

O P I N I O N

on a dissertation for obtaining
the educational and scientific degree "**Doctor**"

Field of higher Education: **5.0. Technical Sciences**, professional field: **5.1. Mechanical Engineering**, PhD program: **Internal Combustion Engines**,
author of the dissertation: **Daniel Zdravkov Ivanov**,
title of dissertation: **Investigation of the Braking Characteristics of a Car with an internal combustion engine**

Prepared by: **Prof. Dr. Borislav Georgiev Angelov**,
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1. Relevance of the problem addressed in the dissertation

Braking performance has a significant impact on the active safety of a vehicle. In this regard, modern passenger cars are equipped with highly reliable, dual-circuit braking systems with electronic control, which includes the following functions: Anti-lock Braking System (ABS), Electronic Brakeforce Distribution (EBD), Brake Assist, and Electronic Stability Program (ESP).

Despite the widespread implementation of electronic systems, the level where the driver is completely removed from the braking process has not yet been reached. Therefore, increasing the effectiveness of modern automotive braking systems through improved collaboration between the driver and the electronic systems is becoming increasingly relevant.

The dissertation research presented to me for evaluation focuses on determining the time intervals of the individual phases and the changes in speed and linear deceleration of a vehicle under emergency braking conditions. The study also examines the influence of oscillatory processes on the performance of the braking system in this extreme mode.

The research is based on two modern passenger cars of the same class but with different structural features – one with a manual transmission and a vacuum brake booster, and the other a hybrid vehicle with an automatic transmission and a hydraulic brake booster.

2. Main scientific, scientific-applied and applied contributions

The list of contributions provided by the author includes a total of six scientific-applied contributions. A thorough review of the dissertation content confirms that the proposed contributions are fully supported by the research results.

From the attached list of publications related to the dissertation, it is clear that the findings of the research have been adequately reflected in scientific journals.

Regarding the author's stated contributions, I would like to offer the following comment:

As a result of the experimental research conducted with the two vehicles, specific values were obtained for the time intervals related to driver reaction, braking system activation, increase in linear deceleration, and total stopping time at maximum deceleration. I believe there is a basis for formulating an applied contribution based on the specific results obtained for the time intervals of the individual phases and changes in speed and linear deceleration during emergency braking for the two tested vehicles.

3. Recommendations and comments to the dissertation

The issue of quantitatively assessing the influence of electronic brake control systems on the parameters characterizing the braking performance of modern passenger cars has not yet been fully clarified. The specialized literature mostly includes data related to vehicles without electronic brake control.

In this regard, I would like to make the following recommendation: the doctoral candidate should continue working towards accumulating sufficient empirical data to establish average values of parameters characterizing the braking performance of modern passenger cars equipped with electronic braking systems.

4. Conclusion

The dissertation submitted for review fully meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the regulations for its application, and the rules for admission and training of doctoral candidates, as well as for obtaining the educational and scientific degree "Doctor" and the scientific degree "Doctor of Sciences" at the Technical University of Varna. The main results of the study have been made available to the scientific community through published papers.

Based on the above conclusions, I respectfully recommend that *the Esteemed Scientific Jury* to award the educational and scientific degree "**Doctor**" in the doctoral program *Internal Combustion Engines* from the professional field **5.1. Mechanical Engineering** to **Daniel Zdravkov Ivanov**.

3 June 2025

The opinion is prepared by: Prof. Dr. Borislav Angelov