Conclusion and Future Work

Approximating a regression function having data points with high level of noises, namely, outliers may lead to fitting these noises and this result in the regression approximation function getting corrupted. In order to overcome this problem, we suggested a new fuzzy support vector regression formulation in Chapter 3 and its solution is obtained using an active set strategy. This approach has the following important advantages that it leads to solving a system of linear equations instead of solving a quadratic programming problem and by making use of Sherman–Morrison-Woodbury formula, the inverse of a matrix of much smaller order is performed.

It is suggested that our method of solution can be further extended to nonlinear regression formulation via kernel function and its accuracy can be verified by considering a number of problems of practical importance.

Motivated by the work of Mangasarian et al. on the application of a Newton method for classification and regression problems, we proposed a new \( \varepsilon \)-insensitive SVR formulation in Chapter 4 as an unconstrained minimization problem and applied a fast Newton-Armijo algorithm for solving it. It has been proved that the algorithm converges and the Newton method terminates at a finite number of iterations. The main advantage of our approach is that the solution of the problem leads to solving a system of linear equations at a finite number of times rather then solving a quadratic minimization problem. For the linear regression case, by making use of Sherman–Morrison-Woodbury formula, the inverse of a matrix of much smaller order can be performed. A MATLAB code which works for linear and
nonlinear regression problems is given. Further, we have demonstrated that the method showed an excellent performance on few real world time series datasets which clearly proves the effectiveness of our method.

An interesting future direction of research work will be on the study of application of Newton method of solution for other class of regression models like fuzzy regression models, interval regression models and fuzzy c-regression models. Also it is suggested that the application of multiple kernel method for regression problems using Newton method can be explored.

In Chapter 5, we presented an overview of a new algorithm called Extreme Learning Machine (ELM) algorithm for Single hidden Layer Feedforward Network architecture which overcomes many of the problems of Artificial Neural Networks such as presence of local minima’s, imprecise learning rate, overfitting and studied its application to chaotic time series generated by the Mackey Glass and Lorenz differential equations with different time delays, Santa Fe A, Santa Fe B, UCR heart beat rate ECG time series and multiclass problem of Iris, Glass, Vowel and Letter datasets. It has been demonstrated that ELM is a promising method for time series prediction and multiclass classification problems.

As future work it is suggested that the extension of ELM to fuzzy neural networks can be explored.