COMBAT UGV: THE CHALLENGE OF THEIR IMPLEMENTATION IN COMBAT UNITS

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Abstract: *This article deals with the issue of combat unmanned ground vehicles (UGV). The authors describe and analyse the current state of the issue. In the light of technological progress, the ambitions of selected states, and future trends, the authors define the needs for successfully implementing combat unmanned vehicles into the line-ups of combat divisions and units. They examine not only the field of application, but also the issue of education and training from a long-term perspective. The article hopes to support professional-scientific discussion on this topic and create the theoretical potential for starting the process of preparing and implementing combat UGV.*

Keywords: autonomy, capabilities, combat unmanned ground vehicle, education, technologies, training

1. Introduction

Since the beginning of the 21st century, there has been increased interest in unmanned technology. Operations carried out after September 11, 2001 became a significant accelerator. In the aftermath of these events, a worldwide ‘race’ was launched in the development and use of autonomous systems. Having only minor limitations, unmanned aerial systems (UAS) were the first to be deployed. Ground operations involved pyrotechnic, semi-autonomous, later also autonomous unmanned ground systems (UGS) or unmanned ground vehicles (UGV). Their primary task was, in the first place, to monitor the situation and then transfer information to the commander to support them in taking the most appropriate decision. Later, with the development of the necessary technologies, they began to be used as a powerful means, in the main, to neutralize or destroy improvised explosive

systems or eliminate individual mines. Vehicles carried special equipment for the X-ray imaging of booby traps, water jets, blasters, and screwdrivers, or for placing a charge to destroy unsafe ammunition on site. Hand in hand with this went the development of military robotics in the field of combat UGV. The biggest problem in terms of technology and the transition to autonomy was – and still is – identifying the right choice of solution in the specific conditions of dynamic tactical activity. In short, systems are not so autonomous as to be able to fully assume the role of vehicle commander and operator. The reason is that they still cannot completely understand the complexity of the tasks performed [1] and all of the contexts, or learn immediately and share this experience promptly throughout the UGS operational configuration.

2. Analysis of the current situation

The role of world leaders in the field of

military robotics has been taken over by the US, Israel, France, Russia, China, and New Zealand[2]. These states experimentally are deploying their combat UGV units in formations during various military exercises, possibly even in selected situations and military operations. Ever increasing advances suggest that these systems will be widely used in the near future, at least in the manned-unmanned team (MUM-T) mode[3], [4]. Or else they are exploited as a technological advantage by those states that have their own development capacity, or their allies who will be able to buy the complete technology. This idea is also supported by the following characteristics, defined in more detail in [5]:

- The strong pressure to reduce military budgets;
- Operations of greater complexity due to advances in technology;
- The attempt to equalize forces by countries with significant military ambitions;
- An increasing threat of WMD (weapons of mass destruction) proliferation;
- Increasing extremism and internal instability of states;
- Rapid improvement of unmanned systems in every direction;
- The future transfer of more and more tasks in conducting military operations to unmanned systems;
- The new dimension of conflict – the cyber domain.

For this reason, many joint but also separate development and experimental projects are underway to keep pace, or to have such a system at their disposal, at least partially. The level and quality of individual means and systems vary, their presentation to the professional public is also different, and in some cases, interpretation may diverge from reality. The recent conflict between Armenia and Azerbaijan, watched around the globe, has publicly revealed the ambitions and evolving capabilities of some states in the field of military robotics.

2.1. Current limitations of UGV capabilities in terms of military tactics

The community of experts and scientists wish for UGV to work just like human-machine systems. As mentioned, at this time the systems are not entirely autonomous. However, it is realistic to consider the use of UGV within MUM-T. At the moment, the main problem of these tasks is how to use human resources. Difficulties arise in terms of the routine and extremely exhausting nature of deployment, and operating in contaminated or extremely high-risk environments.

Selected tactical tasks can be performed, but with knowledge of a certain inadequacies or limitations in the use of UGS. At the moment, systems are mainly having their skills refined in the following areas [6]: ability to learn, situational awareness, increasing general performance, fulfilling multiple roles with one system (all-army UGV), flexibility of task-solving depending on situational developments, deployability in large numbers, and performing tasks over long distances (expedition UGV).

In terms of use, the limit for the commander will be permeability through the terrain in relation to microrelief that is technologically solvable. A big problem is the independent and flexible response of the UGV unit to a specific situation, which the so-called ‘ground commander’ usually solves. This role must still be performed by a human, e.g. in the role of the ground commander of the UGV unit. The connection and data transfer depend on the connection architecture. If it is not robust enough and connectivity is disrupted, even this sub-system will collapse. At the moment, the instability of most means, which is generally true of smaller robotic structures, prevents the application of weapons with a decisive influence on the battlefield – cannons, rocket launchers, etc. For the time being, the trend in development still appears to be using either a smaller calibre weapon or recoilless technology. Typically, anti-tank guided

missiles as the main weapon. The downside is the small supply of missiles for the weapon station. These critical shortcomings determine its use in present-day operations and in operations in the very near future.

2.2. Current possibilities of advanced combat UGV in terms of military tactics

For present-day operations and operations in the very near future, state-of-the-art combat UGVs as part of MUM-T's can be best used as units applying a less dynamic mode of combat activity. Alternatively, they find use in precisely pre-planned combat activities[7] with a minimum of operations or simple tasks, where there is little room for decision autonomy compared to other tactical activities and tasks. These can be tactical tasks such as attack by fire, breach, follow and support, deceive, etc. Such systems can play a very suitable role as part of cover forces or securing forces. It can be assumed that the experimental exercises of those armies dominating the field of military robotics have specific outputs of a doctrinal nature which define the principles of using these systems.

In principle, there will be two uses in the ground unit line-up. Either as a UGV unit in which the whole unit is built on a MUM-T basis and acts independently or has its own task, and its parts are not allocated separately to other elements of line-ups.

Or, as a second option, it will be a UGV unit in the line-up of a 'classic' unit. Its role would then be to support the task rather than bear the brunt of efforts to finish it. The second variant seems more likely in terms of logic and the state of current progress. Systems in this role do not take responsibility for fulfilling the main task. It is possible to derive additional requirements from the system's deployment and to implement the further development of UGV.

2.3. Prediction of development

The entire 'family' of UGV will be gradually improved and deployed in a broader range of tasks. The predominant use of UGV will continue to be in addressing support and combat support (i.e. transport versions, ISR-UGVs, CBRN-

UGVs, Engineer/EOD UGVs, etc.). Gradually, combat UGVs will also be implemented within MUM teams. The first 'public' deployment of UGV/UAV units in a joint operation awaits us. Fully autonomous systems relying on artificial intelligence will not be publicly deployed in the foreseeable future.

3. Requirements for current and future military personnel

Today we are in a situation where we can see significant technological progress all around us. New battlefield domains have been established; we are learning how to fight in them and co-operate in joint operations and tasks [8]. The structures of forces are changing. Trends in automation and robotics continue. The soldier-individual is computerized. In this context, partial modifications of systems need to be considered. These concern organizational changes, material and logistical changes, and, above all, adjustments in the area of preparation, or in military education, learning and training.

3.1. A possible approach for improving military education and training in military robotics

The army, in general, should pursue this topic and strive to be an essential member of the community addressing autonomous systems at the national level. Whether it can or will play a leading role is not always realistic in most countries. The authors make the following recommendations. They are based on andragogical and methodological principles [9], [10], [11], and, to some extent, the experience of the previous generation of military educators conceptual workers, and leaders, when in the second half of the 20th century, armies began to informatize and computerize weapon systems and command and control systems.

To prepare troops, implement training using autonomous and robotic systems to support habituation to sophisticated systems, especially now with simulations [12]. Continue to introduce modern components

and approaches [13], that increase the efficiency of units, which are able to work together as one meaningful whole. Link this into more sophisticated collaborative systems. Automatize routine decision-making activities using software and autonomously generate variant solutions, whereas the final decision would be validated by humans. Apply this principle with greater and greater sophistication into military administrative acts.

Systematically educate the future soldier as an individual in the computerization of society, preferably already in connection with primary and secondary education. Notwithstanding, continue with the proven pillars for preparing future military professionals [14].

Prepare key personnel for accelerating technological and social evolution in AI and robotics. This means focusing first on the commanders and staffs at the operational and strategic level, then at the tactical level. Implement the topic into course programs, especially in courses for 'senior officers' and 'generals', as part of career education. When educating new officers, implement the field of AI and robotics not only into the teaching of technological disciplines, but also into command or managerial specializations. Here it is essential to start training as soon as possible, because by the time they complete their studies, they will join an army in which these systems will be acquired more widely and at qualitatively different levels than now.

Develop military science and research also in the field of AI and robotics. Take the

opportunity to share theoretical knowledge and practical experience in using the most modern tools. To do this, also use the most modern didactic tools – audiovisual technology, 3D environment, and analysis through on-line approaches. Include the tools currently developed, even in prototype phases, in training so students get a solid grasp of how they can be used. Conduct lectures and apply lesson-learned findings from the most current conflicts.

4. Conclusion

The article has confronted the current situation, which is more or less similar in states with the ambition to use UGV in a semi-autonomous or, in the future, an autonomous regime when conducting combat operations. The authors have compiled disparate pieces of information that, if interpreted correctly, can help in the development of the armed forces.

Technological progress will continue to pick up pace, and the ambitions of world leaders in the field of military robotics will be achieved. To this end, however, it is now necessary to train key personnel well in advance, which in terms of the quality of preparation [15] means more than ten years. These measures are closely related to the level of technological advancement of the countries concerned, and their ambition and systemic approach to the issue. The symbiosis of these components will then make it possible to have not only the technology, but also scientifically and managerially perfectly prepared personnel who will be ready to lead the fight at the cutting edge.

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