OUTLOOK

by Assoc. Prof. Dr. Eng. Sergey Georgiev Belchev

Technical University of Varna

on a dissertation for the acquisition of the degree of Doctor

Topic: **"Study of the braking qualities of a car with an internal combustion engine"**

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Doctoral Program: "Internal Combustion Engines"

The opinion is in accordance with the requirements and conditions for the preparation of an opinion on a dissertation for obtaining the degree of Doctor of the RULES for admission, training of doctoral students and the acquisition of the educational and scientific degree of "Doctor" and the scientific degree of "Doctor of Science" at the Technical University of Varna.

1. Relevance of the problem developed in the dissertation.

Road safety is an extremely wide range of measures aimed at reducing the risk of road accidents, protecting road users and minimizing damage. An essential element of road safety is the perfection of the design of modern braking systems and the processes taking place when the car's braking system operates in extreme braking modes. The study and analysis of the vehicle's braking process is key, as the evaluation of braking characteristics and parameters allows the development of more effective assistance and control systems, as well as improving the design and management of braking systems. The analysis of the braking process includes an assessment of the braking time and distance, characteristics of the different phases and can serve to optimize the safety and efficiency of vehicles in real conditions.

All these activities on the research of automotive technology and assistance systems significantly improve the parameters of the braking process, increasing its efficiency and reliability. This results in shorter braking distances, faster response in crisis situations and a lower risk of serious accidents, contributing to a more sustainable and safe transport environment.

Having up-to-date and accurate information about the parameters of the shutdown process is also essential for the optimization of control systems. This is a key factor in improving traffic safety and the development of modern transport technologies and emphasizes the relevance of the problem developed in the dissertation.

2. Identification and assessment of the most significant contributions in the dissertation

In the dissertation, a methodology has been developed and approaches to analysis have been implemented, which are used in experimental research. The results obtained and the conclusions made contain contributions that can be combined into two groups of scientifically applied and applied contributions as follows:

New methods and enrichment of existing knowledge:

- A method has been developed for determining the phases of the periods of the extreme braking process based on data from experimental studies, using derivatives of a high order, giving stable results and insignificant deviations in the position of the boundaries of individual periods, in terms of the intersections of the regression lines.
- A methodology has been developed for preliminary smoothing of the lengths of the elementary periods of displacements and correction of apparatus interruptions by confidence intervals, which is necessary for the subsequent calculations to determine the derivatives of the displacement.
- The limits and duration of the phases during extreme braking for mid-range cars with speeds regulated for driving cars in urban conditions are defined.

Application of scientific achievements in practice.

- A system for precise measurements and high-frequency registration of vehicle movement data has been developed, which allows, through a specially developed sensor and connection with signals external to the system from the vehicle control, to record experimental data synchronously in real time.
- A methodology for smoothing experimental data for processes with variable dynamics of the measured value has been improved, as no interruptions are allowed in the vector of the displayed data and continuity of the function in the general dynamic range is ensured.
- The oscillatory processes in the acceleration of the car during the different periods of braking have been studied, the amplitudes and frequency spectra of the significant harmonics have been determined, and it has been found that during single stops and low temperature of the brake discs, high amplitudes of lower harmonics are registered only during the period of driving with maximum deceleration.

3. Critical remarks on the presented work.

I have the following critical remarks about the work:

1. Some of the conclusions in the dissertation can be refined.
2. It is recommended that the results of the doctoral student's research be reported at scientific conferences and published in refereed and indexed journals in world-renowned databases with scientific information.
3. Some of the graphs in the dissertation lack indications of all processes, and some of the figures do not indicate the graphs for the modes of movement of cars.

CONCLUSION

Sufficient scientific publications have been made on the dissertation. I believe that the presented work complies with the Academic Staff Development Act, the Regulations for its implementation and the Rules of Procedure of the Technical University of Varna. All of the above gives me grounds to propose to the esteemed scientific jury to award Eng. Daniel Zdravkov Ivanov the educational and scientific degree "Doctor" in the field of higher education, area 5. Technical Sciences, Professional field 5.1. Mechanical Engineering.

MEMBER OF THE JURY:

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Varna /Assoc. Prof. Dr. Eng. Sergey Belchev /