

PROBLEMS OF OPTOELECTRONIC SENSOR IN APPLICATION FOR ARMED VEHICLE STAFF SAFETY AND ERGONOMIC IMPROVEMENT

Tomasz Miroslaw

*Przemysłowe Centrum Optyki Spółka Akcyjna
Jana Nowaka Jeziorańskiego Street 28, 03-382, Warsaw, Poland
tel +48 785 91 00 35
tomasz.miroslaw@pcosa.com.pl*

Abstract

The right information at the right time is crucial in task execution and survival on the battlefield. In the contemporary combat systems the optoelectronics system located in observational heads, periscopes etc. are responsible for providing adequate information for the vehicle commander, driver and gunner. The rapid development of photonic technologies and the process of battlefield robotisation make them become ubiquitous. Thanks to optoelectronics technology, the safety of the soldiers and their mental comfort can be based on not only the thickness of the armour plate, but also on active protection systems and the situational awareness. Systems of sensors installed on the accompanying vehicles - "drones" and ground platforms allow for early detection and location of threats. Remote-controlled unmanned armed systems are becoming increasingly popular and briefly will provide advanced fire units. Omnidirectional surveillance systems make transparent armour plate for the crew seeing what is happening around the vehicle. Countering observation and detection systems consisting of an active opponent camouflage - changing object signature

This also applies optoelectronic circuits. In the article, the author presents the concept of surveillance systems and the construction of situational awareness and radio-electronic war with the use of optoelectronic systems and the problems that prevent the development of these systems in Poland. The aim of this article is to draw attention to the potential that these systems have. The author's task is to underline the need of a long-term development program for these systems dedicated to Polish Land Forces.

Keywords: *optoelectronics system, safety and ergonomic, camouflage, battle field robotisation*

1. Introduction

The efficiency and safety of armed vehicle staff depends on many factors. The improvement of these features can be reached by many various actions like introduction new materials for stronger, more resistant and lighter armed plat, smart adaptable camouflage, new more precise weapon and new optoelectronic system for observation, warning and fire control. This last – optoelectronic technology has been changing very fast for last few years. It refers to sensors and displays what are the basic element of human –machine interface, and the new pictures analyses algorithms as well. New photonics material enables to build new devices smaller, lighter, better resolution. In this paper, we would like to present how this technology can effect on staff safety, efficiency and its comfort.

2. Staff comfort and observation skills amplifier

The staff comfort had not been taken account for many years, but in accordance with new tactics basing on more precise weapon, the success relay on staff skills and quality.

Soldiers are exposed on vibrations and unexpected shocks during off road riding in armed vehicle. Vehicle climbs or falls down through ramps, hits in obstacles etc. A soldier, who cannot see what is going on, spins his body for all the time or he is tossed inside vehicle. It is one of the reasons why soldier can be more tired than after a ride by terrain car.

Following after research of car crash effects on driver's and passenger's body we can see that analyses of car crash results on their bodies shows that injuries of drives are less danger than passengers, especially on the rear seats. It is because situation awareness. The driver, who is aware of danger subconsciously strains muscles and put his body in the best position. It also refers to experienced drivers of terrain vehicle who can see obstacles and ramp. In armed vehicle observation are is limited, drivers and others occupant are exposed to unexpected hits. Therefore, it seems that the road observation can help soldier to prepare for coming hits, and he can strain and relax his body in reference to actual road condition. So if we could look though the steel plate we could have been better prepared for the danger.

Normally it is very difficult to spread such information to all occupants in armed vehicle where the windows or periscopes are very small. Therefore, we have to support with optoelectronic systems. The thing what could radically improve situation awareness is the transparent breast plates what enable terrain observation in all direction by all soldiers independently.

Cameras what are observing surrounding around vehicle are standard equipment in armed vehicles as they are not extraordinary devices in modern cars. However, most common solutions based on displays, specially dedicated to drivers. The same picture can be shown to others soldier. However, contemporary optoelectronics devices offer more.



Fig. 1 Sony's Virtual Reality Goggles [1]

The contemporary human-machine interfaces apply virtual reality goggles (Fig. 1). Individual goggle where 3D synthetic pictures of directly visible neighbourhood and invisible reality are shown to soldier is the nearest feature. The presented picture depends on direction where he is looking at. So it is possible to get virtually transparent armed vehicle. To build such systems we need 3D cameras systems, 3D goggles and pictures processing systems. The computer game technology shows that it is almost possible. However, development of system working in real word demands solving of

many problem like, imagine amplifying to see object in the sunny and shadow area, to get individual depth of field image, etc. Optoelectronic system can support individual observers with individual picture processing for instance setting individual filter or contrast and brightness.

Today similar systems seem to be reachable. The expected advantages are better short and long distance situation awareness and getting synergy effects of many observers' results. We cannot forget about observation optoelectronic and radar heads what deliver additional information to virtual reality picture generator.

Therefore, the application of wide and multi band optoelectronics sensors with picture processing and analyses combined with human brain analyses skills gives completely new value in contemporary battlefield.

3. Smart camouflage

The camouflage tries to do the armed vehicle invisible in any observation band. But to reach the aim is a very complicated problem. These vehicles are quite big source of electromagnetic radiation, of heat, acoustic waves (vibration), reflects lights, etc. Therefore, the detection of vehicle seems to be not very complicated. Contrary to that, the hiding of such big vehicle requires smart action like light absorption or bending, shape or colour and pattern adaptation. The production of light absorbing materials, IR emitters, plates reflecting light in different colours patterns became the real fig. 2.



Fig. 2. The concept of adaptive camouflage [2]

Modern observation and detection systems work automatically and compares objects signature to model in libraries. The smart camouflage change objects signature to pretend to be something else (Fig. 3).



Fig. 3. The armoured vehicle fitted with 'Adaptive' infrared side panels, switched off (left), and on to simulate a large car (right)

To be the modern army we have to develop such systems. In the other hand, our detection system should be able to detect enemy objects in spite of their camouflage. It will be possible with application of wide band electromagnetic field and wave sensor with measurement possibilities. Such detectors will be the basic elements for self-guided missiles, aiming systems. Polish liquid crystal and light absorption technology give the basis for developing such systems.

4. Unmanned platform support

The new strategic reconnaissance and attack or tactical observation based on UAV, which are equipped with optoelectronic heads. The gathered information by these devices is used for situation awareness building and planning of safe action. It helps to find and recognize threats, terrain obstacles etc. However, application of this technology is well known for BMS and counter

action are taken by enemy. He can mask his position or provide misleading action. The low altitude UAV can be defeated or its presence can aware enemy about our interests of this area.

The new battlefield robotisation trend shows that the armed ground unmanned platform will be used to fight fig (4). Hidden against UAV for long time well camouflaged against UAV robots can destroy armoured vehicle very easily. Therefore, the manned vehicle should be precede and surrounded by armed robots, which insured them. Reconnaissance robots will patrol area, detects and combat enemy. These robots can be controlled by armed vehicle staff.

In remotely or autonomously controlled systems the passive optoelectronic systems for observation, detection and navigation are required. Robots autonomously working in herds (or swarm) with leader remotely controlled needs new generation of 3D cameras with object and terrain recognition systems. Therefore, we need high-level picture processing. This technology based on IT skills can be developed in Poland.



Fig 4. Armed robots (photo. T. Mirosław Milipol fare Paris 2011)

5. Conclusion

The optoelectronic technology is still attractive for land armed forces. It still gives new possibilities of development. Optoelectronics systems applied in armed vehicle creates new value on battlefield and can effect on soldier efficiency and safety.

The development of Polish photonics is crucial for armed vehicle safety and efficiency. Poland has right potential for virtual reality creation system what can improve soldier's safety and comfort. This technology can use for development of: training, robot control and observation systems.

The long-term program of optoelectronics technology directed to observation, virtual reality systems and robotisation should be set.

References

- [1] <http://www.scientificcomputing.com/news/2014/03/sonys-virtual-reality-goggles-head> date 20.05.2015.
- [2] <http://www.military.com/video/logistics-and-supplies/military-equipment/bae-systems-adaptive-camouflage/1498045769001>.
- [3] <http://en.wikipedia.org/wiki/Adaptiv>.