APPLICATION OF ARTIFICIAL NEURAL NETWORKS MODELING FOR THE PREDICTION OF NOISE MONITORING IN LUCKNOW

ABSTRACT
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THESIS

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ABSTRACT

Long-term exposure to high noise levels causes lifelong hearing loss, stress, heart disease, high blood pressure and generate unpleasant psychological effects on an individual. Due to rapid urbanization, industrialization and environment degradation, the noise levels have increased remarkably across the country and is playing havoc on human health. Understandably, the estimation and prediction of noise levels is extremely important not only for proper urban planning but also to have regulations and environmental protection policy on noise. The secondary data on standard noise level as output variable (Y) and weather parameters i.e., maximum temperature (in $^\circ C$), minimum temperature (in $^\circ C$), relative humidity (in % at 07 hrs), relative humidity (in % at 14 hrs), wind speed (in km/hr), rainfall (in mm) and duration of sunshine (hr/day) as input variables, X_i (for i = 1, 2, …, 7) has been gathered for the period 2011-2016 from the www.indiastat.com, Indian Meteorological Department, Lucknow and Uttar Pradesh Pollution Control Board, Lucknow.

The subject of this thesis is to predict the noise levels in four different zones of Lucknow namely industrial, commercial, residential and silence zone using neural network techniques *viz*., multilayer perceptron (MLP) and radial basis function (RBF). Further, neural network techniques were compared with conventional technique namely, multiple linear regression (MLR) and it reveals that MLP neural network technique with seven hidden neurons performed well with high value of regression score, R and low values of accuracy measures such as mean absolute error (MAE), mean absolute percentage error (MAPE), mean squared error (MSE), root mean squared error (RMSE) as compared to RBF and MLR techniques using MATLAB (R2014a) software for the prediction of noise level. Thus, the noise

prediction models are imperative for researchers as well as policy makers for urban planning, environmental management and to create healthy and noise pollution free environment.

This thesis has five chapters and the work done in these chapters are discussed below:

Chapter 1; *Introduction and Related Concepts*, that presents a brief overview of the outlines of this research such as background of study area, study area under research, application of NN techniques, research objectives, review of literature, materials and methods.

Chapter 2; *Development of MLP-NN model for the prediction of noise levels in four different zones of Lucknow*. In this chapter, the prediction of noise levels using MLP-NN technique that has been trained using three different training algorithms namely Levenberg-Marquardt (LM), Bayesian Regularization (BR) and Scale Conjugate Gradient (SCG). The study found that LM algorithm of MLP-NN technique was better than BR and SCG algorithms for the prediction of noise levels in all four different zones of Lucknow as evidence by the high value of regression score, R and low values of mean absolute error, mean absolute percentage error, mean square error and root mean square error.

Chapter 3; *Development of RBF-NN model for the prediction of noise levels in four different zones of Lucknow*. In this chapter, RBF-NN technique was used for the prediction of noise levels at day and night time. The study was found that RBF-NN model has good predictive strength using gradient descent training algorithm, as it yields the high value of regression score, R and low values of mean absolute error, mean absolute percentage error, mean square error and root mean square error.

Chapter 4; *Comparative analysis of MLP-NN and RBF-NN models for the prediction of noise levels in four different zones of Lucknow*. In this chapter, a comparative study has been carried out to depict the predictive supremacy of MLP-NN and RBF-NN technique for predicting the noise levels. The study was found that MLP-NN technique using LM algorithm was more superior to the other algorithms (BR and SCG). RBF-NN technique was accepted as evidence by highest value of regression score, R and lowest values of mean absolute error, mean absolute percentage error, mean square error and root mean square error.

Chapter 5; *Superiority of NN techniques over conventional technique for the prediction of noise levels in four different zones of Lucknow*. In this chapter, a comparative analysis was performed using MLP-NN and RBF-NN techniques with MLR technique. The study was found that MLP-NN and RBF-NN models were an ideal model to capture the dynamic behaviour of prediction for noise levels rather than MLR model with highest value of regression score, R and lowest values of mean absolute error, mean absolute percentage error, mean square error and root mean square error.