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Bijaya Ketan Panigrahi
Munesh C. Trivedi · Krishn K. Mishra
Shailesh Tiwari · Pradeep Kumar Singh
Editors

Smart Innovations in Communication and Computational Sciences

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Preface

The International Conference on **Smart Innovations in Communications and Computational Sciences (ICSICCS 2017)** has been held at Moga, Punjab, India, during **June 23–24, 2017**. The ICSICCS 2017 has been organized and supported by the **North West Group of Institutions, Moga, Punjab, India**.

The main purpose of ICSICCS 2017 is to provide a forum for researchers, educators, engineers, and government officials involved in the general areas of communication, computational sciences, and technology to disseminate their latest research results and exchange views on the future research directions of these fields.

The field of communications and computational sciences always deals with finding the innovative solutions to problems by proposing different techniques, methods, and tools. Generally, innovation refers to find new ways of doing usual things or doing new things in a different manner but due to increasingly growing technological advances with speedy pace *Smart Innovations* are needed. Smart refers to "*how intelligent the innovation is?*" Nowadays, there is massive need to develop new "*intelligent*" "*ideas, methods, techniques, devices, tools*". The proceedings cover those systems, paradigms, techniques, technical reviews that employ knowledge and intelligence in a broad spectrum.

ICSICCS 2017 received around 350 submissions from around 603 authors of 9 different countries such as Taiwan, Sweden, Italy, Saudi Arabia, China, and Bangladesh. Each submission has gone through the plagiarism check. On the basis of plagiarism report, each submission was rigorously reviewed by at least two reviewers. Even some submissions have more than two reviews. On the basis of these reviews, 73 high-quality papers were selected for publication in proceedings volumes, with an acceptance rate of 20.8%.

This proceedings volume comprises 40 quality research papers in the form of chapters. These chapters are further subdivided into different tracks named as "*Smart Computing Technologies*," "*Intelligent Communications and Networking*," and "*Computational Sciences*."

We are thankful to the speakers Prof. B. K. Panigrahi, IIT Delhi; Dr. Dhanajay Singh, Hankuk (Korea) University of Foreign Studies (HUFS), Seoul, South Korea; and Dr. T. V. Vijay Kumar, JNU, Delhi; delegates, and the authors for their

participation and their interest in ICSICCS as a platform to share their ideas and innovation. We are also thankful to Prof. Dr. Janusz Kacprzyk, Series Editor, AISC, Springer, and Mr. Aninda Bose, Senior Editor, Hard Sciences, Springer, India, for providing continuous guidance and support. Also, we extend our heartfelt gratitude and thanks to the reviewers and Technical Program Committee Members for showing their concern and efforts in the review process. We are indeed thankful to everyone directly or indirectly associated with the conference organizing team leading it toward the success.

We hope you enjoy the conference proceedings and wish you all the best!

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Part I
Smart Computing Technologies

A Neural Network-Based Novel Detection Technique for Analysis of Pollutant Levels in Air

Jagjot Singh Khokhar, Monika Arora, Gurvinder Kaur, Garima Mahendru, Monica Kaushik, Nirdosh and Shikha Singh

Abstract The dispersions or suspensions of the particles in solid and the liquid forms in atmosphere are coined as aerosols. These suspensions are the matter of concern in recent times as the ecosystem and the human health are at risk. These atmospheric aerosols are defined in broader terms; to be more precise, the term particulate matter (PM) is used to define the suspended solid-phase matter in the atmosphere. It is the mixture of the diverse elements. Further pollutants like SO_2 and NO_2 are largely found in the industrial waste. The evidences reveal that sulfate and organic matter are the two main contributing factors for annual PM_{10} concentration, and its consequences are like health problems and ecological imbalance which are correlating and pointing especially toward the particulate matter. In this paper, the average concentration of various pollutants like SO_2, NO_2, PM_{10}, and SPM in air have been predicted efficiently. The detailed analysis of different models and its effects on the environment have been examined with the help of neural network tool.

Keywords Particulate matter · Neural network · Air pollution Human health

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1 Introduction

In the environmental engineering literature, the terms aerosols and PM are often used interchangeably although the former one has broader definition and scope. The aerosols come from the wider range of anthropogenic and natural sources from the earth, whereas airborne PM is not a single pollutant; rather, it is the mixture of many subclasses of pollutants [1]. The fate and transport of gas-phase components in atmosphere is closely linked to the aerosols in contrast to the PM which are either directly emitted by emission sources or are formed due to reaction between the gases; for example, reaction between ammonia and oxides of sulfur or nitrogen results in PM [2].

As per the numerous epidemiologic studies, PM having aerodynamic diameter <10 μm (PM_{10}) or <2.5 μm ($PM_{2.5}$) is of major concern in public health issues. The fact that respirable suspended particulate matter is more dangerous to health than larger particulate up to 100 micron is well established. It is important to remember though that the ratio of RSPM to SPM will be specific to an area and the measurement of the one should be able to infer the other if the ratio has been experimentally determined. The various kinds of the study show that there are mainly two objectives of atmospheric aerosols: firstly, the direct impact on the health as a result of near exposure on the surface of the earth and secondly, the role of aerosols in the physical processes and atmospheric chemicals and the way it is affecting the local climate and the global climate [3]. Further in a narrow way, the recent studies show that concentration of PM_{10} and $PM_{2.5}$ airborne aerosols in urban areas shows the good ratio in traffic-related pollutants and other combustion processes [4]. The long-term exposure to PM_{10} leads to inflammation in lungs. The lungs and heart get affected due to the inhalation of air particles.

Rambagh, located five kilometer northeast of Taj Mahal, Agra, experiences semiarid climate that borders on humid subtropical climate. It has mild winters with hot and dry summers and monsoons. The recent surveys show that Agra is ahead of the capital, Delhi or Kanpur in terms of the black carbon levels in atmosphere. There is also an increase in ratio of particulate matter beyond the permissible values. In this paper, the recent data for 2015–2016 (August) has been gathered across the Rambagh which includes the concentration of PM_{10} μg/m^3, levels of SO_2 and NO_2, and the weather conditions of a place. In the following sections, the statistical analysis, methodologies, and results have been further analyzed.

2 Statistical Analysis

In this research work, many statistical indexes such as Bayesian regularization (BR), Levenberg–Marquardt algorithm (LM), and scaled conjugate gradient (SCG) have been used for the evaluation and accuracy of the performance and results [5].

Bayesian classification is the technique to construct the classifiers. Classifiers are nothing but the models that assign the class labels to the problem instance. Levenberg–Marquardt algorithm is also known as DLS that is damped least squares used for solving generic curve fitting problems by finding the local minimum which may not be the global minimum [6]. Scaled conjugate gradient is feed-forward and supervised algorithm for neural networks; the feed forward here means that in connections there is no loop between the units. The general equations corresponding to each are mentioned below:

Bayesian regularization:

$$x = arg \max_{b \in \{1, \ldots B\}} p(C_b) \prod_{i=1} n\, p(y_i | C_b) \tag{1}$$

Levenberg–Marquardt algorithm:

$$H(\beta) = \sum_{j=1} m\left[x_j - f\left(y_j, \beta\right)\right]^2 \tag{2}$$

Scaled conjugate:

$$S_k = \frac{\dot{E}(W_k + \sigma_k P_k) - \dot{E}(W_k)}{\sigma_k} \tag{3}$$

Bayesian regularization, Levenberg–Marquardt algorithm, and scaled conjugate are the various algorithmic parameters and functions used in the neural networks. BR can eliminate or reduce the need for lengthy cross-validations, and it is more robust than the standard back-propagation methods, whereas to solve nonlinear least squares problems, the LM technique is considered to be the standard one as it shows lower performance in terms of predictive ability. On the other hand, SCG needs O (n) of memory where n represents the number of weights in the network although it uses second order of information from neural networks [7]. Among these three, the BR is considered to be the optimal one as it develops the nonlinear relationships and it has more predictive abilities. To get refined results, the data was tested through five hidden layers, and on observing the results, it can be seen that the BR shows least mean square error (Table 1). In further sections, a brief introduction of neural networks is cited and the results in regard to BR have been shown and explained in the sections after it.

Table 1 No. of hidden layers and mean square values

S. No.	No. of hidden layers	Mean square error	No. of iterations
1	5	0.014719	43
2	10	0.013359	148
3	15	0.013966	50
4	20	0.013095	96
5	25	0.013677	69
6	30	0.012769	57

2.1 Neural Networks

It is one of the concepts, which has been inspired by the functionality of the human brain and its performance in identification of phenomena. Neurons (a single neuron shown in Fig. 1) are placed in different layers in multilayer neuron network [5]. Input layer being the first layer receiving information and till its capability with other neurons, it transfers the information in the form of input signals to the other next layers. Neuron weight is the communication ability of each neuron with other neurons. The number of neurons in each layer depends on the weight of neuron and the previous layers' neurons. In addition to the input layer, the neural network also consists of the hidden layers and the output layers. Some of the advantages of using artificial neural networks are its record-breaking accuracy on a wide variety range of problems, less requirement of formal statistical training, offering various multiple training algorithms, and having the implicit ability of detecting nonlinear complex relationships between independent and dependent variables. In this, neuron is the main processor and adding neurons to hidden layers will reduce calculation error but will be more time consuming for calculations [6]. Hence, deciding on the logical proportion for choosing the number of neurons for hidden layers and processing is obligatory. In the next section, the methodology used in the paper and results have been discussed.

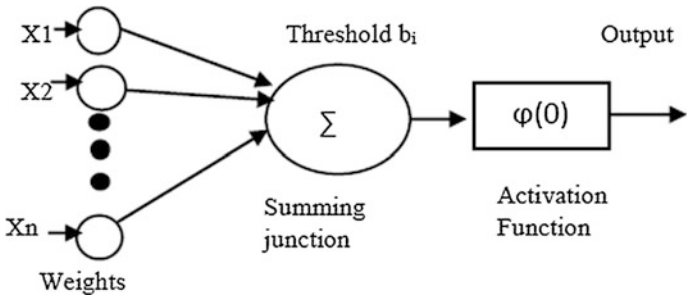

Fig. 1 Single neuron

3 Data and Methodology

The data set used in this paper is the recent one of the place Rambagh located in Agra. The values of SO_2, NO_2, PM_{10}, and suspended particulate matter (SPM) for the one and a half years that is from January to December of 2015 and from January to August of 2016. Central Pollution Control Board (CPCB), Ministry of Environment and Forest, Government of India, has provided this data on the alternate-day basis also including the local weather conditions, for example, cloudy day or sunny day [8]. The values are in $\mu g/m^3$ unit. There are three portions of the data that also act as training set, validation set, and testing set in neural networks having 70%, 15%, and 15% weightage, respectively. These values can be changed, but these particular values give better results. For this paper, 186 sample spaces of data have been used. Figure 2 shows the basic view of the neural network consisting of inputs, hidden layers, and the output.

The nftool (neural fitting tool) of MATLAB has been used in our proposed work to determine the performance and the results. In this, the number of input data to layer and the no. of hidden layers have to be defined. In this paper, 5, 10, 15, 20, 25, and 30 hidden layers have been used one by one to get the output and their mean square errors have been compared to get the performance measures. Since layer 30 gives most refined results with least value of error, the data has been trained till 30 layers.

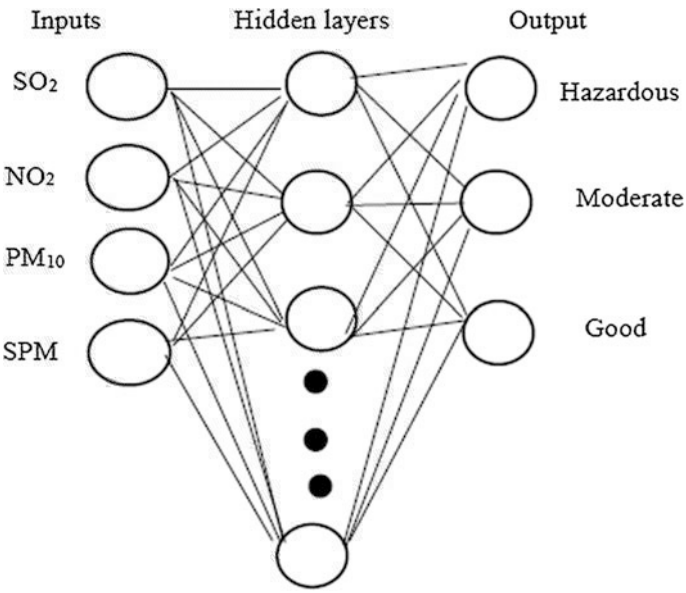

Fig. 2 Neural network

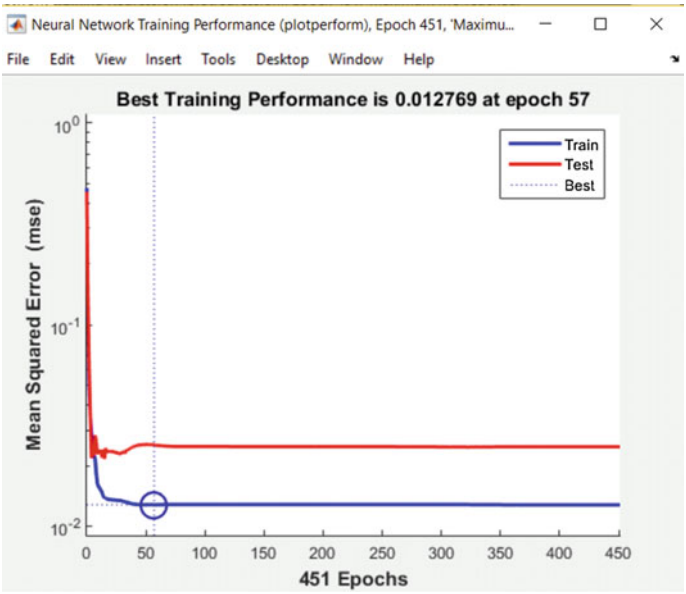

Fig. 3 Performance graph showing mean square error

Figure 2 shows the neural network marked with the inputs such as the values of SO_2, NO_2, PM_{10}, and the SPM, the hidden layers, and the output having three desired values such as hazardous (1), moderate (0.5), and good (0). These are levels of the PM_{10} in which the range of its values 200 and above is considered to be hazardous level, range from 100 to 200 is moderate, and 0–100 is good [8]. These levels further suggest how much harmful is the PM_{10} for the human life and the ecosystem explained in the next section. Table 1 shows the number of hidden layers with their mean square.

Table 1 and Figure 3 show that the validation, test data sets, and the performance of training with respect to epochs of PM_{10} level prediction in the atmosphere. As it is clearly seen the best performance measure is at S. No. 6 that is with the 30 hidden layers and with minimum mean square value that is 0.012769. Further Figs. 4 and 5 show the regression curve between the target data and the output of levels of the pollutant level prediction in the atmosphere and the error histogram of pollutant levels in the atmosphere.

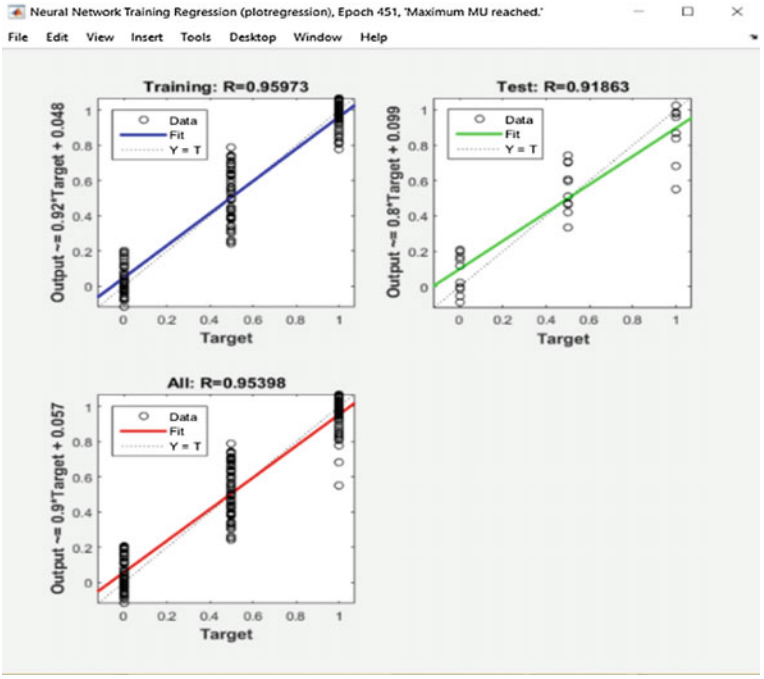

Fig. 4 Regression curve for PM_{10} levels in atmosphere

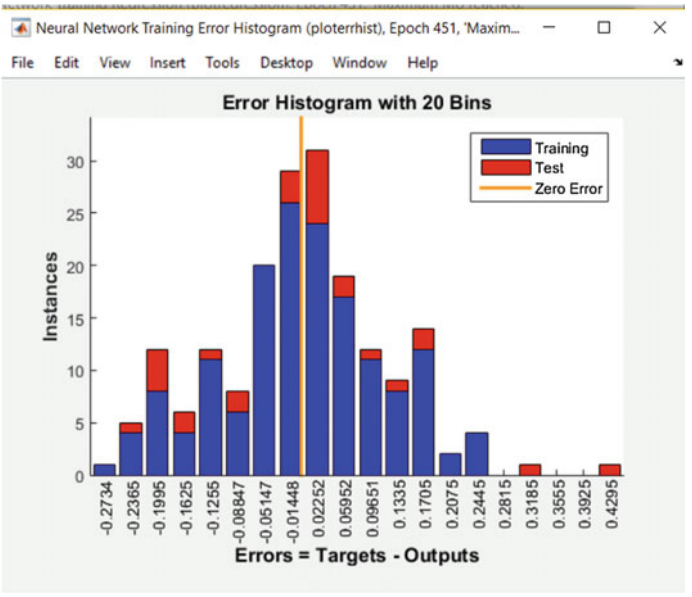

Fig. 5 Error histogram for PM_{10} levels in atmosphere

4 Impact on Human Health and Ecosystem

The recent rate of increase in particulate matter in the atmosphere is a great matter of concern as it is largely affecting the human health and the vegetation [9]. The deposition on the vegetation surface is mainly having three sources that is dry deposition, wet deposition, and the occult deposition, and on the other hand, the particles of size between 2.5 micrometer–10 Âµm are removed by the upper track of respiratory system of humans but the particles of size less than 2.5 Âµm get deposited on the bronchi walls in the bronchi system or bronchi tree. The further analysis shows that the employees working in municipal solid-waste landfill area were observed with increased rate of symptoms of different respiratory troubles. The experiments were conducted by exposing rats to different PM levels at different times, and the reports reveal the increase in size of the lungs' weights and the inflammatory changes [2]. Similarly in plants, the most exposed part are the leaves which persistently absorbs the polluted environment and the dust particles [6]. The rise in levels of SO_2 and NO_2 has largely affected the regional weather patterns, the global effects like greenhouse gas effect and the heritage monuments. Depending on the deposition of the particles, there are differing phytotoxic responses due to the exposure to the airborne particulate matter. It has also led to the heavy acidifying deposition of the sulfates and nitrates on the plant surfaces. The further consequences are reduced growth in plants, less yield, and decrease in the reproduction of plants.

5 Conclusion

In this paper, the predictive analysis of the pollutant levels at Rambagh in Agra has been done through neural networks. The different parameters of the neural network have been used to get the accurate results. The highest concentration of SO_2 and concentration of PM_{10} are found in industrial areas and that of NO_2 is found in commercial areas. So, the topic of concern, it is slowly deteriorating the human health and the ecosystem. In this paper, analysis has been presented using nftool to predict the levels of the various pollutants of a place and the various risks involved. Since the airborne PM is characterized by the diverse effects on climate, human health, ecosystem, etc. Further studies can be done in a manner like analyzing the levels of air pollutants causing pollution and the consequences in different areas, for example, commercial areas, industrial areas, residential areas, and the greenbelts of a particular place in different seasons and weather conditions. Epidemiological studies on large pollutants are unable to identify any threshold concentration below which ambient PM has no effects on health. It is said that within the large human population, there is such a wide range in susceptibility that some subjects are at risk even at the lowest end of the concentration levels. This paper briefly points out the

affects, and therefore, it is a high time that steps should be taken to curb the problem before it destroys life system completely. In further researches, the different parts will be studied and the solutions will be proposed to reduce the effects.

References

1. Chate, D. M. and Murugavel, P., Atmospheric aerosol formation and its growth during the cold season in India. *J. Earth Syst. Sci.*, 2010, 119(4), 471–477 for forest trees. Environmental Pollution, 82: 167–180
2. Sunder Raman, R., Ramachandran, S. and Rastogi, N., Source identification of ambient aerosols over an urban region in western India. *J. Environ. Monit,* 2010, 12(6), 1330–1340.S
3. P. Raktim, K. Ki-Hyun, H. Yoon-Jung, and J. Eui-Chan. "The pollution status of atmospheric carbonyls in a highly industrialized area". Journal of Hazardous Materials, 153(3):1122–1135, 2008.
4. Gianola, D.; Okut, H.; Weigel, K.A.; Rosa, G.J.M. Predicting complex quantitative traits with Bayesian neural networks: A case study with Jersey cows and wheat. BMC Genet. 2011, 12, 1–37.
5. M.I.A. Lourakis. A brief description of the Levenberg-Marquardt algorithm implemented by levmar, Technical Report, Institute of Computer Science, Foundation for Research and Technology - Hellas, 2005.
6. Bui, D.T.; Pradhan, B.; Lofman, O.; Revhaug, I.; Dick, O.B. Landslide susceptibility assessment in the HoaBinh province of Vieatnam: A comparison of the Levenberg–Marqardt and Bayesian regularized neural networks.Geomorphology 2012, 171, 12–29.
7. Tiwari, S., Srivastava, A.K., Bisht, D.S., Bano, T., Singh, S., Behura, S., Srivastava, M.K., Chate, D.M. and Padmanabhamurty, B;.Black carbon and chemical characteristics of PM10 and PM2.5 at an urban site of North India. Journal of Atmospheric Chemistry., 2009, 62(3), 193–209.
8. http://cpcb.nic.in/National_Ambient_Air_Quality_Standards.php Makridakis, S., Wheelwright, S. C. & Hyndman, R. J. (1998), Forecasting: methods and applications, 3rd edn, John Wiley & Sons, New York.
9. M. Younger, H.R. Morrow-Almeida, S. M. Vindigni, and A. L. Dannenberg. "The Built Environment, Climate Change, and Health: Opportunities for Co-Benets". American Journal of Preventive Medicine, 35(5):517–526 2008.