



16th Conference on Reliability and Statistics in Transportation and Communication,
RelStat'2016, 19-22 October, 2016, Riga, Latvia

Development of Interactive Monitoring System for Urban Environmental Impact Assessment of Transport System

Anton Pashkevich^{a*}, Marina Beliakova^b, Alexander Ivanov^b, Alari Purju^a

^aTallinn University of Technology, Ehitajate tee 5, Tallinn 419086, Estonia

^bNizhny Novgorod State University of Architecture and Civil Engineering, Ilyinskaya Str. 65, Nizhny Novgorod 603950, Russia

Abstract

All countries worldwide have a global problem with environmental pollution. One of its main reasons is a negative impact of transport. In such situation, research, assessment and monitoring of this negative environmental impact are the best tools, which could support decision-making process concerning approaches and measures to reduce or to eliminate its consequences and, thereby, could help to address this challenge. This research paper considers emissions of the motor transport system as an air pollution source as well as describes an issue of its assessment and monitoring, especially, in the large cities. Unfortunately, traditional air monitoring systems are unable to present a complex spatial structure of pollution fields for different pollutants, especially, in real time. To solve this problem, an interactive monitoring system was proposed and tested on the example of Nizhny Novgorod (Russian Federation). This system contains a calculation module, which is based on the actual information about traffic flows and weather conditions. It allows to estimate concentrations of chosen pollutants and population health risk in the chosen monitoring points in online mode. The proposed system can be applied to any place with the similar initial situation.

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Peer-review under responsibility of the scientific committee of the International Conference on Reliability and Statistics in Transportation and Communication

Keywords: interactive monitoring, environmental pollution, traffic congestion, Gaussian model

* Corresponding author.

E-mail address: anton.pashkevich@ttu.ee

1. Introduction

Road transport is one of the main sources of greenhouse gas (GHG) emissions as well as air and noise pollution in the cities today. To understand importance and actuality of this issue it is necessary to pay attention to the main transport strategic document in the European Union: The White Paper 2011 on Transport “Towards a competitive and resource efficient transport system” (White Paper, 2011). Between numbers of global and local problems as well as goals mentioned in this document it is possible to point out following of them concerning relations between the transport sector and the environment. First of all, unfortunately, the transport system is not still sustainable: its negative impacts on environment, economy and society are quite large. Secondly, transport sector is the biggest producer of greenhouse gas emissions (GHGs) comparing to other branches of economy. This sector must reduce 60% of GHGs by 2050 in comparison to the level of 1990. In the third place, it must be pointed out that urban transport is a reason of approximately 25% of CO₂ emissions made by all transport. Fourthly, of course, during the last decades transport started to be cleaner, but because of increased traffic volume it is still the main source of air and noise pollution. Cities suffer a lot for this reason. That is why there are a number of suggestions and measures proposed and presented by White Paper 2011 to reduce level of their negative impact, especially, on urban areas.

Although the Russian Federation is not a part of the European Union, it faces similar problems and challenges concerning an influence of transport on the environment. The reasons are also the same: growth of population transport demand and, as a consequence, increase of motorization rate, traffic intensity and traffic congestions.

Thereby, it is clear that research, assessment and monitoring of negative transport impact on the environment, especially, in the cities play an important role. These tools could help to find right solutions for achieving the above-mentioned goals and for solving the above-mentioned problems. They could also support a decision making process as well as a realization of measures and projects in the sphere of environmental management.

As it was seen from above-declared challenges, air pollution occupies a special place in the negative environment impact. Traffic flows on the urban road network create local zones of toxicological risks, which could lead to both immediate and chronic effects. To avoid such negative consequences, it is necessary to organize a steady monitoring of air conditions in the city. Unfortunately, that traditional air monitoring systems are unable to present a complex spatial structure of pollution fields for the required list of pollutants, especially, in real time. This fact underlines the issue to create an interactive monitoring system, which allows to assess urban environmental impact of the transport system in online mode and which could be easily implemented in different towns with the similar traffic problems and conditions.

2. Traffic congestion as a source of environmental problems

Currently, traffic congestion is almost normal condition on the road network in the large cities. Such situations are characterized by small driving speed, high intensity and density of traffic flow, usage of the maximum permitted road capacity and only in exceptional cases by blocking the traffic in one or more directions. Ecological consequences of traffic congestions were confirmed, for example, by research done in Sydney, Australia (Ferreira *et al.*, 2003; Morawska *et al.*, 2004). These long-term studies assessed degrees of air pollution and associated with them carcinogenic and non-carcinogenic risks in tunnel M5 East Motorway. Results showed that concentration of pollutant emissions during traffic congestion could increase in 100 times in comparison with the city average level.

The negative impact of air pollution on public health caused by emissions of motor transport under the conditions of traffic congestions remains still not enough explored because of the extreme complexity of task assignment, especially, in metropolises. Also existing methodological materials and practical research works have not ready nature.

At the same time, the experience of the USA as well as European countries during the last decades led to overestimate the contribution of different pollutants emitted by motor transport systems. In particular, an approach based on the distinction made between carcinogenic and non-carcinogenic risks was created. The second important methodological step was the expansion of the list of analysed carcinogens emitted by motor vehicles (Ministry of Health of the Russian Federation, 2004).

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