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Data mining with various optimization methods

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ABSTRACT

Road traffic represents the main source of noise in urban environments that is proven to significantly affect human mental and physical health and labour productivity. Thus, in order to control noise sound level in urban areas, it is very important to develop methods for modelling the road traffic noise. As observed in the literature, the models that deal with this issue are mainly based on regression analysis, while other approaches are very rare. In this paper a novel approach for modelling traffic noise that is based on optimization is presented. Four optimization techniques were used in simulation in this work: genetic algorithms, Hooke and Jeeves algorithm, simulated annealing and particle swarm optimization. Two different scenarios are presented in this paper. In the first scenario the optimization methods use the whole measurement dataset to find the most suitable parameters, whereas in the second scenario optimized parameters were found using only some of the measurement data, while the rest of the data was used to evaluate the predictive capabilities of the model. The goodness of the model is evaluated by the coefficient of determination and other statistical parameters, and results show agreement of high extent between measured data and calculated values in both scenarios. In addition, the model was compared with classical statistical model, and superior capabilities of proposed model were demonstrated. The simulations were done using the originally developed user friendly software package.

1. Introduction

Road traffic noise along with the noise coming from railways and industries represents very important factor regarding environmental pollution in urban areas. The influence of traffic noise on human health has been studied on numerous occasions in recent years (Brink, 2011; Fyhri & Klboe, 2009; Pirrera, De Valck, & Cluydts, 2010) resulting that this kind of annoyance significantly affects both mental and physical health in many ways: causing anxiety, stress, hearing impediments, sleep disturbance, cardiovascular problems, etc. Thus, in order to control noise sound level in urban areas, it is very important to develop methods for prediction of the traffic noise. Due to the rapid development of means of transportation and road traffic, the influence of the traffic flow structure on the level of traffic noise is an important area of research. Through the monitoring of basic flow parameters and their trends it is possible to predict and monitor noise that appears in the certain part of the transport network. In this way, the effect of noise reduction can be achieved through different modes of traffic management, which is particularly important for human health and environmental improvement.

The first traffic noise prediction (TNP) models date back to early 1950s. Since then large number of methods and models for traffic noise prediction has been developed. The critical reviews of the most used ones are given in Steele (2001) and Quartieri et al. (2009). Most of the TNP models that are presented in literature are based on linear regression analysis. The main limit of those models, as concluded in Quartieri et al. (2009) and Guarnaccia, Lenza, Mastorakis, and Quartieri (2011), is "that they do not take into account the intrinsic random nature of traffic flow, in the sense that they do not take care of how vehicles really run, considering only how many they are". More advanced models involve artificial neural networks (ANN) (Cammarata, Cavalieri, & Fichera, 1995; Givargis & Karimi, 2010) and genetic algorithms (Gndogdu, Gkdad, & Yksel, 2005; Rahmani, Mousavi, & Kamali, 2011). ANN model that was used in Cammarata et al. (1995) has 3 inputs: equivalent number of vehicles, which was obtained by adding to the number of cars number of motorcycles multiplied by 3 and number of trucks multiplied by 6, the average height of the buildings on the sides of the road, and the width of the road. In order to increase the number of inputs authors decomposed equivalent number of vehicles into the number of cars, the number of

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