by using partening of image in ROI has been done. The proposed method is dedicated to lossy medical image compression DWT based and two phases of compression/decompression. Before the RGB to YCbCr transformation, manually is selected the ROI of images. The RGB to YCbCr transformation is the mean value of three plane images R, G and B that are removed and the almost signal energy of the new transformed YCbCr image is contained in the Y plane. In the encoder, before the quantizer indices for the various subbands, these are transform coded, the ROI quantizer indices are scaled upwards by a power of two (i.e., by a left bit shift). The reconstruction process is straightforward: The coefficients are unpacked, rearranged, de-quantized (multiplied by the respective quantization values), and the inverse DWT applied to recover the original m×n pixel values. The ROI set can be chosen to correspond to transform coefficients affecting a particular region in an image or subset of those affecting the region. First, the ROI can have any arbitrary shape and be disjoint. Second, there is no need to explicitly signal the ROI set, since it can be
deduced by the decoder from the ROI shift value and the magnitude of the quantizer indices.

We emphasize that in the proposed method we compare the average PSNR of each ROI when large images are divided into equal ROI size 128×128, 128×64, 64×64 and 32×32. If PSNR is high, it means that reconstructed image quality is better. The average PSNR of different ROI are shown in Fig. 6.7 and Fig. 6.8. From the Fig. 6.7, it is observed that, when we decrease the ROI size then average PSNR of RGB and Y color space are increased but in CbCr color space are decreased. In Fig. 6.8, it is observed that average PSNR is high if we divide the image into 16 equal ROI 32×32. There are important advantages in the proposed technique, the reconstruction algorithm is pretty fast and has a straightforward implementation, there is no redundancy in data transmission, several (rectangular) ROIs can be selected at the same time if required, once the ROIs are selected and their coordinates transmitted to the server, re-encoding the original image to transmit the ROIs progressively is not required, and already transmitted data are different from the new transmitted data to improve the quality of the ROIs and not redundancy in data transmission.

The S-transform is that it uniquely combines a frequency dependent resolution of the time-frequency space and absolutely referenced local phase information, a method to process non-stationary signal, such as electrocardiograms (ECG) based on S-transform, in which a filter is applied to a time frequency distribution instead of the Fourier spectrum in the next proposed method. We
propose the two filters in this method, in first filter we set S-transform equal to zero and in second filter reduce the amplitude of selected frequency of the S-transform. We compare the performance of S-transform method quantitatively with respect to the wavelet transform method based on PSNR, MSE and MAXERR. In the case of S-transform, high PSNR and low MSE indicates that the denoising effect achieved by using the proposed method is satisfactory, but greater MAXERR with respect to wavelet transform, indicates that this model do not follow the data accurately. However, it can be improved by acquiring more transcendental information. The response of filtered S-transform is denoised compared to wavelet response as shown in Fig. 7.4.

8.2 Future Works

In this dissertation, we have proposed the wavelet-based lossless medical image compression of CT image, MR images using DWT by comparing RGB and YCbCr color spaces, MR images using DWT by comparing RGB and YCbCr color spaces, with region-of-interest (ROI), and ECG signal compression with time frequency filtering using S-transform. However, as dealing with the medical image segmentation, there are many unresolved and difficult issues, including real time organ or tissue extraction, early tumor detection, and automatically parameter specification, which require further investigation.

The level set evolution is time consuming since it relies on full-field energy minimization to represent the propagating curves. To
speed up the segmentation, real time algorithm will be developed by integrating fast numerical computing with the evolution of fast convergence. The real-time tracking is a challenging task for many machine vision applications. Tracking of ROI targets such as early tumor appearance is a powerful technique for medical analysis and diagnosis. In the past year, some techniques including particle filtering [35, 37] are successfully used for robust object tracking. Therefore, in addition to study these famous techniques, we will extend the proposed level-set algorithm to extract the targets. Level-set segmentation methods generally need a few parameters to be carefully determined and improper parameters always produce bad segmentation results. In future, we will design an automatic algorithm to reasonably specify the parameters for better segmentation.

In the future, research can be done on the following topics: developing real-time evolution algorithm, extending tracking method to image sequences and videos, and designing automatically parameter specification.