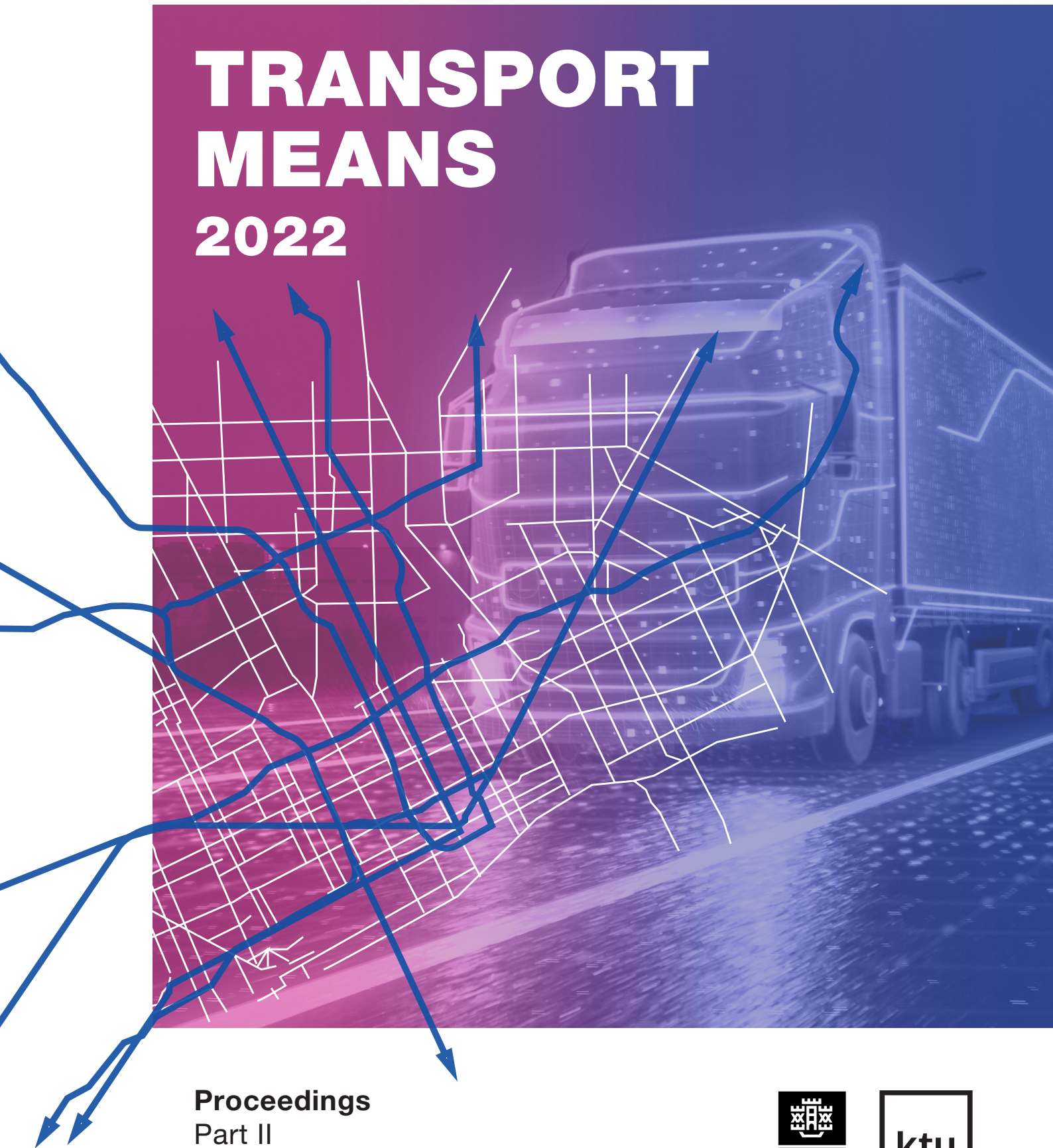
26th International Scientific Conference

October 5–7

TRANSPORT MEANS 2022



Proceedings
Part II

ktu
1922

ISSN 1822-296 X (print)
ISSN 2351-7034 (on-line)

KAUNAS UNIVERSITY OF TECHNOLOGY
KLAIPĖDA UNIVERSITY
IFToMM NATIONAL COMMITTEE OF LITHUANIA
LITHUANIAN SOCIETY OF AUTOMOTIVE ENGINEERS
THE DIVISION OF TECHNICAL SCIENCES
OF LITHUANIAN ACADEMY OF SCIENCES
VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

TRANSPORT MEANS 2022

Sustainability: Research and Solutions

PROCEEDINGS OF THE 26th INTERNATIONAL SCIENTIFIC CONFERENCE

PART II

October 05-07 , 2022
Online Conference - Kaunas, Lithuania

KAUNAS•TECHNOLOGIJA•2022

CONFERENCE IS ORGANIZED BY
Kaunas University of Technology,
In cooperation with
Klaipeda University,
IFToMM National Committee of Lithuania,
Lithuanian Society of Automotive Engineers,
The Division of Technical Sciences of Lithuanian Academy of Sciences,
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The proceedings of the 26th International Scientific Conference Transport Means 2022 contain selected papers of 9 topics: Aviation, Automotive, Defence Technologies, Fuels and Combustion, Intelligent Transport Systems, Railway, Traffic, Transport Infrastructure and Logistics, Waterborne Transport.

All published papers are peer reviewed.

The style and language of authors were not corrected. Only minor editorial corrections may have been carried out by the publisher.

doi: 10.5755/e01.2351-7034.2022.P2

e.book, 2022

Analysis of Problem Related to Experimental Data Processing in the Study of the Rolling Stock Influence on the Track

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Abstract

In paper discusses the problem of the correctness of the unification of experimental data by axes and points of measurement. The purpose of the study is to analyse experimental data in the study of the influence of the rolling stock on the railway track associated with the change of the nature and ratio of values of forces and stresses when combining data. Experimental data obtained from the study of the influence of Tulpar Talgo on the railway track were considered. The main feature is the construction of a trolley having one wheel instead of two, which makes it possible to show the nature of changes in stresses and forces when grouping data. This made it possible to assess the correctness of the unification in terms of the nature of the force ratio for the passage of rolling stock in the study area.
KEY WORDS: *rolling stock, track section, vertical forces, lateral forces, axle load*

1. Introduction

Any experimental measurements of dynamic processes, such as those related to the verification of models of interaction between the railway track [1-3, 5, 6, 8] and the rolling stock [4, 7, 9-11] or the state [12, 13] and design [14-17] issues rolling stock and tracks, as well as those related to climatic processes [18-20], provide continuous or either at specified or randomly determined time intervals on it data recording. The data obtained as a result of measurements are random variables. This is due to the influence of various factors of a probabilistic nature on the result of each experiment. For this reason, the experiments are organized according to the main scheme of (selective) statistical tests, where the number of both measurements and sensors varies. Data processing is carried out according to generally accepted statistical dependencies. However, increasing knowledge in understanding the physics of the measured processes requires a change in approaches to data processing. And the result of this study demonstrates the possibility of expanding knowledge on the issue under study, changing only the approach to the data processing.

2. Research Methodology

The determination of the stress-strain state of the track under the influence of the Tulpar Talgo rolling stock was the objective of these tests. During the tests, 172 runs were performed on 5 experimental sections of the route:

- curve with radius 320 m;
- curve with radius 685 m;
- rail switch 1/11 type P65;
- curve with radius 1842 m;
- straight.

As a result of deciphering the primary recorded data, about 250.000 experimental values of the indicators of the stress-strain state of the track and rail switch were obtained. The article analyses experimental data obtained for the direct section. Characteristics of the test section: straight, spurious track, type P65 rails, reinforced concrete sleepers, type W30 fastening with Skl12 terminal, reinforced concrete sleepers 1840 pieces per kilometer, crushed stone ballast, the thickness of ballast layer 0.60 m. On the basis of experimental data, the elastic modulus values in the test sites were determined. The modulus of elasticity in different sections: the test section was from 23 to 27 MPa. The accepted value for calculations is 25 MPa. Fig. 1 presents a schematic of sensors on the track and a schematic of rolling stock. All requirements for conducting experimental research are given in [21].

Table 1 presents the weighting data of rolling stock and characteristics of wagons:

A – technical wagon with diesel generator;
B – baggage wagon;
C – wagon with seats for tourist class;
D – buffet wagon, E - restaurant wagon;
F – sleeping coach wagon;
G – business class sleeping wagon;
I – sleeping first class wagon with disabled compartment.

effects of type A and F wagons, i.e., the same type of wagon. The load oscillation interval remained the same. For secondary unification, the lateral force interval was 18.28... 49.96 kN (difference 63.41%).

As can be seen from the results of Table 3, the combination of stress values was carried out similarly to the combination of lateral force values. It is very interested fact because two different kinds of values lateral force and stresses at the edges of the rail foot have not only the same unification, they have the same quantity for measuring point Г5 and К9. The reason of this is automatic unification on the position of the trolley relative to the axis of the track The difference between quantity of unification along the axles and measuring point (all sensors Г/К) is explained by different quantity of sensors utilizing for measuring values lateral force and stresses at the edges of the rail foot. The intervals of values for a single passage, the first and second combinations are respectively 39.16…88.02 MPa (difference 55.51%), 27.16…82.17 MPa (difference 66.95%), 15.83…106.6 MPa (difference 85.15%).

4. Conclusions

The existing statistical sampling system allows the variation of the number of cross-sections of track and passages of the rolling stock according to the number of sensors and the number of axles of the rolling stock to ensure an accepted coefficient of variation at the level providing a sample of the correct distribution. However, this approach excludes the study of the physics of the effect of rolling stock on the track depending on the position of the wheels relative to the track axis. The availability of statistics on vertical and lateral force ratios, for certain positions of the wheelset relative to the axis of the track, which is characterized by the wheel-rail contacts, would also make it possible to assess the functional safety of the interaction between the rolling stock and the track. Thus, the paper demonstrates the possibility of expanding knowledge on the issue under study, changing only the approach to data processing. This will allow:

– evaluate the correctness of the unification by the nature of the balance of forces for the passage of the rolling stock in the area under study;
– correctly plan the location of the sensors;
– use most of the primary recorded data.

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