SUMMARY

Auto-adaptive system for the identification of operational road loads on bridge structures using machine learning

The work concerns the development of a system for the identification of operational loads of bridges, enabling the determination of vehicle weight based on the dynamic response of the bridge structure using machine learning methods. The motivation to work on the system is the dynamic increase in traffic and the growing number of vehicles overloaded on the roads.

The aim of the study is to develop the concept of an auto-adaptive comprehensive system for the identification of bridge loads and the methodology of its implementation, verification, and stability assessment.

The paper discusses motivation, research objectives and presents an overview of the content of the work. A literature analysis was conducted, including systems for identifying operating loads, vehicle detection methods and measurement techniques, including sensory monitoring of bridges. Existing load identification solutions were classified and evaluated in terms of usability.

In response to the existing challenges, technologies such as neural networks and autodecoders were presented, followed by the concept of a machine learning-based workload identification system architecture. In addition to the general concept of the load identification system, the proposed method of implementation and validation of the system based on the response simulator of the bridge object was also presented.

The paper presents the developed simulator of the dynamic response of a bridge structure to vehicle loads, its validation and analysis of the impact of various parameters on the results.

Variants of auto-adaptive load identification systems are presented, and their operation is evaluated using a simulator, choosing the best variant.

Finally, the stability of the system was evaluated on the selected system, considering the impact of parameters such as the span of the bridge structure, measurement noise and the uncertainty of the vehicle's parameters. The summary presents the main conclusions of the research and the directions of further research.

The result of the work is the concept of a system that enables monitoring and updating of bridge loads, traffic management, adjustment of infrastructure requirements and monitoring of fatigue processes, which contributes to increasing the durability and safety of bridges.