CHAPTER 5

SUMMARY AND CONCLUSIONS

Pulmonary function test plays an important role for the diagnosis, prognosis, mass screening of respiratory disorders. These tests are often performed using flow-volume spirometers. The parameters estimated through such measurements are useful for clinical inferences and treatment modalities (Enright et al 2005). Particularly, the value of forced expiratory volume in one second (FEV₁) is well established index to quantify the degree of abnormality. In this work, an attempt has been made for the prediction of forced expiratory volume in one second using backpropagation and radial basis function neural networks.

In the prediction of FEV₁, the backpropagation network is trained with different hidden units and the network with ten units is chosen as it had the least prediction error. It is found that the FEV₁ values are predicted more accurately for normal data compared to abnormal. And among the abnormal subjects, the predicted values of FEV₁ for obstructive data correlated well with the measured FEV₁ values.

As RBFNN performs better in prediction and classification, the forced expiratory volume in one second is predicted using radial basis function. Cluster analysis is employed in estimating the cluster centers as it divides data into clusters of similar data objects. Different clustering techniques such as k-means clustering and fuzzy c-means clustering are utilized to determine the widths of the activation function. The network with
five cluster centers is selected based on the performance accuracy and used for the prediction.

The radial basis function network is combined with SOM to predict FEV$_1$ and correlation is found to be high. The radial basis function network with widths determined from the SOM units are trained and used for prediction of FEV$_1$. The neural networks predicted FEV$_1$ accurately for normal subjects with high correlation than abnormal. The prediction of FEV$_1$ in obstructive abnormality is found to be more accurate than in restrictive condition. Further, results suggest that the prediction using neural network can enhance the clinical relevance of spirometry.

Classification of spirometric data into normal and abnormal is carried out using radial basis function neural networks. Then the classification is carried out using values of FEV$_1$ predicted by radial basis function neural networks incorporating k-means clustering and SOM algorithm. It is found that the performance of classification based on prediction is similar to that of classification based on spirometer data.

Classification of severity among abnormal is done using combined neural networks. It is observed that combined neural networks with radial basis algorithm show improvement in accuracy than single neural network in the classification of pulmonary data in to normal and abnormal. The specificity value shows that classification of abnormal data into obstructive and restrictive subjects using CNN, seems to be effective. The positive predictive values indicate that CNN diagnose normal data more correctly than abnormal data. The negative predictive value suggests that classification of spirometric data into abnormal is higher in Layer II than that of the Layer I of CNN.
It appears that this neural network based method of assessment is useful in understanding the pulmonary functions with incomplete data and data with poor recording. The proposed methodology can be effective for the classification of severity among abnormal and to assess the responses to treatments. The performance of combined neural networks can be further enhanced by using large database.

The significance and the clinical relevance of this study is perceived as follows:

- Research shows that 40% of the spirometric results are unacceptable due to the failure in completing the test which makes the diagnosis difficult (Ulmer 2003). This work enhances the diagnostic relevance of spirometry as it helps in classifying the respiratory abnormalities.

- Prediction of FEV\textsubscript{1} which is the most significant parameter is useful in assisting the diagnosis for patients and children who cannot perform the test completely.

- This method of classification is useful in automating the analysis of spirometric investigations with little intervention from clinician and

- This method could be used for real time analysis and mass screening.