OPINION
by Colonel Assoc. Dr. Ivo Georgiev Radulov,
head of the scientific section "SISO" at the Institute for Prospective Defense
Research, Military Academy "G. S. Rakovski"

for the dissertation work of Eng. Lili Tsvetanova Pavlova
on "Electronic Battlefield Visualization with Augmented Reality Elements",
presented for the acquisition of the educational and scientific degree "doctor"
in
field of higher education: 5. "Technical sciences", professional direction: 5.2.
"Electrical Engineering, Electronics and Automation", doctoral program (scientific
specialty): "Automated systems for information processing and management".

1. General presentation of the dissertation work

The subject of the dissertation, as presented by the author, is the application of information technology "augmented reality" to expand cognitive capabilities when presenting elements of an electronic battlefield.

The aim of the dissertation work is to propose an effective model for extended representation of electronic battlefield objects with the application of augmented reality. In order to achieve the set goal, the dissertation work solves a suitable set of tasks that ensure the achievement of the desired results. They are presented correctly in the text of the dissertation.

For the solution of the set tasks, PhD student Pavlova has chosen a suitable complex methodology, which allows to achieve the goal of the research.

The dissertation is structured into an introduction, three chapters, a conclusion, a list of contributions to the dissertation, a list of publications related to the dissertation, a bibliography, lists of abbreviations used, figures, tables and appendices. After each of the separate chapters, the author has formulated conclusions, which summarize the results of the conducted research, making a logical introduction to the problems presented in the following parts.

The dissertation contains 135 pages of academic text, 57 figures and 5 tables, 9 appendices. The bibliography includes 111 sources in Bulgarian and English. The total volume of the dissertation is 165 pages. The applications are formatted according to the requirements, and the sources of the used literature are cited correctly.

2. Assessment of the topicality of the topic, form and content of the dissertation

The realization of the planned level of effectiveness of decisions in the field of defense, and hence the construction of the necessary defense capabilities, depends to a significant extent on and is determined by the level of training of the military units when conducting training and combat missions. This feature is extremely relevant in the conditions of uncertainty of the current and future security environment. The preservation and development of defense capabilities in response to threats and commitments to national and global security in conditions of strong restrictions in terms of available resources requires the search and use of adequate methods to increase the effectiveness of training by adapting and developing emerging and promising information technologies. The mentioned arguments undoubtedly prove the relevance of the topic, on which PhD student Pavlova is focusing on research.

In the first chapter of the dissertation, the author introduces us to the basic concepts of the field under consideration. The scope, functionality and main features of technology platforms for the development of augmented reality applications are presented. An analysis of the problematic moments of the implementation of augmented reality applications was made. Views on important practical aspects of modern understandings of the electronic battlefield are presented, by incorporating elements of it into a video presentation from a mobile device in field conditions.

In the second chapter, an analysis of problematic moments of the functioning of selected computer applications for augmented reality, oriented for application in the military sphere, is carried out. A model of an advanced electronic battlefield is proposed. Methods of data exchange and storage in army command and control systems are analyzed. Algorithms have been created for access to databases in a centralized and local version.

In the third chapter, a formal model of an embedded sensor subsystem for inertial navigation is presented. An analysis of the sources of errors in sensor data processing was performed. Digital filtering methods have been applied in order to increase the reliability in operation of the sensor subsystem. A software application architecture aimed at implementing augmented reality has been created. An algorithm for markerless identification of an object from the electronic battlefield has been developed. An analysis of the effectiveness of the algorithm applied to different types of objects from the composition of the electronic battlefield in field conditions was carried out.

The main points and results of the dissertation could be extracted from the conclusion.

3. Evaluation of publications on the dissertation work

Four publications related to the dissertation are presented. They popularize the ideas of doctoral student Pavlova and sufficiently reflect the obtained results in the dissertation work.

The abstract is also properly structured and sufficient in volume and content.

4. Scientific and scientific-applied contributions of the dissertation work

In the proposal for an opinion on a dissertation thesis, doctoral student Pavlova claims scientific and applied contributions. These contributions are well articulated in the dissertation and its abstract.

I accept the proposed contributions claimed by the author and consider them to be practically applicable and theoretically significant. I accept that the contributions are the work of PhD student Pavlova.

5. Critical notes and recommendations on the dissertation work

The following critical remarks can be made about the dissertation work, mainly concerning the formation of the conclusions:

1. The conclusions from all three chapters are too scarce. Some of them have the nature of findings.

2. There are no general conclusions. The in-depth research done in the dissertation obliges the author to make adequate conclusions on the problem at the level of the research. It is normal to use the same as a starting point for achieving the purpose of the dissertation.

I consider that the remarks made by me are of a clarifying nature and do not change the relevance, significance and essence of the contributions received.

6. Opinion on the presence or absence of plagiarism

At the time of preparing the opinion, I have no information about received signals to establish plagiarism in the dissertation work or in the publications on it.
Using the WEB-based StrikePlagiarism.com application, I performed a plagiarism analysis of the document. The following results were obtained:
- Coefficient of similarity 1 (CS1): 8.98%;
- Coefficient of similarity 2 (CS2): 3.45%;
- Letter replacement: 113;

- White characters: 0;
- Micro spaces: 0;
- Spreads: 0;
- Paraphrases (SmartMarks): 140;
- Content generated by artificial intelligence (AI) is not recognized.

The results show that there are no grounds for suspicion of plagiarism in the dissertation work.

7. Testimonials

Given the topicality and importance of the topic of the research in the dissertation work, recommendations for continuing and deepening the work on the topic can be addressed to doctoral student Pavlova.

8. Summary conclusion and opinion

The dissertation submitted for review meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for the Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations on the Terms and Procedures for Acquiring Scientific Degrees at the Defense Institute "Professor Tsvetan Lazarov". Through the dissertation, the author demonstrates good theoretical training, knowledge of scientific tools and skills for conducting in-depth research. There is relevance and significance of the developed problem, as well as new elements in the used scientific tools. The ideas and results of the conducted research have been popularized by the author in appropriate publications.

In conclusion, I express the opinion that the dissertation proposed for review represents a complete and complete author's research work that examines current issues in defense. Undoubtedly, the work presented is a contribution to the development of existing knowledge in the field of research.

All this gives me the reason to give a positive assessment of the dissertation work and to express my intention to the respected members of the Scientific Jury, to vote "yes" for awarding the educational and scientific degree "doctor" to PhD student Eng. Lili Tsvetanova Pavlova.

Date: August 5, 2024.   Prepared the opinion: /SIG/

                                         (Col. Assoc. Dr. Ivo Radulov)