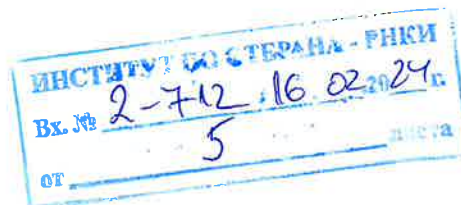




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OPINION

by Associate Professor Dr. Ivan Stefanov Hristozov,
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of the dissertation of **Aleksandar Genchov Ranov**

on **"An autonomous combat platform routing and motion control model"**

for obtaining the educational and scientific degree "Doctor"

in the scientific specialty "Automated systems for information processing and control"

1. Relevance and significance of the developed scientific problem

Modern society is characterized by continuous development and improvement of autonomous vehicle developments. Their application in the civil sphere has a number of advantages, such as increased transport safety, lower financial costs, energy-saving and environmental effects, and others. Their application in the military sphere is aimed at ensuring superiority on the battlefield in terms of the performance of transport-combat tasks, storage of personnel and maximum difficulty of countermeasures by the enemy. From this point of view, the topic of the dissertation examines an actual problem related to the creation and use of a model for determining the routes and controlling the movement of an autonomous ground combat platform.

The main content of the dissertation is related to the presentation of a mathematical apparatus and algorithms for finding routes without using an existing road network and avoiding visibility from an enemy observation post, synthesis and validation of a model for processing information in routing, as well as an application of inertial navigation methods and motion control algorithms of an autonomous ground platform. Regarding the problem presented by the author, I am not aware of similar developments.

New in the development are the proposed algorithms for determining a route with hidden movement, for avoiding mapped obstacles, as well as for detecting obstacles with the application of an inferred interpolation dependence. The model for controlling the speed of movement of the autonomous platform, the software approach and the calculation procedure with the application of an adaptive digital filter in the control process, the method for spatial compensation of deviations in the readings of a magnetometric sensor are also novel.

2. Evaluation of the scientific results and the contributions of the dissertation

I accept the contributions and results proposed by the author.

I believe that the developed methods and models for finding a route with the result of a "hidden movement matrix" and for controlling the speed of movement with the application of closed-loop feedback; the algorithms for drawing up a transport plan of a ground-based autonomous combat platform, without using an existing road network and in the conditions of hidden movement relative to a known enemy observation post and for detecting unmapped obstacles using "computer vision" methods, as well as for compensation of deviations in the readings of a magnetometric sensor represent scientific and applied contributions and enrich existing knowledge. As such, I also define the presented approach for applying digital filtering in controlling the speed of an autonomous combat platform, the methodology for determining the possibilities of executing a set route and the presented architecture for routing and controlling the movement of an autonomous combat platform.

The application of the scientific achievements in practice are the conducted studies of the possibilities of functioning of the proposed routing models by using test software applications, the spatial graphic analysis on experimentally obtained data regarding the method of compensation of deviations in the readings of a magnetometric sensor, the created experimental setup for conducting research and recording of energy characteristics during movement of a physical model of an autonomous platform, etc.

The manner of consistent and thorough presentation of all the main results in the dissertation work, together with the technological path of their obtaining and subsequent approval, is a clear indicator of the author's participation. In terms of content, the presented 4 scientific publications on the topic reflect the idea, the methods used, the research carried out and the results and conclusions of the dissertation. I believe that in this way the main results of the dissertation have gained the necessary publicity. I am not aware of any works by other authors that, in their content, present the results declared by the author of the dissertation work.

The starting points, the basic concepts and the theory of the treated scientific area are presented by citing appropriate, up-to-date sources.

3. Critical remarks

I have no particular critical remarks about the presented dissertation work. It clearly states the statements, the goals, formulates the tasks and defines the framework of the research. The dissertation and the accompanying abstract are developed at a professional level, the language and style are appropriate to the subject area. The chapters of the paper are balanced in terms of content. The graphical representations of the models and the flow charts are precisely developed. Mathematical formulas are written clearly and legibly. All tables, figures and formulas are correctly numbered, in accordance with the text they illustrate. I recommend the doctoral student to continue his research in the field of autonomous ground combat platforms.

4. Conclusion

In my opinion, Aleksandar Genchov Ranov has acquired the necessary knowledge and experience, and is able to independently formulate and develop scientific and scientific-applied problems. I believe that the presented dissertation meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations for its implementation for the acquisition of the scientific and educational degree "DOCTOR".


The achieved results contain the necessary quantitative and qualitative contributions of a scientific-applied and applied nature. They can find practical application in the development of autonomous ground platforms and their application in the military field.

5. Evaluation of the dissertation

I **positively** evaluate the presented dissertation work and propose to award

the doctoral student Aleksandar Genchov Ranov an educational and scientific degree "doctor" in the scientific specialty "Automated systems for information processing and control".

Date
February 16, 2024

Member of jury 
(*Assoc. Prof. Dr. Eng. Ivan Hristozov*)