

Peer review on book
“Digital Infantry Solution. Research and Innovation”

Introduction

The publication presented for the review presents the general characteristics of current capabilities and trends in research on unmanned robotic ground systems of selected countries and projects implemented by the European Union.

In this dynamically developing area, the global landscape has changed dramatically in the last few years, exerting a significant impact on numerous areas related to technology. An attempt to present a complete and full analysis of these changes is impossible due to their extent, on the other hand, it does not seem to be very practical, taking into account the diverse nature of the projects. The examples and analyses described in the publication are intended to present the statistical status and efforts of the Baltic States in particular, but taking into account selected other countries, describing the development of unmanned ground vehicles.

Undoubtedly, robotic and intelligent battlefield systems change the conduct of military operations at the tactical level in a certain range, even operational, all over the world. Their efficiency gives a significant advantage over conventional weapon systems.

Among the factors affecting the development of unmanned ground systems there can be distinguished:

- a strong technological impulse resulting from the growing availability of ever cheaper microprocessor technologies and sensors,
- requirements generated by the need to use unmanned systems in counteracting and fighting against non-traditional threats,
- increasing labour costs resulting from globalization and pressure to equal opportunities in terms of pay and living standards,
- changing the social approach with regard to the level of risk and the acceptability of the sacrifices incurred in human lives.

Falling costs of components and the fact that works can be carried out on a small scale have influenced the universality and popularity of research and development (R&D) in the field of robotics, which have become common and popular around the world. The level of investing in ground robots for the needs of the army and national security is growing. The European Defence Agency (EDA) as well as the defence ministries of France, Germany and Great Britain invest tens of millions of euros. Reports also indicate that China's investments in robotisation have risen by over 300% since 2002. The United States, Canada, France, the Netherlands and Israel are implementing the most active programs of using such systems for the needs of the army.

The group of countries aspiring to research and development of unmanned ground vehicles is joined by three Baltic States, which are planning to make a breakthrough by designing an unmanned system within PESCO. It is emphasized that for these countries the benefits for their national defence industries are undoubtedly important. They assume that terrestrial unmanned platforms are facing the same fate that could be observed in the case of aerial platforms about 10-15 years ago. It is mainly about increasing production and profits. The ambition of the Baltic trio is to develop a solution that will become a "European standard".

Although Japan is the world leader in unmanned ground vehicle technologies, there is little interest in the development of military systems. The explanation may be the fact that traditional and legal restrictions on the export of military systems make investing in their development not very economically attractive.

Unmanned ground systems and their related technologies have a double application. However, the needs of the armed forces are more stringent than their civilian counterparts in terms of the complexity and uncertainty of the environment in which they operate and the tasks for which they were designed.

Basic tasks are: explosive ordnance disposal (EOD), mine clearing, reconnaissance, load carrying or security (e.g. of perimeter monitoring). Some robots are described as autonomous. Some use on-board sensors for autonomous navigation and control. However, the operating area is typically well defined and has fixed features that the vehicle can use to locate and maneuver. Some tactical situations and responses are thus well limited and constrained.

By contrast battlefield environments are unpredictable. As a result some of ground robots manufacturers have invested substantially in advancing sensor-based autonomous control and navigation systems. Some countries arguably take a technical lead in pursuing the cutting-edge technologies. Other countries in contrast appear to be pursuing the development of less-sophisticated approaches which entail less technical risk and may allow systems to be fielded more quickly. This can provide other countries with valuable operational data/experience that may allow them to advance more rapidly in practice.

In several areas, research is being done in anticipation of future advances in robotics. Specific examples are:

- Humanoid and other biomimetic robotic systems. These challenges of navigating and controlling vehicles in complex, rough battlefield terrain are severe. However, advances in automated controls made in biomimetic may yield benefits. One example is the development of reconfigurable locomotion scheme, which in essence, combines features of wheeled and pedal methods. Significant activities in this area are observed in Japan.
- Machine vision including, as an important subset, the use of laser detection and ranging (LADR) imaging and simultaneous localization and mapping (SLAM). Leading capabilities are in Canada, France, Germany, Japan and United Kingdom.
- Work in multi-agent systems. While the implementing hardware has yet to be developed, several countries are pursuing the development of conceptual architectures and techniques to support multi-robot operations. Because so much of this work can be done through modeling and simulation (M&S), it has become a popular topic for academic research worldwide. Among the more active countries are the United States, Japan, France, the United Kingdom, Russia and the Netherlands. Also NATO has a Research Group (RTG) on Military Application for Multi-Robot Systems.

Substantive evaluation

The book is the third part of a wider research project, the previous results of which were published in two parts, namely "Digital Infantry Battlefield Solution: Introduction to Ground Robotics" (2016) and "Digital Infantry Battlefield Solution. Concept of Operations" (2017). The first part is an attempt to analyse the European Union initiatives in the field of research and innovations concerning digitization of the battlefield and evaluation of the research and innovation system in three Baltic countries, ie Estonia, Latvia and Lithuania. The second part presents the state of development of unmanned ground vehicles in selected countries. It contains

seven chapters preceded by an introduction. The following chapters were intended by the authors to create a specific, related whole with reference to the issues of new technologies used in contemporary military operations, i.e. unmanned ground vehicles (UGVs).

In the first chapter entitled "Battlefield digitalisation of thorough research and innovation in the European Union" the author Kristina Prišmantaitė presents analyses of initiatives taken by the European Union in the area of digitalisation of the battlefield through research and innovation, which according to the author are key to strengthening European security and defence. She refers to the European Defence Action Plan calling for competition and innovation in the European defence industry. She also points to the provisions contained in the priorities in the EU Global Strategy (EUGS) and the Defence Implementation Plan and new initiatives under Permanent Structured Cooperation (PESCO) and the European Defence Fund (EDF) establishing a framework for cooperation between the member states. The aim of the chapter is to present the priorities in defence and research, and then to evaluate the current EU policy and initiatives undertaken. At the same time, she points out that the actions of the European Union do not in any way block initiatives undertaken by the member states themselves. She also emphasizes that research spendings in the field of defence research and technology (R & T) have a downward trend.

The author is of the opinion that establishment of the European Research Programme as part of the EU's next Multiannual Financial Framework (2021-2027) will be an important step in strengthening the EU's capacity to invest in defence R&T. By investing in defence research, innovation and technologies, the EU will deepen the defence sector cooperation, enhancement of interoperability and efficiency needed for full spectrum of the armed forces.

In the second chapter author Ieva Bērziņa provides an interesting and comprehensive assessment of the defence research and innovation ecosystems in Estonia, Latvia and Lithuania. The aim of this chapter is to present insight and to compare defence research and innovation development in the three Baltic countries. She emphasizes that Baltic States in comparison with other economically and technologically more advanced countries are in an unfavorable context for the defence research, and therefore they should effectively use opportunities provided by the EU and NATO in this area and adopt a strategic and long-term approach at the governmental level.

In the second part of this book different authors consider the state plan of development of UGVs in selected countries.

In the third chapter authors Yazan Qasrawi, Abdeslem Boukhtout and Peter Gizewski investigate the use of UGVs in the future Canadian Army land operations and present perspective of how its Army of Tomorrow Capstone Operating Concept foresees the exploitation of UGVs and their associated technologies. Additional interesting part of the chapter includes a consolidated look at technological trends that may impact the future operational efficiency and effectiveness of Canadian Forces. They make conclusions that UGVs can reduce risk to soldiers, could be used to reduce cost and increase the effectiveness of their armed forces.

Mirosław Smolarek author of the fourth chapter reminds a long German tradition of the production and use of UGVs referring to the World War II remotely controlled small vehicles. He underlines that Bundeswehr was one of the first armies in the world that introduced a reconnaissance drone in 1969. In conclusion the author states that currently the German government and military leadership are not going to invest too much in UGVs technology and are rather UAVs-oriented.

Thought-provoking analyses are presented by Gérard de Boisboissel in chapter five which consist of the following parts: the advantages of robotics, an inescapable and progressive evolution towards autonomy, a review of historical developments, the use of robotics in future wars, how UGVs will influence the capabilities and tactics of small infantry units, new

intelligence capabilities, new offensive capabilities, defence capabilities, support and logistics, use in urban areas. The author concludes that military robots certainly pose a risk of occasional rejection by soldiers following the inevitable disappointments of initial robotics system, especially when their performance in the field fails to meet expectations. Nevertheless he adds that revolution is underway and they should be progressively integrated into military action, supported by the reduction in the size of armed forces.

The other two chapters by James Rogers and Robert Clark analysing the United Kingdom projects and by Sintija Broka and Serge Lévitiski referring to UVGs in the United Arab Emirates provide comprehensive knowledge about their perspectives.

Final conclusions

The study uses a large dataset, with reasonable coverage. The presented analyses are appropriate, in my opinion, though can be improved in their application and reporting. The conclusions are mostly well supported. The predictions are made using proper approaches, which yield interesting results. The book builds on a good body of research on this topic. It is also quite well written, apart from occasional lack of clarity and details. The authors make clear the intended practical application of the research as well as its novelty. I see no major flaws. The book has been written in a clear way, presenting the problems affordably and with enough detail. The solutions and conclusions contained therein are developed on the basis of current and reliable doctrinal and instructional sources. The work is enriched by well-thought-out and developed drawings and tables. The publication has a significant substantive value.