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POSSIBLE APPLICATTIONS OF USVs IN POLISH NAVY

Key words: *unmanned surface vehicles, Polish Navy modernization, maritime security applications, maritime critical infrastructure protection, maritime security, unmanned platforms, unmanned maritime vehicles,*

Abstract:

Polish Navy modernization process is underway. Year 2015 was vital because of two historical events. Newly build corvette (*Gawron* Class) and minehunter (*Kormoran II* Class) were launched in Polish shipyards. Naval modernization program consist of many aspects and is implemented in Polish industry. Simultaneously, couple of programs focused on unmanned vehicles are on track (aerial, surface and underwater). One of them is *Buried Mines* (BURMIN) program as a part of *European Unmanned Systems for Mine Counter Measures* and other naval applications (UMS) organized by *European Defense Agency* (EDA), together with sufficient players of the branch like *Thales* (leader), *Atlas, RMA, TNO. WTD-71*, *Atlas Elektronik, Fraunhofer, IPHT, CTM* (Poland). Unmanned Surface Vehicles (USVs) become increasingly popular in military and maritime security applications. With growing role of shallow and confined waters in maritime tactics some specific threats start play significant role (asymmetric threats, sea mine, submarines). Polish Navy is engaged in *Multinational Capability Development Campaign* (MCDC) project dedicated to Joint and Combined Operations in and from Confined Waters. Ideas proposed in the paper represent the author's personal point of view.

Introduction

Project of minehunter construction *Kormoran II* assumes the purchase of three units build in Gdansk. With a magnetic steel hull construction the new MCM vessel will be equipped with, wide variety of high specialized outfit contain inter alia, AUV - *Hugin 1000*, Self-Propelled Variable Depth Sonar (SPVDS) - *Double Eagle Mk III*, ROV - *Morswin*, one shot disposal system – *Głuptak*, Side Scan Sonar – *Klein* together with Unmanned Surface Vehicle (USV).

Other parts of Polish Navy modernization program include three new submarines supply (codename *Orka*) together with missile corvettes *Miecznik* (three units) and patrol ship *Czajka* (three units with minecounter measures components onboard).

Purchase of a second Coastal Missile Squadron with Kongsberg's *Naval Strike Missiles* (NSM) missiles creates new quality of strike possibilities for the navy. Coastal

Missile Unit (two squadrons) will be equipped with several dozen of modern long range precision strike missiles as a part of flexible system. Unmanned Aerial Vehicles dedicated for ISR missions acting as the forward observers.

Also USVs are in the area of interests of military authorities responsible for the army development. The use of unmanned surface systems (autonomous platforms and support subsystems) has been demonstrated successfully during Iraqi War (force protection, maritime security) as well as on Haifa and Singapore harbors (maritime critical infrastructure applications - harbor protection). Since WW II unmanned systems were used for new strike armament testing (missiles, nuclear explosions). Unmanned systems also have long history in MCM purpose (e.g. Troika, SAM). Polish Navy used modernized to the target vessel, remotely controlled ex torpedo boat, in the late 70's. This paper presents the authors opinion about possible applications of USVs in Polish Navy with reference to new tasks and future challenges. Article discusses the design and outfit (sensors and effectors) according to distanced tasks (missions and scenarios appearance).

According to Unmanned Systems Integrated Roadmap FY2011-2036, Unmanned Maritime Systems can be defined as unmanned vehicles that displace water at rest. They can be categorized into two groups. First one represents unmanned underwater vehicles (UUV) and the second one is the group of unmanned surface vehicles (USV). In the area of our interests are USVs that operate with near-continuous contact with water surface. In such category, conventional hull crafts, hydrofoils as well as semi-submersible units can be encapsulated[1]. Couple of unmanned platforms classification attempts eventuated in the last years. The most popular proffered by the *Navy Unmanned Surface Vehicle Master Plan* leads four basic classes (*X-Class, Harbor, Snorkeler, Fleet*). Another US document proposes additional three classes (*E-Class, F-Class, G-Class*), where the main difference is connected with the main dimensions[2]. Advanced researches are focused on unmanned maritime platforms autonomy all over the word. Leaving out problems connected with the law regulations about USVs activity at sea (IMO resolutions, national regulations in a matter of ships classification and registration). Increasing autonomy is the key for further USVs progress. The level of independency is straightly connected with the level of autonomy (less control from "mother ship" is required). Many autonomous levels descriptions appeared in the subject literature. Some of them present six autonomy levels (none, minimum, basic, intermediate, advanced, highly advanced suggested by Marine

[1] *Unmanned Systems Integrated Roadmap FY2011-2036,* USA Department of Defense, p.25.
[2] S. Savitz, I. Blickstein, P. Buryk, R. W. Button, P. DeLuca, J. Dryden, J. Mastbaum, J. Osburg, P. Padilla, A. Potter, C. C. Price, L. Thrall, S. K. Woodward, R. J. Yardley, J. M. Yurchak *U.S. Navy Employment Options for Unmanned Surface Vehicles (USVs*), RAND, 2013, p.50,

Vehicle Legal Working Group). Others unveiled four levels (human operated, human delegated, human supervised and fully autonomous).

Polish experiences

Edredon is the first Unmanned Surface Vehicle made in Poland. The current status of this platform is based on technology demonstrator. The research project entitled: *Unmanned swimming platforms for the protection of national sea services* was led by prof. Kitowski (Polish Naval Academy). The construction of *Edredon* is based on the rigid hull of a hybrid boat (RHIB) with the length of 5.7 m, load capacity of 1 tone and max. speed up to 30 – 35 km. Platform has operational range up to 20 km. The major components of the vehicles includes:[3]

- navigation system, GPS, AIS, ARPA, electronic compass, autopilot, sounder, plotter, electronic chart, log;
- position tracking system;
- remote control system (coded);
- power supply system;
- observation system consist: day/light camera, laser, distance measurement, sonar, panoramic camera;
- chemical and meteorological sensors;
- communication system.

With reconfigurable modules (open architecture), low structure and high maneuverability, *Edredon* seems to be appropriable tool for harbor protection missions as response to emerging asymmetric threats (including terrorists). Platform can be remotely controlled from the Mobile Control Center MCC. MCC is located in standard container and can be situate at harbor area, other shore point or on vessels board (if big enough). Control center is fully equipped with navigational purposes, navigation devices and planning station. Two operators are responsible for conducting the tasks.

The core vehicles fire system creates (optional) remotely controlled armament module with 7.62, ZSMU – 127 KOBUS (*Turrets – Remote Controlled Weapon Station*), with grenade launcher and/or Non-Lethal Weapon System e.g. acoustic emitter (Long Range Acoustic Device). Other devices come into play are markers, water cannons for optionally deterring or designating of the intruders.

Main deck architecture assures sufficient place for AUV/ROV, towing sonar or underwater camera docking station. Launching and recovery system for AUV/ROV

[3] Z. Kitowski, "Autonomous Unmanned Surface Vehicle Edredon", *Polish Hiperbaric Research*, vol. 3 (40), 2012, p. 8.

purchase, are crucial for creation advanced MCM system. Sea trials on the Gulf of Gdansk basin contains among others communication, data transfer, remotely control, target identification have been executed.

According to the bathymetric character of Polish EEZ the whole area is classified as littoral (shallow) waters. As very particular theatre of operations, many limitations for maritime forces courses of actions occur. This area is specific for many reasons. First of all landward coastal territory encompasses many domains (maritime, land and air space, cyber) for military and other systems. Together with opposite conflict sides other systems are affected e.g. merchant trade lines, maritime critical infrastructure objects, neutral ships. Shallow waters are regarded as very specific environment for conducting maritime operations. Number of diverse elements affect all actors (threats, risks, particularities). However, the area should be viewed also as a bouquet of opportunities that may be exploited to one's advantage. Complex of factors have to be taken into account when consider the shallow waters operating environment included (selected)[4]:

- mine threats;
- threats posed by submarines;
- employment of Unmanned Systems (underwater, air, surface);
- divers activities;
- asymmetric threats (Improvised Explosives Devices - IED);
- broad and flexible use of Surface to Surface Missiles (SSM) also from ground-ashore batteries launchers;
- easy from ashore detection;
- permanent conventional air strike threat;
- traffic, number of non-combatants, oil rigs, pipe lines and other objects vulnerable to strike actions.

Based on threats unveiled above, some basic applications for national defense (maritime domain) and security at sea on Polish water areas, as well as outside, can be indicated, in priority order:

- Mine Countermeasures (MCM),
- Force Protection (FP),
- Maritime Security (MS),
- Special Operations Forces (SOF) support,
- Electronic Warfare (EW).

[4] *Prospective Operations in Confined and Shallow Waters. Study Paper*, COE CSW, Kiel, 2015, p. 14

Other missions package appear less workable in reference to national realities (reducing applications packages):

- Anti-Submarine Warfare (ASW),
- Surface Warfare (SW).

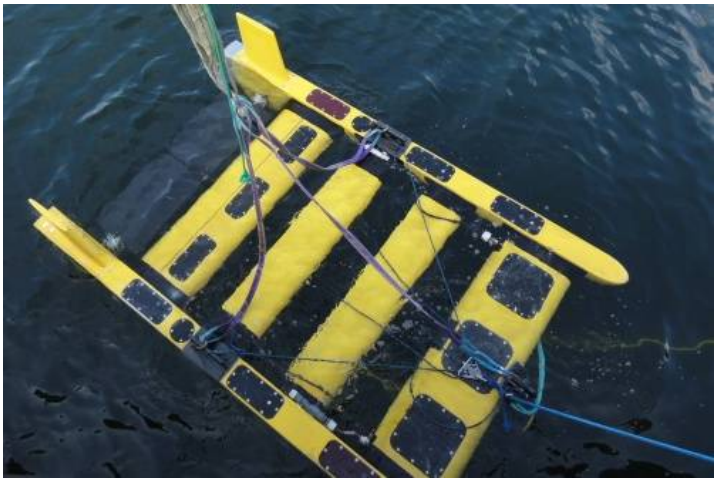
Some possible applications of unmanned platforms designated to surface operations conducting will be described as follows. All of them are connected with the typical form of operations:

- Naval Mine Warfare (as a part of MCM activities),
- FP with selected MS elements,
- Special Operation Forces support (SOF),
- Electronic Warfare (EW) together with Intelligence, Surveillance, Reconnaissance (ISR).

MCM applications

The growing threat from new generations of mines (buried mines, quasi-intelligence mines, limited signatures technology mines - stealth), as well as WBIED/MIED in a natural way causes demand for new counteracting methods. Other categories are mines dedicated to MCM vessels combat. In a natural way new MCM technologies approach to autonomous platforms assured higher deck personnel safety.

Because of limited communication range (horizontal) between commanding center and unmanned platform (on patrol) the idea based on the usage of single or swarm of USVs operate near and radio controlled from *"mother ship"* appear more practice nowadays. Because of the same reasons the surveillance horizon is shorter than in air action. BURMIN idea is based on unmanned surface minesweeper use. Unmanned surface unit with reduced physical signatures can operate yielding the speed for BURMIN. Such solution creates opportunity to use surface vehicle as retranslation station for data transition linked shore or onboard commanding center with action BURMIN.



BURMIN with characteristic stabilization fins (towing by the USV) as a part of MCM system

source: www.altair.com.pl/news/view?news_id=17794

Autonomous capabilities development can make unmanned platforms more vulnerable to long range unassisted (in autonomous meaning) missions. Another step of increasing remote controlling range can be a cooperation within federated systems architecture of maritime drones acting on surface and in the air. Unmanned Aerial Systems can be used as a commands retranslations for USVs. All those aspects could bring main advantage which greater effectiveness of conducted MCM missions is.

Force Protection and Maritime Security

Naval actors (combatants and merchant ships), operating with the natural protection of the sea, inherently have a reduced vulnerability to vide variety of threats (e.g. asymmetric threats). Force Protection (FP) contains all measures and means aimed to minimize the vulnerability of personnel, facilities, equipment and operations to any threat and in all situations, to preserve freedom of action and the operational effectiveness of the force[5]. On the other hand, Maritime Security (MS) consists of securing allied domestic ports, together with protecting ships and maritime infrastructure against the spectrum of threats from broad stock of threats. The MS mission rubric includes such aspects like Chemical, Biological, Nuclear, Radiological, and Explosive (CBNRE) hazards detection and localization. To carry on with threats monitoring, non-lethal and lethal threat deterrence should be considered. The role of Gdynia and Świnoujście for the Polish Navy and expected NATO support demand high

[5] AAP-6, NSA, 2008, p. 2-F-6

level of FP and MS. The mobile character of USVs together with command centers (on containers on a truck or sidecar as well as situated onboard of e.g. MCM commanding ship) create possibility of create of protection umbrella over the small regional harbors.

MS represents a fundamental USV mission and is essential not only for the traditional purpose of intelligence collection and threat deterrence, but also as a precursor and enabler for essentially all other missions.

Unmanned platform can play significant role in Force Protection acting inside and outside the military bases (anchorages, fairways, etc.). First idea is to use unmanned platforms as ISR platforms gathering data for the port (naval base) security/operational centers. Time deficit between threat detection and counteracting, together with very dynamic character of majority of hazards, are the factors determining the security/protection effectiveness. The main role for maritime surface drones is to be the first response measures. USVs could be a response by preventing surprise actions risen by an opponent.

It is required to gather surface and underwater sphere information to assure the Maritime Critical Infrastructure protection by different sensors. Balanced complex of modern detection and counter technologies seems to be the key for effective objects and ships protection. Observed time deficit between threat symptoms detection and counteracting is a big challenge. That is why use of differentiated surveillance measures is crucial for effective harbor/naval bases protection system. Unique ability to act as a reconnaissance and counteract performer improve time reduction.

Such missions serve to protect vessels (high value units) and port facilities as main assets form unexpected threats. USVs are highly suitable for other surface platforms protection encompassed kind of confined and littoral areas escort for vessels. Buffer zones forming around the anchored military vessels or ships under transit along confined waters (e.g. due depth limitations) is a single idea of force protection capabilities buildup. Additional "*eyes and ears*" created with the unmanned vehicles sensors stock, together with fast response readiness creates new possibilities for FP architecture. It could be the method of one of the maritime forces joint functions improvement. The idea could be useful in "small boats swarm attacks" counteracting as a part of higher priority of enabling the force to conduct its mission unimpeded by the actions of an adversary.

Special Operations Forces missions support

Some aspects of SOF missions support with USVs must be consider like providing essential intelligence or providing early warnings for SOF personnel. The main objectives for USVs in SOF operations could concentrate around mission support (especially in difficult, high-risk and hazardous area). Together with resupply, transportation, injury personnel withdrawal USV mission packages for SOF mission

support depends of specific needs. Nevertheless some specific and even unique capabilities d USVs design and equipment will be required in the subject of possible applications in the Polish Special Forces, which are not integral part of Polish Navy. Just some special units poses capability to conduct missions in the maritime domain. At the head of future USVs applications in the subject of SOF operations support are small signature (less detection), high speed (higher engine power), data transfer or deck weapon systems. In some publications the role of riverine and coastal SOF activities supported by USVs are raised. Such ideas outlines the unique environmental cover necessity. USVs platforms could act as pre-players and/or provide early warnings for main forces.

Electronic Warfare (EW), Intelligence, Surveillance, Reconnaissance (ISR)

A wide variety of missions as a part of EW together with influence activities (IA) could be conducted. Significant advantages for this role are possibilities of providing jamming activities, early warnings together with some forms of electronic attack. Such missions are in obvious way close relevant to the intelligence, surveillance and reconnaissance. It seems too easy to adopt USV deck to the role of false echo generator as a part of deception in support of anti- surface warfare (ASUW). EW activity with USVs engagement could create other disruptive IA missions like local area network jamming (with many limitations connected with the displacement of the unmanned unit), instigate spoofing focused on opponents denial of service[6]. Other roles of EW missions cover the area of GPS jamming or counter maritime/ waterborne improvised explosive devices (MIED/WBIED as a part of hostile maritime infrastructure protection). Simultaneously USVs could conduct passive spectrum detection and threat warning based on the above-mentioned.

The main receivers of this idea could be intelligence ships together with specialized EW onshore units. USVs with EW equipment onboard could operate in the near land areas secured own high value units. Some advantages connected with range, capacity, economic speed or operational range and endurance together with adequate levels of autonomy of *Edredon* could be a good starting point for the future analyses. Together with the possible applications like jamming, new aspects of cyber protection appear. Command and control elements of USVs have to be prevented and well secured as a result of possible EW threats.

Conclusions

Unmanned surface vehicles, in general, have proven to be a useful platforms in military, and maritime critical infrastructure protection as well as in many other

[6] *Guidance for developing of Maritime Unmanned Systems (MUS) capability*, Combined Joint Operations from the Sea Centre of Excellence, 2012, p. 51.

humans activities areas of activity (ecology, sea domain researches). According to development in USVs technologies, legal status of such platforms is still largely undefined in Poland. Similar to other USVs users there are growing concerns about liability issues. Practical knowledge acquired during the training speaks louder than low regulations of the maritime unmanned systems status. The following conclusions could be considered based on foregoing:

- USV can play significant role in action performing in and from littoral waters especially on very shallow and surf zone areas where the vessels freedom of maneuvering is limited because of the depths,
- real possibility of FP measures support (e.g. with buffer zones creation, fast reaction time, high readiness for action, additional "eyes" for vessels reconnaissance systems),
- higher degree of autonomy is the key for another improvements,
- new applications progress as well as existing missions complexity depends on increasingly advanced autonomy and communication (especially data transfer),
- commercial shipping with greater intensity on confined areas (traffic lines, SLOCs) as well as number of obstacles (natural and human made) is a prominent challenge in aspect of USVs navigation (obstacles detection and avoidance),
- low limitations implementation plays vital role in future USVs development as a part of national maritime services,
- MCM branch is the most expected area of USV applications in Polish Navy nowadays,
- USVs use means the greater effectiveness for MCM vessels,
- Some other USVs applications could be unveiled including training, special operations support, anti-submarine warfare in narrow sense,
- Researches focused on modern unmanned maritime technologies could provide ASUW and ASW as well as EW technology demonstrators in the first step,
- Increasing tonnage overloaded in big polish harbors together with two specific specialist objects (LNG terminal in Świnoujście, oil terminal in Gdansk) creates high level of security precautions creation necessity.

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