ASPECTS OF EMPLOYING ARTIFICIAL INTELLIGENCE IN THE FIGHTING AREA

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Abstract. The contemporary technological revolution in the military field based on intelligence and knowledge has determined significant changes within the modern combat area architecture, in the organization and execution of combat operations, in the optimization of the command and control activities through cybernetic and informational systems, in the use of the procedures and modes of operation aiming at permanently ensuring the competitive advantage to the adversary.

Keywords: artificial intelligence, information, cybernetic systems, informational systems, combat area

New weapons based on exact science principles have emerged in the modern combat area, alongside the intelligent and high-precision weapons, which play an essential role in the accomplishment of military operations.

The dynamism, complexity and diversity of the forces participating in the modern military operations, as well as the vastness of the area where they take place, have considerably amplified the role of information as a fundamental element in the decision making process and real-time execution of combat actions.

The ample development of the information technology, automatics and the other modern scientific disciplines have established the premises

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necessary for a multi-sided approach of the combat conditions and of the efficiency of the actions executed by the fighting forces.

The modern, complex and dynamic conflicts characterized by symmetric and asymmetric actions have revealed the fact that the high technology, as a result of the human and artificial intelligence, has had and will continue to have a decisive role in the operation of military actions based on modern combat equipment. In this context, the future soldier's equipment will also be cybernetized and highly technologized, which requires a multi-sided specific training of the fighting forces.

Both the soldiers in the combat area and the aircraft pilots are submitted to a continuous cybernetization and electronization process, aiming at enhancing the efficiency of their actions, diminishing the stress they undergo and reducing human losses.

The cybernetic soldier has weapon systems, surveillance of the combat field and target identification systems, command, control, communication and data processing systems, all these being integrated in his equipment, thus enabling a friendly interface between the human and the technics at his disposal.

Weapons that are highly-technologized, based on the theory of systems, cybernetics, artificial intelligence and information and communication technology are mostly employed by the modern armies, contributing to the reduction of human losses and increasing the efficiency of the fighting actions.

In the modern combat area, the information processing and the communication networks represent the core of every military action[1]. Thus, the main change in the organization and operation of fighting missions mainly consist in the fact that the war has become mostly informational, and the information, knowledge and precision resulted from the use of *artificial intelligence* are decisive in the successful execution of the military actions.

Therefore, the *artificial intelligence,* as a main branch of the computer science, represents a new discipline with a high potential of influencing the economic, social and *military* activities' development.

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[1] Joint Vision 2020, *Americas Military - Preparing for Tomorrov*, USA, GPO, Washington D.C., June 2000.

The *artificial intelligence* essentially represents[2] the study of ideas which enable computers to perform those actions that make humans look intelligent. Intelligence may be considered as a set of information processing and representation skills, involving the abilities to perceive and to reason, to acquire and apply knowledge, to manipulate and convey ideas and to produce new technologies, as well.

According to specialists in the field[3], a system is considered to be intelligent based on observation of its behaviour, adaptability to new situations, ability to reason, to comprehend connections between facts, to discover meanings and recognized the truth, and to learn, that is to improve performances based on previous experience.

The main objectives of the artificial intelligence consist in enabling computers to be more useful, to make decisions similarly to humans and to better understand the human intelligence. Thus, the artificial intelligence relies on computer programs founded on computer science, psychology and physiology, which makes it possible for many of the humans' intellectual preoccupations to be transferred to machines. The computer intelligence will be based on phenomena description, object representation, problem solving and solution identification.

The command and control process supposes the collecting, processing, systematizing and disseminating of the data obtained, activities that require the existence of an optimized informational-decisional system, as well as of a set of technics, procedures, rules, restrictions and criteria.

In the command and control processes, substantiating a decision is essential, as it ensures the identification of the optimal solution from a variety of possible solutions, having in view the restrictions and criteria imposed for the respective mission. The execution process must take into account a logical organization of the activities, which requires appropriate planning and adjustment depending on the dynamics and complexity of the combat area. Therefore, the command and control process presupposes the existence of secure informational links between the management (decisional) system and the execution system, which conclude the

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[2] Patrick H. Winston, *Inteligenţa artificială*, Editura Tehnică, Bucureşti, 1981, pp. 17-19.
[3] M. I. Findler, *Artificial Intelligence*, in Encylopedia of Computer Science, Petrocelli/Charter, New-York, 1996, p.106.

informational circle and transform the management system into a closed information cycle.

The C4ISR[4] command and control systems - where the multitude of the component subsystems require optimal real-time and online coordination - are a fundamental element in a complex fighting environment.

The computers' ability to memorize high amounts of data and to process extremely fast (almost in real-time) produce basic changes in the development of various sciences, especially cybernetics, which now make use of the achievements in the artificial intelligence field as regards the reality's systematic approach.

The artificial intelligence is performed through *symbolic communication* and the following characteristics can be identified[5]:

- it can be implemented in the technical equipment for which it was designed;

- it is not influenced by external factors;

- it is permanent;

- it can be updated whenever necessary;

- it ensures logical coherence;

- it is accessible, verify able.

Artificial intelligence resides on symbolic calculation[6] based on the programs' ability to manipulate symbols, which requires a considerable memorizing capacity, relying on knowledge organization, restriction exploitation, search through solution spaces and control problems. The system based on artificial intelligence is able to learn in order to improve without any external interference.

Moreover, artificial intelligence revolves around "*knowledge*" rather than the abstract notion of "*information*" formalized in a theory of information. In this context, interpreting this knowledge in the language of machines constitutes one on the most current issues.

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[4] *C4ISR* – Comandă, Control, Comunicaţii, Calculatoare, Informaţii, Supraveghere şi Recunoaştere.

[5] Alexandrescu C-tin, Alexandrescu Gelu, Boaru Gheorghe, *Sisteme informaţionale militare – servicii şi tehnologie*, Editura UNAp „Carol I", Bucureşti, 2010, p.109.

[6] Allan M. Din, *Arms and Artificial Intelligence*, Oxford University, Press, 1987, pp. 47, 51.

In artificial intelligence, the technics of knowledge representation are translated[7] into combinations of data structures and interpretation procedures enabling programs to display intelligent behaviour and generate inferences. The knowledge employed in representations of artificial intelligence systems are made of objectives, events, performances and metaknowledge. *Metaknowledge,* or knowledge about what we know, represents knowledge on knowledge or knowledge regarding the operation mode or the reasoning mode by an expert system.

Exploiting knowledge in programs for recognizing the objectives, identifying answers to questions or manipulating robots, implies acquiring new data, finding facts in the knowledge base and performing the reasoning so as to reach the optimal solution. The intelligent behaviour of various systems, including the informational ones, cannot be achieved without the interaction of data structures.

The main functions of the modern equipment which use artificial intelligence are accomplished by means of programs based in simultaneous data processing, completed with their ability to learn permanently from their activities.

The artificial intelligence has multiple applications, especially in fields that involve linguistics, recognizing forms and the decision theory. The military field has been and will remain a large domain of artificial intelligence application, in the modern combat area.

Generally, in cybernetic and informational systems, the artificial intelligence solves problems[8] about the intelligence-communications correlation, the recognition of writing and speaking, the understanding of language and the representation of knowledge. A principal progress element has been the automatic recognition of speaking in human-technics communication, thus simplifying the command and the process of introducing data in the computer, which requires using advanced artificial intelligence elements.

In military operations, the *artificial intelligence technology* used for developing informatic systems in the decision making process enables the

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[7] P. Tabarcea, Gh. Ghiur, *Sisteme de inteligenţă artificială şi roboţi*, Editura Militară, Bucureşti, 1986, pp.40, 132.
[8] Mariana Beliş, *Inteligenţă şi comunicaţie*, în volumul „Sisteme de inteligenţă artificială", Editura Academiei Române, Bucureşti, 1991, p.107.

management system to disseminate decisions accurately and synthesize the huge amount of data on the combat area for optimizing the command and control.

Research in the military field has materialized in the development of several classes of cybernetic robots with various destinations in the combat area, including the use of artificial intelligence in informational networks aiming to collect data, in different services, on intelligent ammunitions and unmanned aircraft, as well as in creating autonomous systems of combat area search and surveillance, early warning, identification and target acquisition.

Another application that uses the artificial intelligence consists in the study of real systems' behaviour, with the aid of the electronic computer, by modelling and simulating their operation through a mathematic-logical model, method which may have a wide use also for the development of informational and decisional systems.

The combat area's cybernatization by using modern high-precision and strike technics and armament equipment constitutes another field in which the artificial intelligence may be largely exploited, determining significant changes of the war character.

The precision of engaging the forces in the combat area is based on [9] using a "*system of systems*", mostly informational, which enables the forces to locate objectives and targets in real-time and to provide the response command that will ensure the accomplishment of the goal, with collateral losses and minimum risk. Thus, the high precision weapons relying on the usage of artificial intelligence, cybernetics and information technology impose a complex informational ensurance, performed in real time with various electronic means (radars, sensors, GPS, ISTAR[10] systems etc), which play an important role in the modern armament, emphasizing the cybernetic force of the military actions and transforming the computer networks in potential targets of the first strike.

The use of sensors as means of intelligent data and information collection (observation and recording) for making decisions in the command

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[9] Alison Brown, R. Wilkinson, *Direct Sensor to Weapon Network (DSTWN) Architecture* (AIAA-98-5104), USA.
ISTAR - „Intelligence (I), Surveillance (S), Target Acquisition (TA) and Reconnaissance (R)".

and control system, allows the continuous surveillance of the enemy and the precise strike of the targets, contributing to the decrease of human and material losses. Consequently, the targets of the enemy in the combat area can be permanently surveilled, identified in due time and struck in real time with high precision armament, based on *artifical intelligence*. Furthermore, objects and targets in the combat area can be detected, images of areas of interest can be recorded and physical phenomena can be predicted by observing the environment and weather forecasting, all these enabling a real image of the combat area based on the fusion of the main information provided or characterized by the respective area.

The complexity of the combat area imposes the establishment of a global informational network whose structure is based mainly in the use of highly technologized means, among which an important role is played by the sensor networks which, together with other technical means of reconnaissance (including GIS) will be able to ensure the search of the combat area and the command and control of the modern weapon systems, principally of those intelligent and highly technologized.

Autonomous weapon systems comprise a set of subsystems based on artificial intelligence and advanced technologies that are able to make execution decisions, provide self-guidance and self-control, observe, understand, think and accomplish various programmed missions. These systems have required an advanced reality perception technology, based on advanced sensors and miniature computers, with high memory and data processing ability, and with possibilities of using performant modelling and simulating algorithms.

Employing this technology, the systems of modern weapons must be able to establish appropriate tactics and to configure every piece of equipment of the system depending on the concrete situation in the combat area.

The artificial intelligence in evolved algorithms for identifying and counter striking targets identified by radars, by means of three-dimensional (3D) or bidimensional (2D) image constitutes another application in the system of air operation flying assistance, based on calculation technique.

The modern technical means, including the artificial intelligence, ensure data acquisition through images processed and analyzed automatically in real time.

Ample research has been carried out also for developing an associate cybernetic system, relying on artificial intelligence supporting the fighting aircraft pilots, working in a highly complex electronic environment and using sophisticated weapon systems. The cybernetic system assists the fighting pilot to fly the aircraft in any situation, to optimally use the electronic means and the board armament and to protect the aircraft against the enemy's actions.
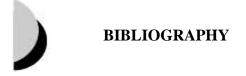
The automatization, cybernitization and artificial intelligence are widely used also for monitoring and reconfiguring the communications networks during the military operations, in order to enable flexibility in providing information to the entities involved in the combat area, in an environment of complex actions of the enemy and of the informational war, ensuring connection stability in jamming and interception conditions.

Artificial intelligence is also applicable in solving automated encryption of messages, as well as information from data bases, using logical mathematical relations structured and programmed according to specific calculation technics, influencing the operation of the automatic data distribution system regarding specific situations in the combat area.

The military technical systems have considerably developed their complexity, versatility and automatization, have become intelligent and highly precise, some of them being able to function autonomously, without human intervention, with a strong ability to collect, transmit, process and disseminate information, substantially modifying the physiognomy, the mode of operation and the denouement of the modern war. The military cybernetized technics used in war time determines the complete automatization of the combat area.

The impact of using artificial intelligence in the organization and operation of informational systems determines a high degree of automatization and cybernization, as well as a new model of the human-technics relationship.

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