

REVIEW

by Dr. Eng. Todor Stoyanov Djamiykov, Professor at the Technical University – Sofia
of a dissertation for the award of the educational and scientific degree **Doctor**
in: Field of Higher Education 5. Technical Sciences
Professional Direction 5.3. Communication and Computer Technology
Doctoral Program "Automation of Areas in the Non-Material Sphere (Medicine,
Education, Science, Administrative Activities, etc.)

Author: M.Sc. Eng. Hristo Anastasov Kanevski

Topic: Application of Computer Technologies for Improving Environmental Indicators in
the Automotive Sector

Scientific Supervisor: Prof. Dr. Eng. Slavi Yassenov Lyubomirov,
Plovdiv University "Paisii Hilendarski"

1. General Description of the Submitted Materials

By Order No. RD-22-93/17.01.2025 of the Rector of Plovdiv University "Paisii Hilendarski" (PU), I have been appointed as a member of the scientific jury to ensure the procedure for defending a dissertation on the topic "Application of Computer Technologies for Improving Environmental Indicators in the Automotive Sector" for the acquisition of the educational and scientific degree "Doctor" in the field of higher education 5. Technical Sciences, professional direction 5.3. Communication and Computer Technology, doctoral program "Automation of Areas in the Non-Material Sphere (Medicine, Education, Science, Administrative Activities, etc.)". The author of the dissertation is M.Sc. Eng. Hristo Anastasov Kanevski, a doctoral student in regular form of study at the Department of Electronics, Communications, and Computer Technology of the Faculty of Physics and Technology, with scientific supervisor Assoc. Prof. Dr. Eng. Slavi Lyubomirov, Plovdiv University "Paisii Hilendarski".

The set of materials submitted by M.Sc. Eng. Hristo Anastasov Kanevski on paper complies with Art. 36 (1) of the Regulations for the Development of Academic Staff at PU and includes the following documents:

- Application to the Rector of PU for initiating the dissertation defense procedure;
- Curriculum vitae in European format;
- Protocol of preliminary discussion at the department;
- Abstract;
- Declaration of originality and authenticity of the submitted documents;
- Certificate of compliance with specific requirements;
- List of publications;
- Dissertation;
- Copies of publications related to the dissertation;

The doctoral student has submitted 1 copy of the dissertation, 1 copy of the abstract of the dissertation, and 6 publications. All publications are related to the dissertation.

2. Brief Biographical Data of the Doctoral Student

Hristo Anastasov Kanevski completed his secondary education in 2007–2011 at the Vocational High School of Transport and Transport Technologies "Hristo Botev", Smolyan. Subsequently, he graduated from Plovdiv University "Paisii Hilendarski", Faculty of Physics and Technology, and obtained the degrees of Professional Bachelor, Bachelor of Engineering, and Master of Engineering in "Automotive Engineering" in 2020. Since 2021, he has been enrolled as a regular doctoral student at the same faculty.

Mr. Hristo Kanevski began his professional career in 2011 as an automotive mechanic. In 2020, he became an assistant at Plovdiv University "Paisii Hilendarski", Faculty of Physics and Technology.

3. Relevance of the Topic and Appropriateness of the Set Goals and Objectives

The dissertation addresses a current topic related to the development of computer technologies for improving environmental indicators in the automotive sector, which is of global significance. The environmental characteristics of vehicles are a focus for manufacturers, regulators, and consumers, highlighting the importance of the research. The identification of pollutants and the mechanisms that generate them leads to stricter regulations for addressing these issues, making the topic even more relevant.

The main goal of the dissertation is to explore the possibilities of applying computer technologies to improve environmental indicators in the automotive sector and, based on this, to justify approaches for research aimed at improving environmental characteristics regarding CO, HC, and CO₂. To achieve this goal, the following tasks have been set: investigation and analysis of the specifics of exhaust gases, implementation and testing of an experimental setup, selection of an approach for studying factors influencing emissions, conducting experimental research, and analyzing the results.

The research is appropriate as it covers a wide range of factors influencing emissions, including the air/fuel ratio, ignition timing, and various engine malfunctions.

4. Understanding of the Problem

The first chapter of the dissertation provides an analysis of the problem of air pollution, which is of critical importance on both a national and global scale. The specifics of the main sources of pollution in the automotive sector, with an emphasis on the operation of internal combustion engines, are detailed, highlighting their impact on air pollution. Methods and systems for reducing the toxicity of exhaust gases are also reviewed.

Existing sources on the problem have been reviewed and interpreted through critical analysis. The literature review covers 131 sources in English, including electronic ones. All sources are current scientific publications from reputable journals, proceedings of international conferences, and works by leading foreign and domestic scholars and specialists in the field.

5. Research Methodology

The chosen methodology in the dissertation corresponds to the set goal and includes the following aspects:

Experimental research has been conducted by applying computer technologies to improve factors influencing environmental indicators. Studies have been carried out on a vehicle to improve environmental characteristics regarding CO, HC, and CO₂, and the results have been analyzed. The influence of the air/fuel ratio and ignition timing on harmful emissions from a gasoline engine equipped with an additional electronic control unit has been investigated. Concentrations of carbon monoxide (CO), carbon dioxide (CO₂), and unburned hydrocarbons (HC) have been measured at different engine speeds, air/fuel ratios, and ignition timings. The data have been analyzed using statistical methods to determine the correlation between the air/fuel ratio, ignition timing, and levels of harmful emissions.

6. Characteristics and Evaluation of the Dissertation

The dissertation consists of 155 pages. The analytical part is developed on 134 pages within 4 chapters. Additionally, it includes a conclusion, scientific and applied contributions, a list of the author's publications, and a list of references. The work contains 81 figures and 12 tables. The first chapter analyzes the problem of air pollution, the main sources (automotive transport), and its impact on a national and global scale. The tasks of the dissertation are defined, and the relevance of the problem for EU policy is emphasized. The achievement of the correctly set goal and corresponding tasks is the subject of the next 3 chapters, which demonstrate consistency, logical connection, and methodological presentation of new important theoretical and practical solutions regarding the contributions of the dissertation.

The second chapter discusses the problems caused by carbon deposits in internal combustion engines, their impact on power and environmental characteristics. Methods and systems for reducing the toxicity of exhaust gases, as well as the application of technologies for improving environmental indicators, are analyzed.

The third chapter simulates various malfunctions in an automotive engine and indicates their impact on emissions. An experimental methodology for investigating malfunctions has been implemented.

The fourth chapter examines the influence of the air/fuel ratio and ignition timing on harmful emissions from a gasoline engine.

The dissertation demonstrates consistency and methodology in presenting the material, starting with an analysis of the problem, proceeding through experimental research and simulations, and concluding with findings and recommendations. Statistical

methods have been used for data analysis, and correlation equations have been developed.

7. Contributions and Significance of the Development for Science and Practice

The author has presented 5 scientific and applied contributions and 5 applied contributions in the dissertation. I accept that the work contains both types of contributions and would summarize them as follows:

Scientific and Applied Contributions:

- Investigation and systematization of methods for assessing harmful emissions and the specifics of the composition of exhaust gases, contributing to a better understanding of their impact on the environment.
- Development and testing of an experimental setup for investigating various malfunctions in internal combustion engines and their impact on harmful emissions. This allows for the identification of critical points leading to pollution.
- Research and analysis of data on the influence of the air/fuel ratio on the composition of exhaust gases. It has been established that the ratio range of 15:1 to 17:1 results in minimal environmental consequences regarding CO₂, CO, and HC emissions.
- Analysis of the influence of ignition timing correction on the quantity and composition of exhaust gases. It has been experimentally proven that minimal environmental consequences from harmful emissions of CO₂, CO, and HC are observed in the range of 15 to 25 degrees.

Applied Contributions:

- Research has been conducted on simulated malfunctions in a spark-ignition automotive engine through laboratory tests, allowing for an assessment of their impact on harmful emissions.
- Studies have been conducted on electronically controlled fuel injectors, showing their influence on the levels of harmful emissions.
- The variation of unburned hydrocarbons (HC), carbon oxides (CO), and carbon dioxide (CO₂) depending on ignition timing corrections and engine speed has been analyzed.
- Research has been conducted on harmful emissions depending on the air/fuel ratio controlled by a microprocessor unit. Practical measurements have been carried out at different engine speeds, and data on the air/fuel ratio and levels of harmful emissions have been analyzed using statistical methods.

8. Assessment of Publications Related to the Dissertation

The dissertation of Hristo Kanevski is supported by six publications.

- Two of the publications were presented at the International Conference of Education, Research and Innovation.
- Two publications are included in the proceedings of the SU – Smolyan.

- One publication was published in the proceedings "Education, Science, Society".
- One publication is included in the international journal "Ecologia Balkanica".

One of the publications was presented at a reputable forum of the scientific community with Scopus and Web of Science rankings (Q4). Five of the publications are co-authored with the scientific supervisor, and one is independent.

The review of the publications shows that they cover the topic of the dissertation and present the achieved results to the scientific community. Their number is sufficient and complies with the accepted requirements.

9. Personal Involvement of the Doctoral Student

The described scientific and applied contributions are reflected in a sufficient volume and content in the doctoral student's publications. They have been presented at reputable and established scientific forums in the field, which means that the results have gained appropriate popularity and recognition in scientific circles. I believe that the personal involvement of the doctoral student is evident and indisputably confirmed by the independent publication and co-authorship in the other publications with the scientific supervisor.

10. Abstract

A careful review of the abstract of the dissertation shows full compliance with the requirements for its preparation. It adequately reflects the main points and contributions of the dissertation. The abstract of the dissertation can be fully evaluated and characterized as a synthesized version of the content and main results achieved in the dissertation. It fully corresponds to the defined scientific and applied contributions contained in the full text of the dissertation.

In conclusion, the abstract corresponds to the dissertation in terms of structure, thematic focus, methodology, and contributions.

11. Critical Remarks and Recommendations

The analysis of the submitted dissertation shows a basic description of the research, methodology, experimental results, and conclusions. All theoretical and practical statements are well-argued, correct, and presented in a methodologically appropriate sequence. There are no explicit critical remarks or statements of weaknesses. Nevertheless, some minor editorial inaccuracies and omissions can be pointed out, including:

- There may be an influence of external factors such as ambient temperature and fuel quality on the results. This suggests that future research could focus on controlling or accounting for these factors for greater precision.

- The text mentions the need to compare reference data with measured data from various simulations. This can be considered as an opportunity for further development of the experimental methodology and data analysis.

I believe that these recommendations and remarks will be valuable and useful in the future scientific and publication activities of the doctoral student.

12. Personal Impressions

I do not personally know M.Sc. Eng. Hristo Anastasov Kanevski, but my contacts with the scientific supervisor, the results presented in the work from models and tests, as well as their validation in scientific publications, give me reason to believe that he is the author of the proposed ideas and their implementation.

I have no joint publications with the doctoral student.

13. Recommendations for Future Use of the Dissertation Contributions and Results

The applied contributions are directly applicable in practice. They can find wide application in the education and training of students. For the scientific and applied contributions, it is too early to make an assessment.

Conclusion

The dissertation contains scientific and applied results that represent an original contribution to science and meets all the requirements of the Law for the Development of Academic Staff in the Republic of Bulgaria (LDASRB), the Regulations for the Implementation of LDASRB, and the corresponding Regulations of PU "Paisii Hilendarski". The dissertation shows that the doctoral student M.Sc. Eng. Hristo Anastasov Kanevski possesses in-depth theoretical knowledge and professional skills in the scientific specialty 5. Technical Sciences, professional direction 5.3. Communication and Computer Technology, demonstrating qualities and skills for independent scientific research.

For the above reasons, I am convinced to give my **positive assessment** of the conducted research, presented in the reviewed dissertation, abstract, achieved results, and contributions, and propose to the esteemed scientific jury to award the educational and scientific degree "Doctor" to M.Sc. Eng. Hristo Anastasov Kanevski in the field of higher education: 5. Technical Sciences, professional direction 5.3. Communication and Computer Technology, doctoral program "Automation of Areas in the Non-Material Sphere (Medicine, Education, Science, Administrative Activities, etc.)".

26.02.2025

Reviewer:

(Prof. Dr. Todor Djamiykov)