**Review** of the master's thesis by Kulikov Daniil

on the theme: «**Tasks of mathematical modelling of traffic flows in megacity**»

Structure of the master’s thesis: this work consists of 44 pages with an introduction, three chapters, conclusion and bibliography.

One of the most important factors in the life of large cities is their transportation system, consisting of a huge number of independent components. In previous years, they tried to model this as multi-component, but now it is clear that in current state of computational technique and informational nets it is possible to talk on serious models of control of city transportation. It demonstrated by the normal activity of accounting systems of business in the scale of a whole city. Some systems are considered now as an important path of support the vital support of a city and its population. But where appeared tasks which earlier resolved by models of old type, but now they did not properly contacted with needs of arising city transport park.

Effective functioning of the transport system of the city is the most important factor in ensuring its livelihoods and an indicator of the standard of living of the population. Despite the fact that many of the world's mega-cities in their policy focus on the development of public transport and non-motorized modes of transport, the attractiveness of the use of personal cars practically not reduced in recent years. And in the cities of Russia there is still an increase in the level of motorization of the population, dictating the need for the development of the street-road network and its more efficient use. The introduction of intelligent transport systems, improvement of traffic management, the widespread proliferation of mobile navigation systems can significantly improve the efficiency of transport systems of cities, especially in the areas of historic centers, where the limited possibility of laying of new roads or the construction of transport facilities. In this sense, the work presented on the development of mathematical methods for improving traffic on the urban road network is extremely relevant.

The goal of the paper was the study of exist mathematical models of transportation flows, investigation of action problems on optimization of street movement, development of own algorithms to solve the considered problems, application of the algorithms on real regions of a large Russian city. In the first chapter the author in details considered and described the models, of movement of a flow of transportation units on a network of streets and related to description of movement of flow of transportation tools on street and way network. In the second chapter the author presents the models which improve and develop world practice on optimization of conditions of movement of transportation flow on УДС and on crossroads. The author proposed a model of optimization of transportation flow on a unit of the network and its implementation on the program level.

The aim of the work was to study the existing mathematical models of traffic flows, to study actual problems of road traffic optimization, to develop own algorithms for solving the problems examined, and to apply algorithms on real sites in a large city of Russia. In the first chapter, the author has thoroughly studied and described the models developed to date, describing the flow of vehicles on the road network. In the second chapter, the author presents models that improve and develop the best practices in the world in terms of optimizing the traffic flow conditions on the y and intersections. The author suggests a model of traffic flow optimization on the network section, as well as its implementation at the program level. The third chapter is devoted to approbation of the developed models by the example of two districts of St. Petersburg. Demonstrated results showing a significant improvement in traffic in specified areas, as well as data on which the program was tested and its implementation. It is important to note that the author has developed approaches that complement and develop existing modeling methods, but are focused on solving new urgent problems.

The results of the work are of undoubted practical significance. Developed and tested models can find application both for use in mobile applications targeted at traffic participants, and for improving methods of organizing traffic management, in particular, as part of the development of automated traffic management systems.

It should be noted that the theme of the master's work «Tasks of mathematical modelling of traffic flows in megacity», proposed by the author, implies a broader scope of tasks related to the use of mathematical models, not limited to a complex of problems of optimization of traffic at intersections and sections of the street-road network. Thus, the city (agglomeration) model is not mentioned in the work, describing the distribution by types of movement, the formation of demand matrices for inter-district correspondence, the calculation of the intensity of automobile and passenger flows, etc. In this sense, it would be more correct to first outline the range of models studied and improved in the work in the context of the entire range of transport (transport and urban planning) models. It should also be noted that the models proposed by the author can be used not only in megacities, but also in small cities or on a road network outside populated areas. The emphasis on creating models for megacities implies the study of their internal planning and functional structure, which is reflected in the work in a very weak degree: the account of functional heterogeneity is presented only when considering the model of a cross-shaped intersection (section 2.2).

The third chapter contains an approbation of the developed models in two examples of St Petersburg regions. Both regions are well known. The first one is located near the entrance to the famous palace park in Peterhof that means a specific large morning coming flow of tourists, with later returns back to St-Petersburg. I did not find in the paper how this feature is took in account and how it is used in regulation I didn’t find in the text how this specific could be used in regulation of the phone … by transite routes.

To use the second region was my personal choice. It is a region of Lesnoy prospect with a zone that contains the Finland region and an angle to North. As an inhabitant of this region I was interested by details of recent refit of roadbed on *Lesnoy prospect* and of parallel to it *Big Sampsony prospect*. It was interesting to compare the difficulty of refit the traditional roadbed of this important path with a refit with the refit of this path by a интересно сравнить трудности ремонта важной трассы поочередными исключениями ее частей из транспортного оборота с передачами нагрузки на дублирующий путь. Печальный пример реконструкции важного участка таким способом недавно критиковался в печати.

Результаты работы имеют несомненную практическую значимость. Разработанные и апробированные модели могут найти применение как для использования в мобильных приложениях, ориентированных на участников движения, так и для совершенствования методов организации управления движением, в частности, в составе разработки АСУ дорожным движением, включая выбор ремонтных режимов.

I think that, despite some methodological shortcomings, the submitted work can be evaluated highly enough and recommended for protection.

**Reviewer**:

|  |  |  |
| --- | --- | --- |
| Ph.D., Head of Chair of Operations Research  SPB State University, Joseph V. Romanovsky | |  |
|  |  | «31» may 2018 |