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IMPROVEMENT OF METHODS FOR ASSESSING THE ECOLOGICAL AND TRAFFIC SAFETY OF URBAN TRANSPORT FLOW

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Abstract
This thesis is devoted to improving modern methods for assessing the ecological impact and traffic safety of urban transport flows. The study analyzes the limitations of traditional assessment methods – reliance on static analyses, insufficient consideration of environmental factors, and inadequate data bases. The advantages of the improved methods – accuracy, predictive capability, complexity, and support for decision-making – are presented.
Keywords: Urban transport flow, ecological assessment, traffic safety, Intelligent Transportation Systems (ITS), Artificial Intelligence (AI), dynamic modeling, real-time monitoring, air pollution, accident prediction, data analysis, IoT (Internet of Things), urban sustainability.

Introduction

The rapid development of cities sharply increases the demand for transport systems. The growth in traffic flows, in turn, leads to ecological problems (air pollution, noise) and traffic safety issues. Traditional assessment methods often have limitations in studying these problems comprehensively and dynamically. Therefore, the urgency of improving assessment methods based on modern technologies and innovative approaches is increasing.

1. Limitations of Traditional Assessment Methods

1.1. Reliance on static analyses: Most existing methods conduct assessments based on average annual or monthly data, without taking into account real-time changes.

1.2. Insufficient consideration of environmental factors: Assessment is often focused on traffic flow parameters (density, speed, flow), while ecological impact (e.g., emissions from each vehicle) is not accurately predicted.

1.3. Inadequate data base: Traditional monitoring methods (manual counting, simple sensors) do not ensure the accuracy and completeness of data.

2. Directions for Improvement

2.1. Modernization of data collection and monitoring systems

2.1.1. Utilization of Intelligent Transportation Systems (ITS) elements:

Automatic traffic detection systems (video surveillance, radars, induction loops).

IoT (Internet of Things)-based sensor networks (air quality, noise, traffic flow).

2.1.2. Use of mobile data and GPS/GLONASS data:

Real-time tracking of vehicle movement.

Accurate modeling of urban traffic flow.

2.2. Improvement of mathematical and computer modeling methods

2.2.1. Dynamic modeling:

Integration of macro, meso, and micro-level models.

Real-time simulation of traffic flow.

2.2.2. Artificial intelligence and data analysis methods:

Traffic flow forecasting using Machine Learning algorithms.
Early identification of risk situations (accidents, congestion).
2.3. Deepening ecological assessment methods
2.3.1. Individual emission monitoring:
Real-time calculation of emissions for each vehicle.
Basis for accurate calculation of environmental taxes.
2.3.2. Creating ecological maps:
Mapping pollution levels using GIS (Geographic Information Systems) technologies.
Assessing the impact on public health.
2.4. Innovative methods for safety assessment
2.4.1. Automatic identification of conflict points:
Identifying potential hazardous situations using video analysis and AI.
In-depth analysis of accident statistics.
2.4.2. Models considering the human factor:
Studying driver and pedestrian behavior.
Developing safety indices.
3. Advantages of Improved Assessment Methods
3.1. Accuracy and speed: Assessment processes are carried out in real time.
3.2. Predictive capability: Anticipating future situations and developing preventive measures.
3.3. Complexity: Simultaneous assessment of ecological, safety, and economic factors.
3.4. Support for decision-making: Effective implementation of urban planning and transport policy.

Conclusion

Improving methods for assessing the ecological and safety aspects of urban transport flow is an important condition for the sustainable development of modern cities. By utilizing innovative technologies such as digitalization, artificial intelligence, big data analysis, and real-time monitoring, it is possible to overcome the limitations of traditional methods and make effective management decisions. Implementing improved methods contributes to increasing traffic safety, reducing environmental pollution, and enhancing the overall efficiency of the urban transport system.

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