CHAPTER 7

CONCLUSION

7.1 CONTRIBUTION OF THE THESIS

A CAD system is vital to achieve the best possible outcome in the fight against breast cancer. Early detection is fundamental in this fight. Currently X-ray mammography is the most widely used procedure for detecting and diagnosing breast cancers. Rapid advances of CAD technologies help radiologist accomplish their diagnosis with the aid of computer systems. Digital image processing techniques represent useful tools in breast imaging CAD to detect and highlight abnormalities and further improve the performance and confidence of a radiologist. One of the main tasks of CAD system for breast cancer consists of the detection of microcalcification, which has been shown to be crucial for early diagnosis of breast cancer.

In this thesis advanced image processing algorithms using Maximum Overlapping Wavelet Transform are developed for microcalcification and mass detection. Certain investigations on the applications of feature extraction, feature selection, classification of microcalcification and masses have been proposed. Characterization of detected abnormalities in to benign and malignant has been approached based on multi frequency analysis using Wave Atom transform and complex neural networks.
The proposed method was evaluated using the mammogram images of Digital Database for Screening Mammography and Mammographic Image Analysis Society data bases. The proposed method produces promising results for both the databases where existing methods mostly reports results considering only one specific database. Also attempts have been made using different transforms which are applied to the image for feature extraction and the resultant image is decomposed into different scales, best coefficients from each scale are retained as feature vector. This feature vector is analyzed in different classifiers. The classifiers used in this research work learns faster, increase functionality and generalizes the proposed system by producing significant results surpassing the existing methods. The main drawback of existing methods to detect microcalcifications is that researchers put their efforts into optimizing one or two blocks of the general scheme, while not considering the optimization of the others. However in this research an extensive study on different methods for every block is performed and the best methods are used for each stage to develop an optimal CAD tool. And also through ROC analysis, it is found that the proposed method can accurately detect the presence of microcalcifications and masses with highest detection rate. Further it is also found that it can characterize into benign or malignant with a classification efficiency of 96.19 % for microcalcifications and 94% for mass.

The major contributions are

1. The implementation of Maximum Overlapping Wavelet transform and Curvelet transform for detection of mass and microcalcification in mammograms and improve the sensitivity and performance of the CAD system.
2. The application of advanced neural networks like SVM, ELM, PECELM and CC-ELM for classification and the selection of user defined parameters of the classifiers such that the results are at their best.


4. The implication of sequential learning algorithm for learning different classes of microcalcifications that may be observed in mammograms.

5. The experimental investigation of CAD system which provides hand in hand detection and characterization of microcalcifications and masses.

6. The validation of the proposed system performance by comparing its Receiver Operating Characteristics (ROC) with different neural networks and different texture feature measures.

A practical model of GUI based comprehensive tool for automated detection, characterization, and risk nature analysis of breast cancer combined with tissue density analysis has been provided in this research work. In this thesis a detailed review of various algorithms and procedures used for developing CAD systems for breast cancer detection is provided to develop and establish the progress of the knowledge in that area.
7.2 SCOPE FOR FUTURE WORK

1. The clinical information may be added to the classifier so that the decision about the assessment could be influenced by clinical factors, genetic risk and environmental factors that can help in epidemiological studies.

2. Each imaging technique has its own strengths and weaknesses. Therefore mammograms can be combined with different imaging modalities like MRI, Ultrasound that can provide complementary information’s to assist the radiologists in breast cancer diagnosis.

3. The major unsolved problems of CAD mammography systems like dense breast tissue which is difficult to single out the regions of higher contrast in classifying benign and malignant breast disease by radiologists that needs to be taken care.

4. The proposed method can be further extended in categorizing the different types of mass.