

## REVIEW

by Assoc. Dr. Eng. Georgi Georgiev Komitov  
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of a dissertation for awarding the educational and scientific degree "**Doctor**"

By: Field of Higher Education 5 "*Technical Sciences*"

Professional Field 5.1 "*Mechanical Engineering*"

Doctoral Program "*Methods for Control and Testing of Materials,  
products and equipment*"

**Author:** Mag. Eng. Nikolay Asenov Toshev

**Topic:** "*Research on active safety systems in cars*"

**Supervisors:** Prof. Georgi Atanasov Mishev, DSc, Assoc. Prof. Kaneta Ilieva Paskaleva, PhD

### 1. General description of the submitted materials

I have been appointed as a member of the scientific jury under the procedure for defending a dissertation for obtaining a PhD degree in the field of higher education 5 "Technical Sciences", professional field 5.1 "Mechanical Engineering", PhD program "Methods for Control and Testing of Materials, Products and Equipment" of the University of Plovdiv "Paisii Hilendarski" by Order of the Rector No PD-22-1060/10.05.2025. cars" by Mag. Eng. Nikolay Asenov Toshev. He is a full-time PhD student at the Department of Mechanical Engineering and Transport of the Faculty of Physics and Technology with supervisors Prof. Doctor of Technical Sciences Eng. Georgi Atanasov Mishev and Assoc. Dr. Eng. Kaneta Ilieva Paskaleva.

The set of paper materials presented by Mag. Eng. Nikolay Toshev is in accordance with Article 36 (1) of the Regulations for the Development of the Academic Staff of the University of Plovdiv and includes the following documents:

- an application to the Rector of the University of Plovdiv for disclosure of the procedure for defending a dissertation;
- CV in European format;
- minutes of the Departmental Council related to reporting on the readiness to open the procedure and with a preliminary discussion of the dissertation;
- dissertation;
- abstract;
- a list of scientific publications on the topic of the dissertation;
- copies of scientific publications;
- list of noticed citations;
- a declaration of originality and authenticity of the attached documents;
- a reference for compliance with the specific requirements of the respective faculty (only for PhD students enrolled until 04.05.2018);

The PhD student has attached 4 publications.

### 2. Brief biographical data about the PhD student

The PhD student was born in 1973 and graduated from Technical College "Smolyan" in 1998 with a degree in Technology and Management of Road Transport. In 2002 he graduated with a master's degree from Burgas Free University with a degree in Technology and Transport Management.

Since 2021 he has been a full-time PhD student at the Faculty of Economics. "Mechanical Engineering and Transport" of the Faculty of Physics of the University of Plovdiv "Paisii Hilendarski". The professional career of Mag. Ing. Toshev is related to road safety, and over the years he has held various positions in the Traffic Police Sector at the Regional Directorate of the Ministry of Interior - Smolyan to Head of Sector from 2022 and Head of the ROPSANDV Group from 2024.

He has been an assistant professor at the department since 2020, where he conducts exercises in various disciplines related to the topic of his dissertation.

The candidate has a wide range of research interests related entirely to the road safety of cars and the prevention of the risk of road accidents.

### **3. Relevance of the topics and appropriateness of the set goals and objectives**

The increase in the number of road vehicles inevitably leads to an increase in road accidents. Safety is an extremely broad concept and is extremely important in order to protect human life. Road safety is a set of measures, procedures and rules that aim to ensure safe traffic on the roads and reduce the risk of road accidents and accidents. It covers all aspects related to road traffic – from traffic rules, through the state of road infrastructure, to the behaviour of road users and the technical condition of vehicles.

Considering the broad scope of road safety, the main goals set for it can be formulated as:

prevention of road accidents by reducing the risk of accidents that can lead to injuries or death;  
ensuring safe travel conditions by ensuring the safety of road users themselves (drivers, pedestrians, cyclists, etc.) and also the safety of road infrastructure;

information and training through further training of drivers and pedestrians on traffic rules and safety.

As mentioned, road safety is a very broad concept and the types of road safety can be formulated as: personal road safety (it can include compliance with traffic rules, use of safety equipment such as seat belts, helmets for motorcyclists and cyclists, adherence to speed limits and professional training of drivers), infrastructure road safety (it includes the condition of roads, road signs and facilities and may include good road lighting, maintenance of roads and bridges, installation of road signs and barriers and construction of zones for the safety of various road users), legal road safety (it may include the legal and regulatory measures that regulate road traffic), psychological road safety (it includes the behaviour of road users and their mental preparation) and technological road safety (includes the use of new technologies to increase road safety such as adaptive speed control systems, autonomous vehicles, smart road signs and traffic monitoring systems).

The factors influencing road safety can be formulated as: human factor, road infrastructure, weather conditions and technical condition of vehicles and traffic.

It is noteworthy that the PhD student knows in detail all aspects of road safety from the experience gained during his professional career.

The dissertation examines problems related to road safety, namely the study of the behaviour of active road safety systems installed on cars. They are part of technological road safety and are one of the factors affecting road safety in general. The dissertation examines various operational aspects of the application of such systems in cars under different road conditions and how this affects the behaviour of the car on the road. Naturally, the testing of such systems is not intended to compromise an automobile manufacturer or to compare the systems of different manufacturers, but to show the effectiveness of the application of the system in different road conditions and in different types of vehicle construction.

The topic of the dissertation is clearly formulated, which is always relevant as long as road vehicles exist. From the wording, a set of tasks to be performed is correctly selected, with the implementation of which the fulfilment of the goal is achieved.

### **4. Knowledge of the problem**

As mentioned above, the professional career of a PhD student is entirely related to road safety in all its aspects. The PhD student has nineteen years of experience in the traffic police sector and road safety. In his career, he has repeatedly encountered road accidents, their consequences in all aspects, including legal road safety with the implementation of regulations of legal and regulatory measures leading to road safety.

Despite the regulated rules and numerous inspections of the roadworthiness of cars and road infrastructure, the PhD student in his career inevitably encountered road accidents related to the use of active safety systems and more precisely to their improper use. It is the good knowledge of the problems related to these systems and the way it behaves that help to correctly formulate the purpose of the dissertation and the tasks to be performed.

The literature review of active road safety systems shows an in-depth knowledge of autonomous and automated emergency braking, as well as the anti-lock braking system. It is the way they are arranged in the literature review that shows that the PhD student approaches his development with a view to road safety

from the side of road accident prevention. During the movement of cars, it inevitably comes to a state in which the braking system of the car must be used to establish it in emergency mode. The driver's first reaction is to decide to press the brake pedal, and it is the force of pressure that is essential for the car's handling or loss of traction or stability. Here again, there is a correct formulation of the overview with the traction control systems and the electronic stability program.

The warning and assistance systems discussed subsequently, such as the Forward Collision Warning System and the Lane Departure Warning System, are not less important than the previous ones, but they have the function of assisting the driver or protecting him from the accident itself. As an example, a large part of road accidents are related to leaving the lane of the car or abruptly stopping the previous car.

Assisting intelligent systems such as cruise control and adaptive front lighting, which gives sufficient light output when driving on a road with multiple turns by monitoring the road, are also considered. The theoretical foundations in the study of braking distances are also considered.

As a result of the literature review, at the end of the first chapter, a conclusion is made about the effectiveness of the systems and their role in road safety.

### **5. Methodology of the study**

The selected objects of study are some of the most popular cars in our country. Three different brands of cars of different classes were used to conduct the study. They were manufactured in the period 1991-2013 and their technical characteristics are considered, providing data on their level of equipment with active road safety systems and the type of tires used and the tread height.

The selected road test site gives reason to assume that the tests are carried out in accordance with an EU vehicle test regulation. With the thus selected methodology for conducting road tests, the set tasks for implementation are achieved. Changing the coefficient of adhesion is also important when conducting experiments of this type. The studies were carried out at different levels of contamination at the landfill. Experiments have been carried out on dry and wet pavement, as well as on sandy pavement.

When conducting the experiments, the influence of weather conditions was also taken into account. In order to obtain adequate answers to the tasks, studies were carried out at different temperatures, humidity of the surrounding air and pavement. Experiments were carried out with several different vehicle speeds, taking into account the vehicle's braking delay, braking distance, and braking time.

The methodology used to solve the tasks set allows you to fully achieve the goal of this development. It allows for a comprehensive and adequate answer to the questions posed.

### **6. Characteristics and evaluation of the dissertation**

The dissertation submitted to me for review contains 182 pages. The work is divided into four chapters and 55 figures, an introduction, a conclusion, major contributions and literature from 135 sources. Of these, 2 are in Bulgarian and the rest are in English. In my opinion, this is a completely finished work of this type.

The first chapter is 30 pages long and provides a literature review of brake control systems, traction and stability control systems, warning and assistance systems, intelligent control systems, communication and communication systems. 10 main systems that increase active road safety are considered. An overview of modern methods for studying braking distances, braking delay and their role in active safety systems is made. The review is adequate and shows the strengths and weaknesses of the systems of such a scope. This knowledge of the PhD student and the synthesized conclusions from the literature review determine the correct formulation of the purpose and tasks with which the scientific research is realized. On this basis, the conclusions made, the clearly formulated goal and the tasks for achieving it fully correspond to the title of the dissertation.

The second chapter is entitled "Methodology and Tools for Experimental Research", examines the issues related to the methodological part of the development. The objects of the research, the measuring equipment, the test site with a change in the coefficient of adhesion and the different conditions for conducting the experiments are considered. A methodology for conducting experimental studies is described in detail. It selects two factors influencing the braking performance of the tested vehicles. Work is underway on plan B2. One factor is the grip of the running wheels on the road. It is a major factor in the

loss of vehicle controllability. The other factor is the speed at which the brake system is actuated. This factor is also essential when conducting experiments, and road safety in general. The middle of the factor was chosen in view of the maximum allowed speed for movement in urban conditions. On this basis, the 10 km/h variations fully satisfy the requirements for emergency braking, respectively road safety. The methodology provides for parallel experiments with and without an active safety system for a car equipped with summer and winter tires. The selected and completed test equipment makes it possible to accurately record the results of the experiment. The proposed methodology fully corresponds to the title of the development and leads to the implementation of the goal and tasks.

The evaluation of the braking performance of the tested vehicles is made in Chapter Three. According to the adopted design of the experiment, the results obtained are authentic and show original theoretical and experimental data on the braking performance of the tested vehicles under different operating conditions. Based on the experiments carried out, a maximum braking delay with the ABS module of the test vehicle A2 on and off is obtained of more than 11 m/s<sup>2</sup>. On the other hand, a minimum braking time of around 1.5 s was obtained for all three test vehicles at a speed of 40 km/h for dry and wet surfaces. With the results thus obtained, respectively, the braking distance of the A2 is the shortest on dry surfaces and when driving at 40 km/h. Original results were also obtained when driving cars with different types of tires. As a result of the experiments carried out, a difference was obtained between the real and theoretical braking performance of cars.

All results and conclusions under this chapter give good enough answers to basic questions related to road safety in the event of an emergency.

In Chapter Four, the effectiveness of the AEB active safety system is examined. Original experimental data have been obtained regarding the probability of triggering the system based on a large number of experiments at low, medium and high speed. Data were also obtained on the braking qualities of the tested vehicle at different speeds.

All the conclusions of this fourth chapter provide clarity on the issues relating to the effectiveness of the use of active safety systems under different operating conditions.

At the end of the dissertation, a conclusion is made about the development and possible directions for future research.

I believe that the presented results are reliable and are an authentic work of the author and his supervisors.

## **7. Contributions and relevance of the development to science and practice**

The nine contributions proposed by the author are distributed as scientific-applied and applied. There are three scientific and applied ones and are mainly related to the development of methodologies for conducting experiments. The applied contributions are six and relate to the receipt of corroboratory facts.

I accept the contributions as they are arranged by the author, because they are the author's work and reflect the nature of his work. They have significance for the practical use of modern active road safety systems in various operating modes. Their significance indicates the level of security of these systems or the possibility of drivers relying on them.

On the basis of the developed methodologies, other active safety systems can be created and tested, which would lead to the development of options for practical application in the training of young drivers.

## **8. Evaluation of the publications on the dissertation**

On the development, the author has provided a total of four publications. One of the publications is from a national forum, and the other three from the publications are from international forums. One of the articles under SCOPUS.

Two of the articles are independent, and the others are developed in a team of authors. No separation protocol is attached. However, I believe that the author participates equally in this collective, because

The proposed publications fully reflect the results of the developed dissertation. and one is from the General Description of the publications that reflect the results of the dissertation – monographs, articles, certificates and patents, classified by subject matter or other feature and reduction due to coincidence or overlap (with participation in other procedures). Judgment of the reviewer of the publications on the

dissertation (results of the dissertation used in scientific and social practice; results achieved in the dissertation, applied/used in projects. Reflection of the results of the dissertation science – use and citation in the works of other authors. Numerical indicators – citations (without self-citations and hidden citations), impact factor, etc. In case of collective publications, the contribution of the PhD student should be reflected.

#### **9. Personal participation of the PhD student**

The dissertation is a research development in the field of "Mechanical Engineering". The publications on the dissertation, as well as the conversations with the PhD student about the essence of the research carried out and the results achieved, give me reason to assume that the present dissertation, including the contributions, are an indisputable contribution of the PhD student and his supervisors. Taking into account the circumstances related to the volume and type of research carried out on the dissertation and the fact that the PhD student is a long-time civil servant in the field of road safety, I believe that there is no doubt about his personal contribution to the entire process of preparation and implementation of the dissertation.

#### **10. Abstract**

The presented abstract contains 32 pages, including an annotation. I didn't notice an annotation in English. However, I believe that it is structured according to the requirements for presenting the essence of the dissertation and its contributions and definitely reflects the essence of the dissertation with its goals, objectives and achieved results.

#### **11. Critical remarks and recommendations**

The peer-reviewed dissertation is at a good scientific level. It is written competently and meets the requirements of the Academic Staff Growth Act in the Republic of Bulgaria and the Regulations for the Implementation of the Academic Staff Growth Act in the Republic of Bulgaria.

I have no critical remarks about the development.

As a recommendation, I can suggest to the PhD student in his future works to apply more the mathematical modelling of the studied processes.

#### **12. Personal impressions**

I know a cursory eng. Toshev from my few meetings with him. From the presented professional biography, you can see his impressive career in the field of civil servant and in particular as a person working in the field of road safety. This, together with my conversations with him, show that Eng. Toshev is active in his studies, as well as scientific activity. The written publications and the dissertation show that he also has the potential for serious scientific work. He is definitely well aware of the legal framework related to road safety and works freely with specialized testing equipment. All this, in my opinion, defines him as a young scientist with hope for rapid and successful development in the scientific field.

#### **13. Recommendations for future use of dissertation contributions and results**

As a recommendation for future use of the research results, I can suggest that the PhD student focus his research on increasing the number of active road safety modules being tested, such as ESP, etc.

#### **CONCLUSION**

After reviewing the materials provided to me, I believe that the dissertation of Mag. Eng. Nikolay Asenov Toshev complies with the Higher Education and Academic Staff Development Acts in the Republic of Bulgaria. I have no information about the presence of plagiarism or illegal citations in his works.

I think that the value of his work is determined by the experimental nature of the research and the practical applicability of the results obtained.

All this gives me reason to recommend to the esteemed scientific jury to propose to the University of Plovdiv "Paisii Hilendarski" to award Mag. Eng. Nikolay Asenov Toshev Educational and Scientific Degree "Doctor" in the field of higher education 5. Technical Sciences, professional field 5.1 "Mechanical Engineering" and scientific specialty "Methods for Control and Testing of Materials, Products and Equipment".

19.06. 2005

Reviewer:.....

