CHAPTER 9

CONCLUSION AND FUTURE SCOPE

9.1 INTRODUCTION

In the presented work, the various aspects of the classification methods of tumor tissue and normal brain tissue from magnetic resonance images are studied. The modified technique is implemented for feature extraction from spatial domain as well as time scale domain. These extracted features are applied as input vectors for training of back propagation artificial neural network. The conclusions drawn in these studies are summarized in the next section.

9.2 IDENTIFICATION OF BRAIN TUMOR TISSUE

A fast and effective diagnostic tool to separate tumor tissue and normal brain tissue is increasingly needed due to the fact that incidences of brain tumor in recent years have risen drastically in recent years and an early detection can improve the survival rate of the patients.
In this research work, an attempt is made to develop a supportive diagnostic tool to differentiate brain tumor tissue from normal brain tissue. For this purpose, a method of feature extraction is derived and implemented.

As an outcome, the following results are confirmed in this research work:

(i) The supportive diagnostic tool developed in the presented work, provides highly promising and encouraging results for classification of tumor and normal brain tissue in MR images. The classification accuracy as high as 82% is achieved for classification of abnormal tumor tissue and normal brain tissue.

(ii) From the results, it is concluded that the classification performance by using integration of three feature sets (spatial domain + DWT + DT-CWT) is superior to performance by individual feature set.

(iii) By using statistical approach, twelve texture features are calculated using gray level co-occurrence matrix. It is observed that not all these features contribute for discrimination of tumor tissue and normal brain tissue. It is observed that contrast, entropy, variance, and energy are the main discriminating features whereas feature ‘correlation’ has overlapping range of values for both the classes. Addition of the feature in feature vector results in reduction in classification accuracy.

(iv) In transform domain, wavelet analysis provides a good analytic tool for texture analysis. The features are calculated using Discrete Wavelet Transform (CWT) and Dual Tree Complex Wavelet Transform (DTCWT). In case of DWT analysis, the wavelet basis function Biortho-2.2 gives differentiating values of energy levels of LL band. DWT analysis using wavelet basis functions Haar and Daubachies do not improves classification accuracy.
(v) It is concluded in this research that the conventional Discrete Wavelet Transform (DWT) provides texture information in three directions i.e. horizontal, vertical and diagonal with maximum energy content in LL band. Feature extraction using Dual Tree Complex Wavelet Transform (DT-CWT) overcomes the drawbacks of DWT and improves directional sensitivity.

(vi) Also, it is observed that the classification accuracy has improved substantially as the feature vector is formed by integration of features derived from spatial domain and time scale domain.

(vii) The present study also concludes that ANN are good choice for classification of MR images using supervised training and produce results faster results than other traditional classifier.

9.3 FUTURE SCOPE OF THE WORK

(i) The presented technique is based on two dimensional MR images acquired from MRI scanner. The use of in-vivo MRIs to improve present results with simulated MRI can be further investigated.

(ii) Automatic segmentation is difficult due to overlapping intensities, anatomic variability in shape, INU artifacts and noise. If the given image shows large amount of overlapping intensities among various brain tissue, then the selection of optimum global threshold becomes difficult and the presented algorithm does not provide satisfactory results.

(iii) For segmentation of brain tumor from MR image, the techniques used in the study sets the threshold at valley between two peaks. These algorithms work well for the images where the tumor has brighter contrast as compared to the normal brain tissue, i.e. Glioblastoma Multiforme. Therefore, knowledge based techniques can be used for segmentation of various types of tumors.

(iv) In the present study, texture features from time space domain are extracted by using Discrete Wavelet Transform (DWT) and Dual Tree Complex
Wavelet Transform (DT-CWT). The additional features can be extracted by using Rotated Complex Wavelet to improve classification accuracy further.

(v) In specific types of tumors like mixed gliomas, the tumor shows multiple lobes having different contrasts and textures. Research on segmentation and classification of such tumors need to be explored further with extraction of additional features.

(vi) Back propagation trained ANN is used here as a classifier. It is observed that the intensity variations across MR images cause instability on training data. This due to the fact that supervised learning relies on operator intervention for selection of data is crucial. Hence, the implementation of Linear Vector Quantization (LVQ) ANN may improve the performance of the classifier.

(vii) A fuzzy-neural expert system can be built as a further study of the presented work.