USE OF AUTONOMOUS SYSTEMS IN THE PERFORMANCE OF SECURITY MISSIONS

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DOI: 10.19062/1842-9238.2020.18.1.2

Abstract: *New types of threats to global security affect the entire infrastructure for production and transportation, storage of material, equipment, resources and energy. The number and size of these facilities prevent the use of conventional protection means and require a large number of well-trained personnel. To these high costs are added. For this reason, autonomous systems with increased remote sensing, monitoring and even equipment with lethal armament offer a promising means of extending protection with limited human resources. This article presents some possibilities for the use of autonomous systems: protection of military bases, protection and automation of air bases and use of autonomous convoys.*

Keywords: *UGV (Unmanned Ground Vehicle); UAV (Unmanned Aerial Vehicle)' USV (Unmanned Surface Vehicle); Security mission.*

1. INTRODUCTION

Within the new types of conflicts (asymmetric, unconventional, hybrid wars) their autonomous systems have an important place. Military theoreticians imagine a new face of war with autonomous systems, drones, robots, sensors. To avoid the image of soldiers returning home in metal coffins dressed in flags, instead of grief-stricken families, autonomous robots that can make decisions, such as shooting at a target, can be used. In the future, the tacticians want to carry out missions without human intervention, to be able to replace the human soldier from a growing range of dangerous missions such as carrying out missions in caves, in search of terrorists, securing streets in locations exposed to sniper fire, air and naval cover, FDI road and waterway cleaners, overseeing damage from biochemical weapons, permanent guarding of borders and buildings of strategic importance, to control potentially hostile crowds and even infantry-specific combat missions. These robots would be "smart" enough to make decisions that only humans can now make; and as conflicts increase in pace and require much faster processing of information and responses, robots have a distinct advantage over limited and failing human cognitive capabilities. Autonomous systems bring a significant multiplication effect to the battlefield and lead to the disappearance of some human medical phenomena (distress, fatigue, low morale, perceptual and communication challenges in conditions of war etc., lack of emotions, adrenaline and stress) that cause the soldiers to exaggerate or deliberately go beyond humanitarian laws and commit atrocities, war crimes (illegal actions that have a significant political cost) [1].

According to Unmanned Systems Roadmap 2007-2032 US (Unmanned System - Autonomous System) is a "system whose components include the equipment, network and personnel required to control an unmanned aircraft". And a vehicle without a crew is defined as a motor vehicle that does not carry a human operator, can be operated autonomously or remotely, can be consumable or recoverable and can carry a lethal or non-lethal load [2].

2. USE OF AUTONOMOUS SYSTEMS IN THE SURVEILLANCE AND PROTECTION OF MILITARY BASES

It is known that human alertness begins to decline after approximately 30 minutes of sensor monitoring, and monitoring all video cameras and sensor streams required to protect a large surface 24 hours / 7 days requires extensive and costly human resources. This has led to increased demand for the use of autonomous systems within security systems. Advanced sensors can provide assistance for all aspects of the security task, including finding, evaluating, tracking or targeting intruders. The autonomous platforms equipped with sensors can take over the boring, dirty and dangerous aspects of the surveillance and security of some objectives and installations, reducing the operator overload.

Currently, the concept of I-IBD (Interim Integrated Base Defense) for the protection of military bases has emerged. The integrated base defense program is designed to improve the integration and interoperability of existing basic defense systems, leading to the improvement of basic operations. These enhancements include automatically displaying threat data, merging and correlating basic defense information through a graphical interface, evaluating and disseminating threat information, and reducing task / band ratio and training requirements. The effectiveness of the basic defense operations will be achieved by reducing duplicate capacities and assistance requirements [3].

The combination of C^4/I^2 systems with UGV, UAV, USV systems provides integrated protection from the base control center. These autonomous systems are targeted as force projection units. The useful tasks of these systems and physical sensors provide situational awareness, but also a physical response capacity to possible threats. Within this concept, the following autonomous systems can be used.

-UGV (Unmanned Ground Vehicle): within the base security missions this autonomous system is equipped with useful tasks for intrusion detection and evaluation, and physical response possibilities [4]. Its capabilities include autonomous navigation, obstacle avoidance, motion detection, day and night images, barrier access control by automatically evaluating access cards and even using lethal weapons against potential physical threats.

- AutoScan Under Vehicle Inspection System: The access area can be equipped with UVIS. These automatic scanning systems improve the security of the bases, providing a reliable threat detection capability at the check points. As the vehicles cross the automatic scanning platform, the system operator receives a real-time image of the vehicle ready for inspection. From a security position, the operator can then zoom in on any part of the image for closer inspection with more detailed magnifying levels. In addition, unlike manual inspection methods, the automatic scanning system produces images that can be stored for future comparison and analysis[5].

- USV is an autonomous naval vehicle used for protection against suicide boats, being equipped with on board ammunition (explosives, weapons), designed to investigate a suspicious boat, warn and attack if necessary [6].

- UAV is an autonomous air vehicle, which can perform the same missions as UGV but much faster and over a longer distance [7].

- Semi-autonomous weapon tower for security service on the defensive lines: optical, laser and thermal sensor, voice recognition, automatic weapons, grenade launcher, gas grenade launcher of different types of gas tanks. These towers can perform autonomous detection of human targets, target shooting autonomously or with human control [8].

In Fig. 1 a typical I-IBD configuration is presented. The towers, air balloon and UAV sensors offer wide coverage of the area near the protected area. Ground-based sensors can detect intrusions in the outer perimeter of a protected area and signal violations. Ground sensors offer a rough location and a type of target. Further information must be obtained from the nearest sensor, with the ability to more accurately measure location, title and speed and to make a more positive identification of the target type. Other sensors may be needed to positively identify the target as friendly or enemy and to continuously track the target Visible / IR cameras and radar sensors are used to identify and track intrusions. Human patrols and UGV / UAV systems intervene in the protected area. Finally, weapon systems may be needed to deter or neutralize the threat.

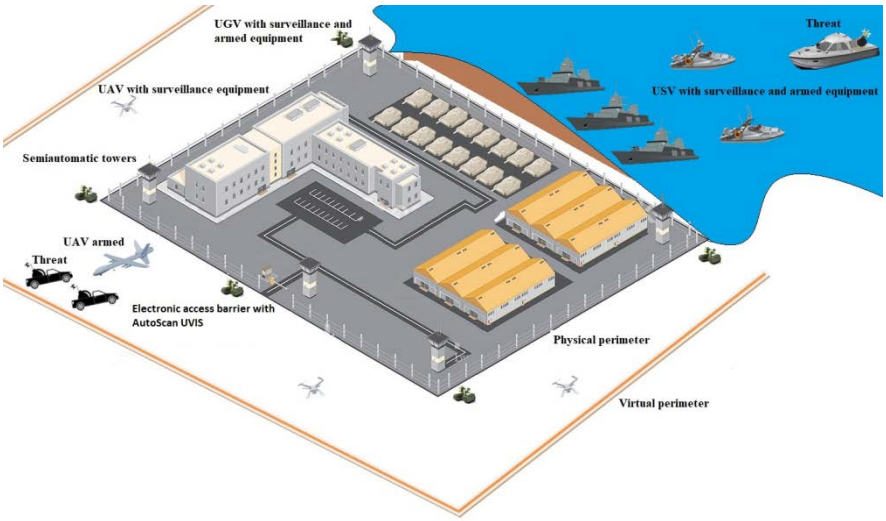

FIG. 1 The use of autonomous systems in the integrated defense of the bases [9]

2. SECURITY OF AIR BASES

Related to the security of air bases (the physical security of the air bases as well as the security of the flight), in order to improve the effectiveness and the efficiency, the air forces have developed the concept of SAB (Smart Air Base) that takes advantage of technologies such as robotics, artificial intelligence and automatic data analysis. They will perform the following functions:

1. The awareness of the situation of the upper air base: The basic control base will be better connected to all systems of the air base. Decision Support Systems (DSS) based on data analysis and using artificial intelligence systems will recommend further action, allowing faster decision making for more complex air operations.

2. Automated Aircraft Inspection: Hangars with sensors and UGVs will check whether aircraft are suitable for flight. This reduces aircraft return time.

3. Proactive Maintenance: A network of cameras in the aircraft hangar that will feed images of the aircraft's surface onto a computer running specialized software.

Using specific algorithms, the software will identify areas of the aircraft that require further human rectification or intervention. With data analysis, the intelligent fleet management system will provide information on aircraft performance and proactively recommend maintenance actions.

4. Evaluation and repairs of tread and track damage: if at present the inspection of the tracks and the treads and the problem solving is done manually by the human personnel, to reduce the labor force and the necessary time the autonomous systems will be used (Aerial drones will check quickly and transmit the exact location of the problem areas and the terrestrial ones will quickly remedy the situation regardless of time or weather). DSS will prioritize track repair operations and the choice of running tracks to minimize launch and recovery interruptions.

5. Improved Air Base Security: Using advanced sensors and video analysis by means of artificial intelligence systems will increase the capabilities of current systems used to improve air base security. UAVs can be used to catch "stray" drones [10]

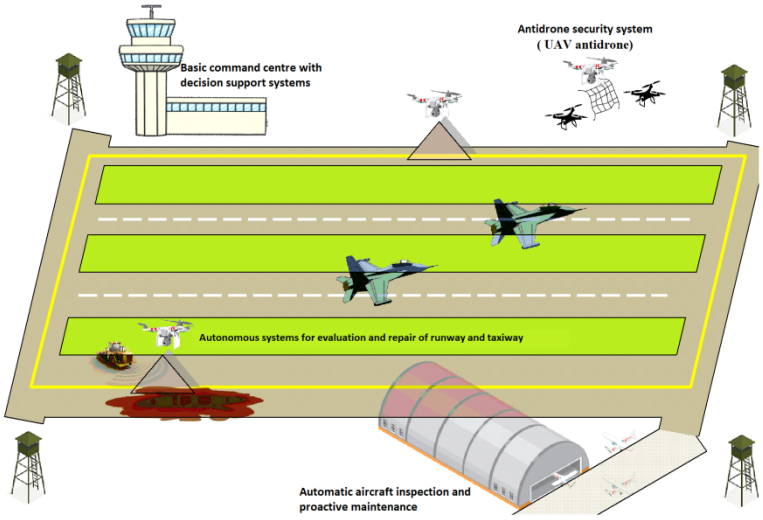

FIG. 2 Use of autonomous systems within the concept of intelligent air base [11]

3. SECURITY OF CONVOYS AND INDEPENDENT CONVOYS

The military relies on convoys to move people and supplies, usually on large and sometimes unpredictable grounds. Improvised explosive devices (IED) are one of the biggest threats to today's ground forces carrying out logistics missions in hostile environments. While tactical vehicle armor has been effective in reducing casualties, the fighter remains in danger due to increased quantities of explosives used for IEDs. Obstacles, enemy fighters, even bad weather can pose challenges that can prevent a successful convoy moving. In the event of an attack on a convoy, the drivers are targeted and cannot defend themselves. For this reason the armed forces are studying the ways in which operations with ground vehicles can be made safer and more efficient by integrating autonomous solutions[12]. The purpose of this use of autonomous systems thing is to completely remove the soldier from the cabins of military trucks that make supply convoys transporting food, water, ammunition, fuel, etc., in war zones, where the troops need them. Not only does this release more soldiers that can be used to effectively fight, but it avoids exposing them to the risk of being blown up by bombs or mines, or exposing enemy fire in ambushes.

To increase the efficiency of a reduced force structure, UGVs will serve as force multipliers, allowing a fighter in a protected vehicle to oversee the coordinated operation of multiple UGVs from a safe distance. These UGVs will be able to operate for long periods of time, during the day and at night, and through dust and adverse weather conditions, without fatigue or loss of consciousness[13].

The protection of military convoys becomes a critical issue for military operational planners facing modern war threats. The armed UGV and UAV will protect the supply convoy. The typical protection systems of the logistic convoy are autonomous vehicles with mobile firefighting system, equipped with audio and video detection equipment of enemy shooters and coupled to weapons operated autonomously or by remote control. This integrated sensor system can instantly turn fire in the direction of the enemy, on the move. These vehicles are also equipped with electronic countermeasures to block radio controlled improvised explosive devices (IEDs). These locks are designed to pre-activate IEDs (by mimicking the command signal) or to disrupt the communications channel when the convoy passes nearby. Enemy activity along the road or in certain locations suspected of being ambush points, also monitored from the air, by unmanned vehicles. While tactical UAVs are primarily tasked with collecting information and are rarely available for such missions, mini UAVs (MAVs) are currently optimized for such missions. By applying moving control systems, such MAVs can function as the vanguard, providing an area of several kilometers up to several hundred meters before the first element of the convoy. Sensors engaged by these MAVs can be programmed to detect recent field changes that indicate an IED or ambush on the roadside. Armed tactical UAVs patrolling the area can be used to eliminate possible threats [14].

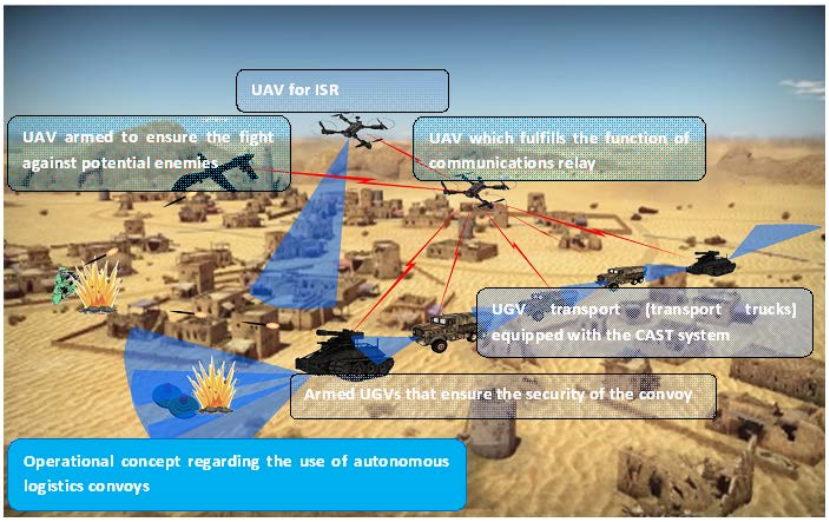

FIG. 3 Use of autonomous systems within a logistics convoy

It is quite simple to configure a vehicle with a GPS navigation system to follow a route independently, but it appears the probability of hitting other vehicles in the columns, crossing over pedestrians, colliding with unforeseen objects on the road, etc.15. This is why the concept of Convoy Active Safety Technology (CAST) has emerged. Thus, not only a GPS guidance unit is applied to the cars in the convoy, but also a LIDAR scanner.

This can detect things like cars, pedestrians, inopportune objects, etc. and the software can then command to stop and wait, drive or do anything else that needs to be done. The vehicles can be connected electronically with each other [15].

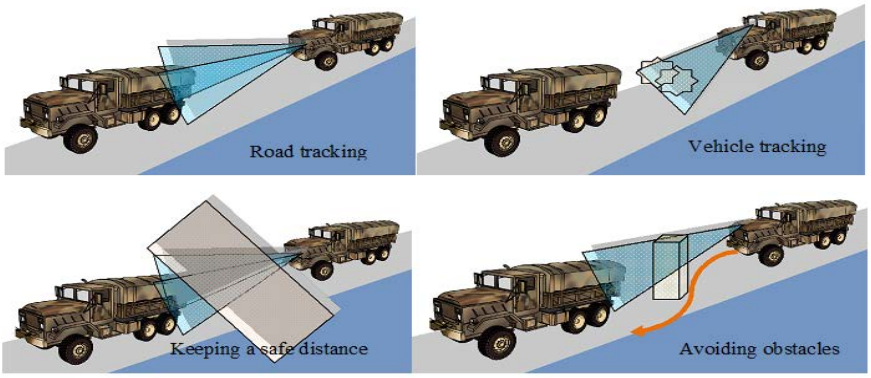

FIG. 4 CAST system capabilities [16]

CONCLUSIONS

The autonomous systems used to protect the military bases represent a viable improvement of this mission. These will be used to greatly reduce the risks of responding to high threat incidents and to offset the costs associated with the labor force used to perform routine repetitive tasks.

- In the use of sensors and autonomous systems within the protection of military bases such problems can occur: multiple simultaneous intrusions from different directions make the scenario even more complex, because the sensors have to coordinate between several competing tasks with different priorities. At some point, they can be overloaded and in this context the calculation algorithms used must perform the identification, tracking and engagement of the most critical targets.

- Troops can exit the field with autonomous supply vehicles following them. When supplies are depleted, vehicles can return to the base and take over much of what the ground troops need. This saves time and costs by not having to use personnel back and forth on potentially dangerous supply lines, allowing them to continue their mission.

- Autonomous logistics convoys offer a significant advantage of force protection - the removal of personnel from the vehicles concerned, the protection against IED and the use of a small number of operators necessary to simultaneously supervise more activity.

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