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Modeling and Simulation of Road Traffic Noise Using Artificial Neural Network and Regression

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Modeling and simulation of noise pollution has been done in a large city, where the population is over 2 millions. Two models of artificial neural network and regression were developed to predict in-city road traffic noise pollution with using the data of noise measurements and vehicle counts at three points of the city for a period of 12 hours. The MATLAB and DATAFIT softwares were used for simulation. The predicted results of noise level were compared with the measured noise levels in three stations. The values of normalized bias, sum of squared errors, mean of squared errors, root mean of squared errors, and squared correlation coefficient calculated for each model show the results of two models are suitable, and the predictions of artificial neural network are closer to the experimental data.

Key words: *Artificial neural network, road traffic noise, regression, modeling, simulation*

1. Introduction

The disturbance produced in our environment by various kinds of undesirable loud sounds is called noise pollution. Noise is one of the most pervasive pollutants. Like other pollutants, noise is a product of industrialization and modern civilization. It is an inescapable part of everyday life. It has become a growing concern throughout the world as it affects not only daily activities of people but also their productivity, health, and emotion.

Noise pollution is an increasing problem throughout the world. Traffic noise is considered as one of the major contributors to noise pollution. Particularly, road traffic noise is considered to be one of the most widespread and growing environmental problems in urban areas. People consider noise pollution to be the main local environmental problem, sometimes even more than air pollution or quality of drinking water.

Airport, railway, seaport and vehicular noises are major groups of traffic noise. Vehicular traffic noise sources include any cars, vans, trucks, motorcycles and buses that exist in roads and streets of a city. Vehicular traffic noise is one of the most invasive types of noise pollution, so it has become an issue of immediate concern for authorities in cities. The main sources of vehicular noise are: vehicle engine, exhaust systems and aerodynamic friction. The other factors affecting moving vehicle noise propagation level are stop signs, acceleration and deceleration, road surface gradient, tire–pavement interaction[1], speed bumps[2] and traffic lights[3]. Thus, traffic noise is affected by traffic volume, composition, location, speed, road surface and its gradient. As a result, road traffic noise is among the extensively most studied fields of noise pollution and therefore, several studies have been made on different aspects of traffic noise[4-10].

Some researchers have investigated noise pollution and its propagation levels in different countries. Sheadel classified noise models into four categories, i.e. regulatory, commercial, trade, and design[11]. Steele reviewed some of the most popular developed models, such as Federal Highway Administration Traffic Noise Model (FHWA TNM) with STAMINA 2.0/ OPTIMA for United States, Calculation of Road Traffic Noise (CoRTN) for United Kingdom, Richtlinien zum Lärmschutz an Straßen (RLS) 90 Standard for Germany, etc[12].

Some models assume point source[13]. While this assumption is a simple assumption, noise sources, with good approximation, behave as area sources[14]. For closely spaced sources, i.e. major roadways, they have a linear behavior[15]. A dynamic optimization was suggested for the prediction of periodic non-stationary road traffic noise[16]. The researchers developed the methods for the determination of road traffic noise downstream of a traffic signal[3,17]. Lam and Tam proposed a noise prediction tool based on the Monte-Carlo technique[18]. Calixto et al. presented a statistical model to predict road traffic noise[19].

Large cities suffer a great deal of noise pollution due to vehicular traffic. The main objective of the present paper is to develop two models of regression and artificial neural

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