ANALYSIS OF SOFTWARE TOOLS FOR THE REGULATION AND MODELING OF INTERSECTIONS

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Annotation. This article presents an analysis of user software applied in intersection regulation and outlines the main advantages of modeling traffic flows using modern software tools. It discusses the main methods and objectives of transport system modeling.

Additionally, the paper introduces an example of an intersection model created using PTV Vissim, one of the modern tools for traffic flow modeling.

Keywords: Intersection, traffic light, traffic modeling, modern software, PTV Vissim.

CHORRAHALARNI TARTIBGA SOLISH VA ULARNI MODELLASHTIRUVCHI DASTURIY VOSITALARNI TAHLIL QILISH

Anotatsiya. Ushbu maqolada chorrahalarni tartibga solishda foydalanuvchi dasturlar tahlili va transport oqimlarini zamonaviy dasturiy ta'minotlarda modellashtishning asosiy afzalliklari bayon qilingan. Transport tizimlarini modellashtirishning asosiy usullari va vazifalari keltirilgan.

Shuningdek transport oqimini modellashtiruvchi zamonaviy dasturlardan biri bo'lgan PTV Vissim dasturi misolida chorraha modeli keltirilgan.

Kalit so'zlar: Chorraha, svetofor, trafikni modellashtirish, PTV Vissim.

At the current stage of development in our country's transport sector, there is an increasing need to implement innovative approaches to traffic flow management, develop effective control policies at both macro and micro levels, apply modern mechanisms in the transport and logistics networks, and adopt intelligent transportation systems (ITS) [3].

Traffic congestion in urban road networks remains a growing challenge in the development of modern cities. Reducing traffic congestion on city streets can potentially be achieved by expanding road infrastructure or decreasing the demand for private vehicles. However, assuming that improvements can always be made through increasing the number of roads is not always realistic, given the limitations of existing road infrastructure. Therefore, it is necessary to focus on the application of traffic flow management in order to reduce congestion and, ultimately, improve urban transport mobility.

For decades, traffic light regulation has been one of the most critical areas of research and application aimed at ensuring maximum efficiency in urban road networks. During this time, various technical solutions have been developed and numerous studies have been conducted. However, with the continuous increase in the number of vehicles, the subsequent deterioration of road conditions, and the rising number of traffic jams, there is a growing demand for new and advanced technologies that can not only address existing challenges but also provide more effective and sustainable solutions." In large cities, prolonged delays of vehicles on urban roads are the result of a mismatch between the geometric parameters of street and road networks and the increasing intensity of traffic.

It is evident that increasing the number of roads and streets, as well as reconstructing at-grade intersections into grade-separated ones, leads to the redistribution of traffic flows and a reduction of overload on under-capacity segments of the urban road network.

However, it is widely known that constructing new roads and road elements is extremely costly. Therefore, it is essential first to identify and utilize the existing capacity reserves of the road network and then make decisions on structural modifications to certain segments. To effectively solve this problem, modern software tools must be applied.

Road segments without long-term congestion do not require capacity enhancement measures. Instead, attention should be directed to identifying "bottlenecks" in the street and road network and evaluating their capacity reserves.

Under conditions of dense urban development, intersections with the highest traffic-carrying capacity are regulated. Proper placement of traffic lights at intersections can significantly improve the quality of movement for public transport, bicycles, and pedestrians. On high-capacity roads with heavy traffic intensity, traffic light regulation is used to limit access to these roads and improve exit conditions.

In many cases, traffic light regulation systems help reduce the spatial footprint of transport infrastructure facilities. Some systems operate continuously under pre-set configurations, while others can adjust signal intervals. Based on this, traffic lights are classified into two types: fixed-time control and adaptive control.

In the first case, the system operates in a constant mode regardless of the day of the week, traffic conditions, or time of day. In large cities, such systems are increasingly being replaced with adaptive signal control systems.

For more efficient traffic management, the duration of signal cycles can be adjusted in various ways, which helps prevent traffic congestion.

Modern software allows for the modeling of traffic flows, enabling transport system optimization, planning of new systems, assessment of their effectiveness, and analysis and forecasting of various aspects of transportation activity.

Traffic modeling is the process of creating mathematical or computer-based models that reflect the transport situation in a city or region. These models make it possible to analyze and predict how traffic flows behave under different scenarios, such as increased traffic volumes, infrastructure changes, or unexpected incidents.

Using modern software for modeling offers several advantages, including[2]:

- Route optimization, including planning, visualization, and analysis;
- Visualization of traffic flows, allowing for a better understanding of traffic behavior and identification of problem areas;
- Transport optimization, congestion reduction, travel time minimization, improved logistics, and cost reduction;
- Support in planning new transport systems (e.g., roads, bridges, intersections), assessing their efficiency, and selecting the best design solutions.

The main objectives of traffic flow modeling include:

- Optimizing road traffic;
- Increasing road safety;
- Reducing transportation costs;
- Improving environmental conditions;
- Modeling emergency situations and their impacts.

Figure 1- illustrates the main methods of transport system modeling.

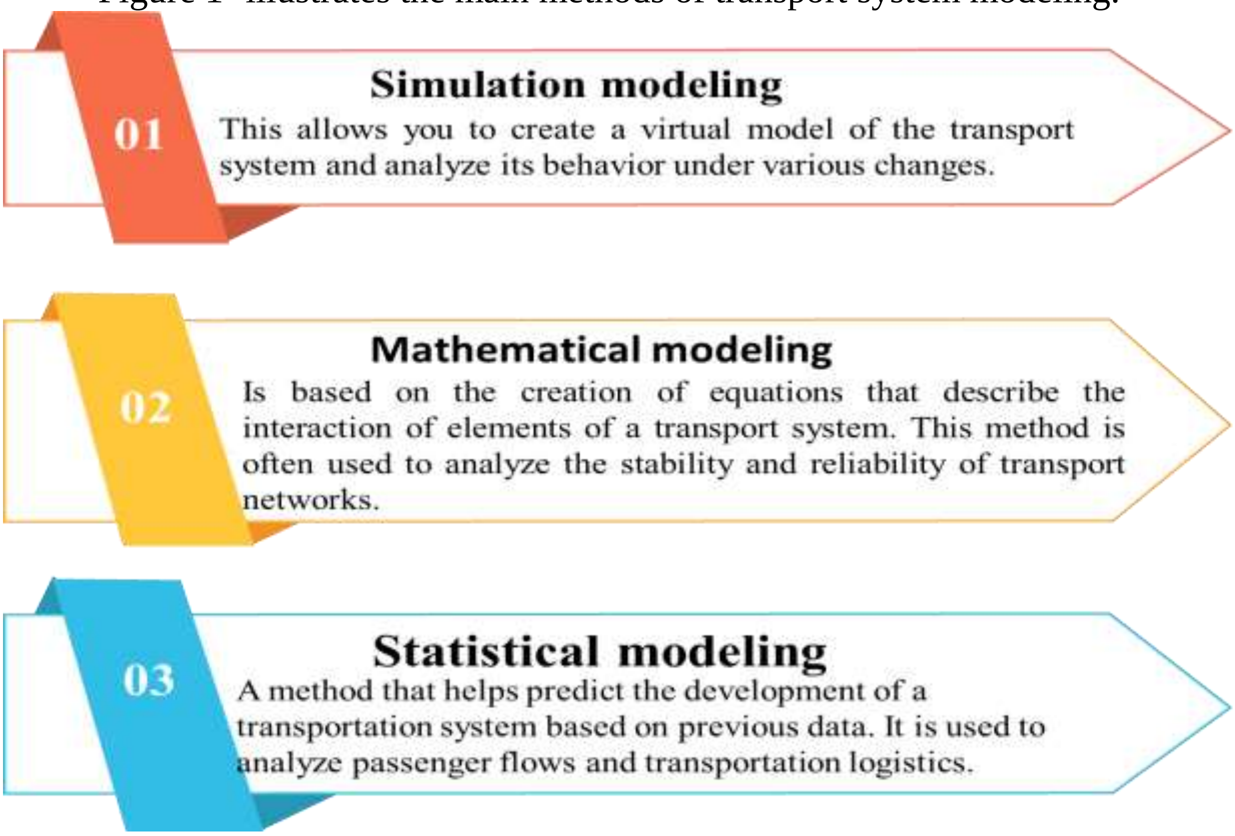

Figure 1. Main Methods of Transport System Modeling

Taking into account multiple factors, software tools allow for the consideration of various elements that influence traffic flow, such as the number of vehicles, speed of movement, presence of pedestrians, different incidents, and more.

There are numerous software tools designed specifically for traffic flow modeling. Some notable examples include VISSIM, AIMSUN, PTRANS, TRASSAN, HCM, MATLAB, and Open Model.

These software tools apply different approaches to traffic flow modeling. However, they all enable the analysis and optimization of transport systems, which makes them essential tools in transport planning and design [5].

The advantages of transport system modeling are illustrated in Figure 2.

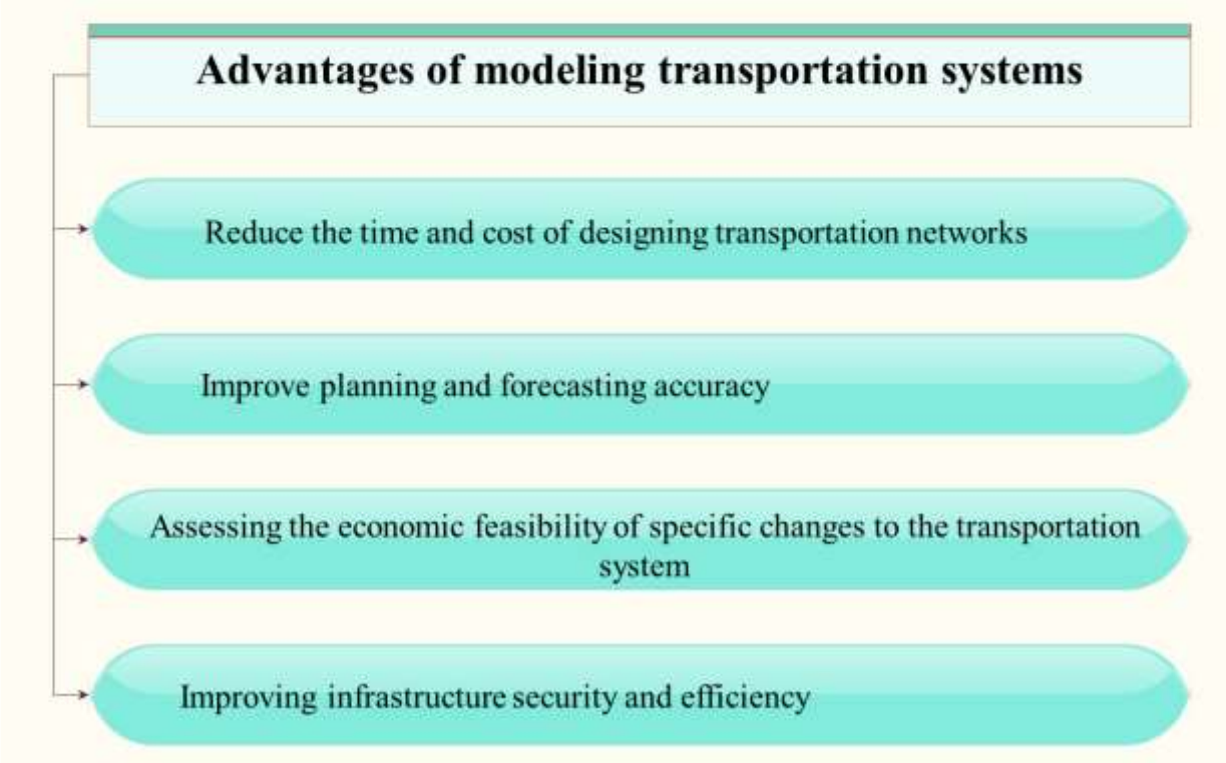

Figure 2. Advantages of Transport System Modeling

For example, to create an intersection model in the PTV Vissim software, the following initial data are required [4, 6]:

- A detailed scheme of the area to be modeled;
- The number of lanes in each traffic direction;
- Lane width;
- Traffic directions for each segment;
- Technical and geometric characteristics of all types of vehicles;
- Traffic intensity;
- Composition of incoming vehicle and pedestrian flows;
- Location and width of sidewalks;
- Movement priorities at conflict points.

Due to the simplicity and clarity of the PTV Vissim software interface, creating a model is not very difficult for users. Therefore, users without programming skills can model any part of the road network. Below is a visualization of one of the central intersections of Termiz city modeled using PTV Vissim (Figure 3).

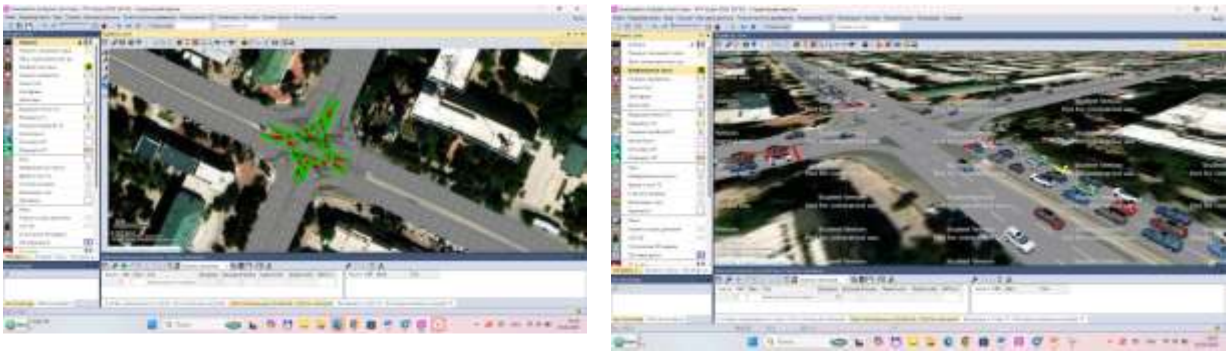

Figure 3. Visualization of One of the Central Intersections of Termiz City Modeled in PTV Vissim Software

During simulation, Vissim allows performing the following types of analyses**:**

- Analyzing the organization of traffic on roads and city streets, controlling traffic directions both in individual segments and across the entire route;
- Analyzing the possibility of prioritizing public transport;
- Analyzing changes in the distances between mandatory vehicle stops, checking entry points, and organizing one-way public transport;
- Analyzing the capacity of the transport network or its individual nodes.

Conclusion: Modeling transport processes and systems is an important tool for effective management of transport infrastructure. Modern modeling methods can significantly improve planning quality, enhance safety, and optimize the performance of transport networks.

Thus, transport models are designed to simulate the volume of transport activities in networks where flow-generating objects of the city have specific locations. Using these models, it is possible to predict the consequences of changes in the urban transport network in advance. Such models are used to support decision-making in urban transport planning, select alternative projects for the development of transport networks, and analyze the impacts of certain measures aimed at organizing transport activities.

Foydalanilgan adabiyotlar

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