

CAPABILITIES TO USE THE UNMANNED WATER VEHICLES IN COMBAT MISSIONS

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DOI: 10.19062/1842-9238.2025.23.2.3

Abstract: *Unmanned Water Vehicles represent an essential element in modernizing and increasing the efficiency of naval forces, meeting the requirements imposed by asymmetric threats and the complexity of contemporary operations. In this article, the possible capabilities of using these systems in combat type missions are presented. These autonomous, unmanned systems are categorized by size and type of use and are capable of diverse missions, from surveillance and reconnaissance (ISR) operations to anti-submarine warfare, mine clearance and defense against surface threats. Autonomous systems contribute to precise offensive power design and fleet protection by integrating advanced technologies and state-of-the-art sensors. These systems improve rapid response in critical situations, reduce risks to personnel and enable operations in hostile or inaccessible environments for human crews.*

Keywords: UWV, USWV, UUWV, naval strike, naval shield, combat missions...

1. INTRODUCTION

The development of the use of autonomous systems in combat represents a significant transformation in the way military operations are conducted. These systems, powered by advances in artificial intelligence, robotics and advanced sensors, are designed to perform critical missions such as reconnaissance, precision strike, logistics and tactical support. Their use enables the reduction of risks to human troops by providing operational capabilities in dangerous or inaccessible environments. For example, UAVs can perform surveillance or attack missions while autonomous ground vehicles provide equipment transport or logistical support. Autonomous naval systems such as robotic submarines play an important role in maritime defense and monitoring of strategic areas [1].

The development of these technologies has been accelerated by modern military requirements for efficiency, speed of reaction and loss minimization. At the same time, the associated challenges, such as the integration of these systems into existing command structures, the ethics of their use in combat, and protection against cyber-attacks, are essential topics within this technological advance. Thus, autonomous systems are becoming a central pillar of the future of modern warfare, with the potential to fundamentally change the dynamics of military confrontations.

The use of autonomous naval vehicles presents the following advantages:

1. Essential strategic role: Autonomous Water Systems (UWS) are a vital component in the modernization of maritime forces, having the ability to effectively respond to contemporary threats, including asymmetric ones and complex operational environments.

2. Operational Versatility: UWS can perform a wide range of combat-type missions, from ISR and demining, to defense against cyber and physical threats. This adaptability makes them indispensable tools for modern navies.

3. Risk Reduction and Personnel Protection: By eliminating the need for a human crew in hazardous environments, autonomous systems improve personnel safety, reducing the risks associated with operations in hostile areas.

4. Increased efficiency through advanced technology: The use of artificial intelligence, advanced sensors and autonomous capabilities enables rapid detection of threats and accurate reactions, optimizing resources and response time.

5. Littoral operations and defense of strategic resources: Due to increased risks in littoral areas, UWSs play a crucial role in operations such as combating diesel submarines, neutralizing small boat swarms and harbor protection.

6. Complementary offensive and defensive capabilities: Naval autonomous systems can perform both naval strike and naval shield missions, supporting both offensive power projection and defense of fleets and critical assets.

2. UNMANNED WATER VEHICLE IN COMBAT MISSIONS

Broadly speaking, the role of naval forces is to provide credible and sustained sea combat power when and where it is needed. Increased uncertainty about possible threats, the possible locations of attacks, and the means by which they might be carried out have shifted power projection, force protection, and expeditionary operations from global (“blue water”) areas to littoral (“brown water” or “green water”)¹ [2]. Many future naval combat operations will likely be littoral to project power ashore and provide a defensive umbrella for forces operating ashore. Naval forces are expected to be attacked by diesel submarines, swarms of small boats, and artillery and anti-ship missile batteries, and naval operations are expected to take place in areas planted with surface or depth mines [3].

Thus arose the requirement for new capabilities of the respective naval forces: ISR, bathymetric surveys, battlespace preparation, battlespace awareness, naval surface warfare, ASW (anti-submarine warfare), demining operations, special operations and attack support, A²/AD (Anti-Access/Area Denial) missions, protection and defense of ports and port facilities against small but fast boats loaded with explosives.

Increasing needs arising from new threats can be mitigated to an increasing extent by exploiting the benefits of unmanned systems [4]. In an era where technology is redefining the rules of war, naval drones provide a crucial strategic advantage, supporting naval forces to carry out their missions efficiently and with little impact on human and material resources. The use of naval drones in combat missions has revolutionized the way maritime forces conduct their operations, offering a unique combination of autonomy, versatility and efficiency. These systems, known as Unmanned Water Vehicles (UWS), play a critical role in adapting to the new challenges of modern warfare, characterized by asymmetric threats and complex operational environments. In the context of threats such as diesel submarines, swarms of armed small boats, sea mines and anti-ship missiles, the naval drone becomes an indispensable tool to protect fleets, strategic resources and trade routes.

Naval autonomous systems are used for missions such as mine clearance, anti-submarine warfare, surface target neutralization and defense against cyber and electronic attacks.

¹ Blue water navy - A blue water navy is a maritime force capable of operating globally, essentially over the deep waters of the open oceans, brown - water navy, green - water navy – naval forces on the river and near shore, naval forces close to the shore

By integrating artificial intelligence and advanced sensors, naval drones enable rapid detection and response to threats, reducing risks to human personnel and enabling operations in dangerous or inaccessible environments. This flexibility and adaptability make them key elements for offensive and defensive operations in littoral and offshore regions. Table 1 presents a classification of UWS and their capabilities.

Table 1. Classification of UWS systems [5]

UWS (Unmanned Water Vehicles)	
USWV (Unmanned Surface Water Vehicles)	UUWV (Unmanned Under Water Vehicles)
LUWSV (Large UWSV) (Class 4; Length >50m)	XL UWSV(ExtraLarge UWSV) Dia. >84in
MUWSV MediumUWSV (Class 3; $12\text{m} \leq \text{Length} \leq 50\text{m}$)	LUUWV(Large UUWV) ($21\text{in} \leq \text{Dia.} \leq 84\text{in}$)
S UWSV (Smal. UWSV) (Class 2; $7\text{m} \leq \text{Length} > 7\text{m}$ and $\leq 12\text{m}$)	MUUWV (Medium UUWV) ($10 \leq \text{Dia.} \leq 21\text{in}$)
VSUWSV (Very Smal. UWSV) (Class 1; Length $\leq 7\text{m}$)	SUUWV (Smal UUWV) ($3\text{in} \leq \text{Dia.} \leq 10\text{in}$)
They are unmanned surface boats and can be used in a number of missions such as mine clearance missions, ISR, anti-submarine warfare or as fast attack craft.	They are underwater systems used to retrieve objects from the seabed and even to carry out clandestine intelligence missions.

In accordance with the capabilities presented above, the UWS can carry out the following types of combat type missions:

1. Naval strike (offensive operations): is a broad concept for projecting precise and persistent offensive power at sea. Under this concept, networked autonomous naval sensors integrated with national and alliance systems will provide persistent ISR data, enabling the development of a comprehensive understanding of adversary capabilities and vulnerabilities. Tightly integrated with these capabilities, naval forces will be able to strike static or moving targets so as to defeat any plausible enemy force.

2. Naval shield (defensive operations): it is a concept focused on the protection of resources and national interests at sea through defensive operations. Traditionally, navies maintain vital lines of communication at sea, protect their own offensive forces, detect and intercept ships of hostile intent, participate in mine clearance missions, anti-submarine operations, air defense protection missions by providing sensor carrier platforms and even anti-aircraft weaponry [3].

3. NAVAL STRIKE (OFFENSIVE OPERATIONS)

1. C⁴ISR missions: cover a wide range of missions related to decision-making, as well as data collection, processing and transmission. Many of these missions must be carried out clandestinely, especially in terms of intelligence gathering. The C⁴ISR missions, presented in FIG. 1 that can be executed by the UWS include ensuring communications; carrying out the operational order; electronic attack and counter attack; cyber attack; cyber security; developing and maintaining the operational picture; observation and data collection as well as data processing, exploitation and dissemination. Naval drones play a crucial role in achieving these missions, contributing to informed decision-making, reducing risks for personnel and replacing traditional solutions with modern high-precision technologies.

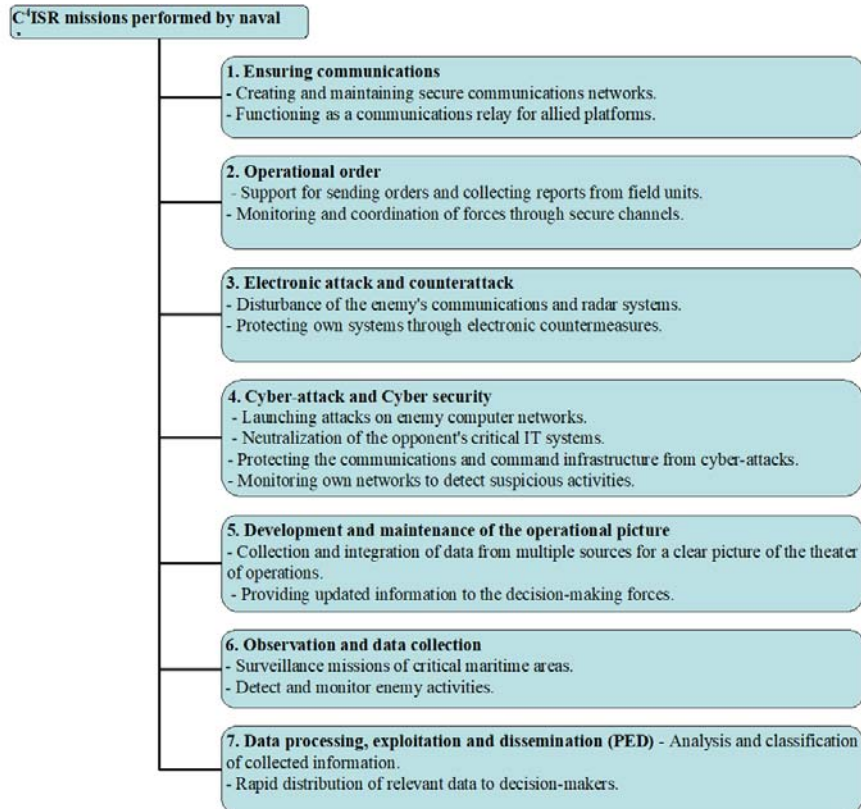


FIG. 1 Possible C4ISR missions that can be performed by naval drones

2. Offensive missions: Naval drones play a crucial role in the execution of offensive missions, being able to use controlled force or support operations involving it. Offensive missions involve the use of controlled force or support for the use of controlled force. These missions, shown in FIG. 2, may include conventional strike, forcible entry into ports and maritime bases, transport of special forces, mine planting and ASW missions. Current systems require a person to be in the decision loop for each of these missions, which requires the provision of communications links. UMSs could be a component in a system dedicated to one of these missions (eg, serving as a platform that houses the sensors for a conventional attack weapon system). One possible mission is to use a UWSV as a "surface torpedo" that hits a target with guidance, or as a blockade that detonates and sinks in a narrow waterway, preventing other ships from passing [6].

4. NAVAL SHIELD (DEFENSE OPERATIONS)

Missions of this type serve to protect the fleet or other key objectives from possible attacks, ASW protection, demining, cloaking and deception measures, defense against terrorist attacks by small boats, anti-submarine missions. In some cases, such as defense against small craft these missions can be performed almost entirely by a UWS. In other cases, such as anti-ship missile defense, a UWV can serve as part of a network, as the platform for detection sensors or an interception system.

It is for this reason that the Navy has begun development of a LCS (Littoral Combat Ship) model, the purpose of which is to secure littoral regions, to protect the Navy from a number of significant asymmetric threats, such as mines, diesel submarines and swarms of small surface ships. LCS is a platform for several types of autonomous systems, namely air, naval, land. This ship type can use different mission-specific modules that can be swapped out as needed [3].

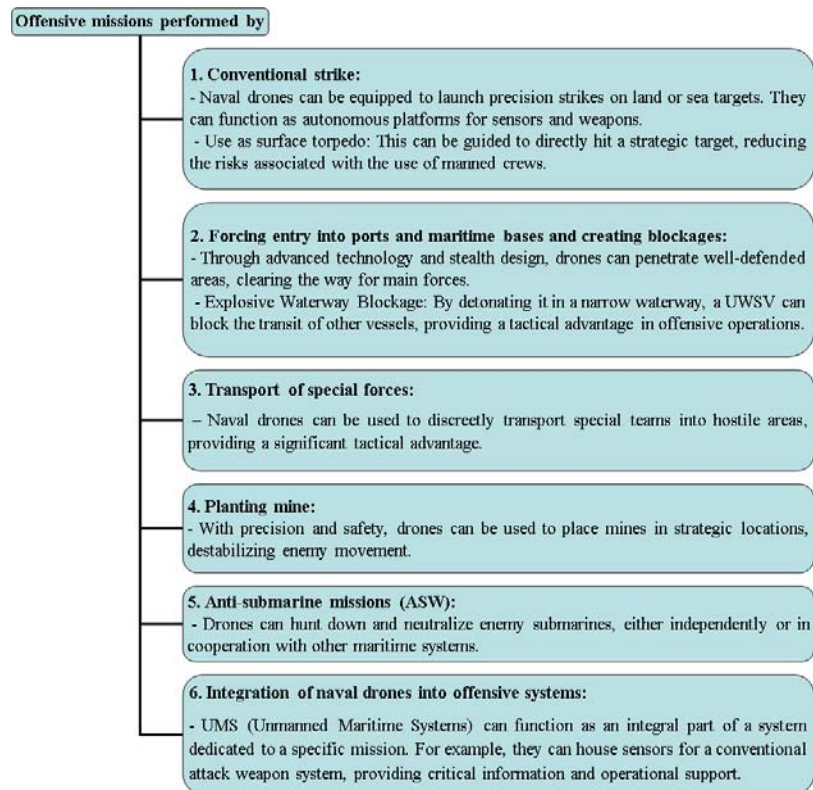


FIG. 2 Possible offensive missions that can be carried out by naval drones

1. Minesweeping: Mines are a major impediment to naval forces, are relatively cheap, can be widely deployed, and are difficult to detect. The methods used today to combat mines are cumbersome, very slow, expensive. One of the modules on the LCS is the UISS (Unmanned Influence Sweep System), and FIG. 3 shows a possibility of its use on an LCS. It consists of an underwater system that uses an acoustic and magnetic signal generator that provides a false signature that triggers the mines. The surface ship during operation will be far enough away not to be damaged by a detonating mine [7].

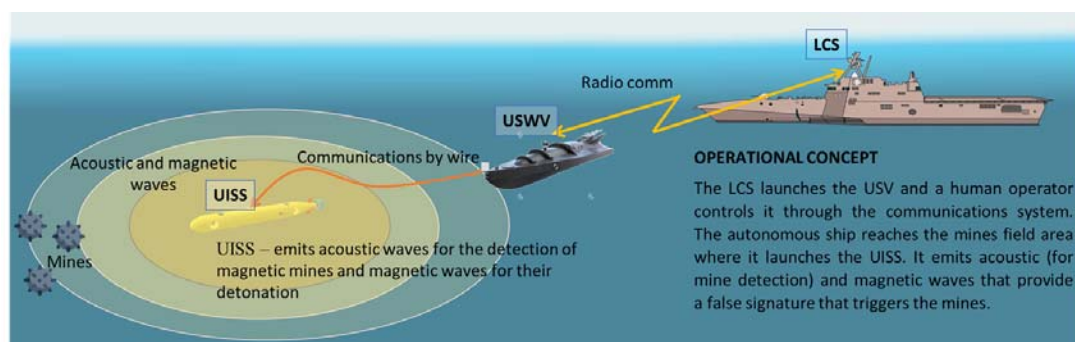


FIG. 3 Using the UISS system in a demining mission [8]

2. Anti-submarine warfare: Modern diesel submarines, while moving slowly near the littoral, are difficult to detect, thus they pose a serious threat to a littoral naval force, requiring increased anti-submarine capabilities. Autonomous systems can play a major role in providing this capability. UUWVs can help detect and combat submarines by deploying and monitoring various sonar sensors, tagging submarines and, if necessary, attacking them, as shown in FIG. 4. USWVs can also play a role platform for sensors such as laser radars, sonar and magnetic anomaly detectors and platforms for anti-submarine grenades.

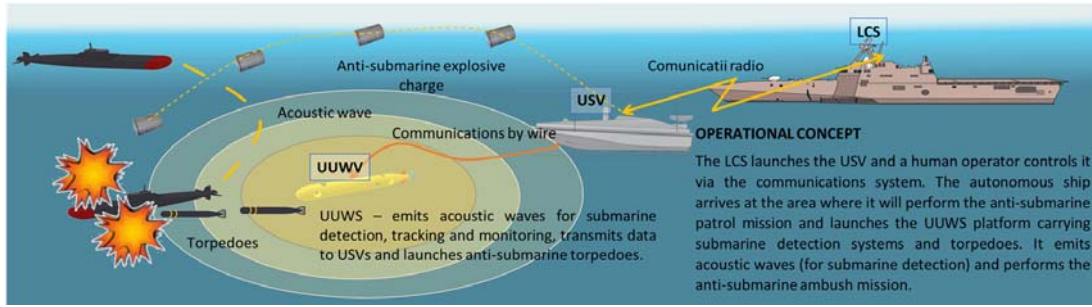


FIG. 4 The use of Naval Autonomous Systems within an anti-submarine mission [8]

3. *Countering Surface Threats:* A serious threat to surface ships in a littoral region today is swarms of small boats, armed or carrying explosives. The severity of the threat is compounded by the potential for very large numbers of boats in the attack area. Potential countermeasures, presented in FIG. 5, include the following:

- Their early detection with autonomous systems using ISR sensors.
- Attacking them with USVs equipped with targeting sensors, autonomous or controlled by a human operator equipped with a rapid-fire weapon system [3].

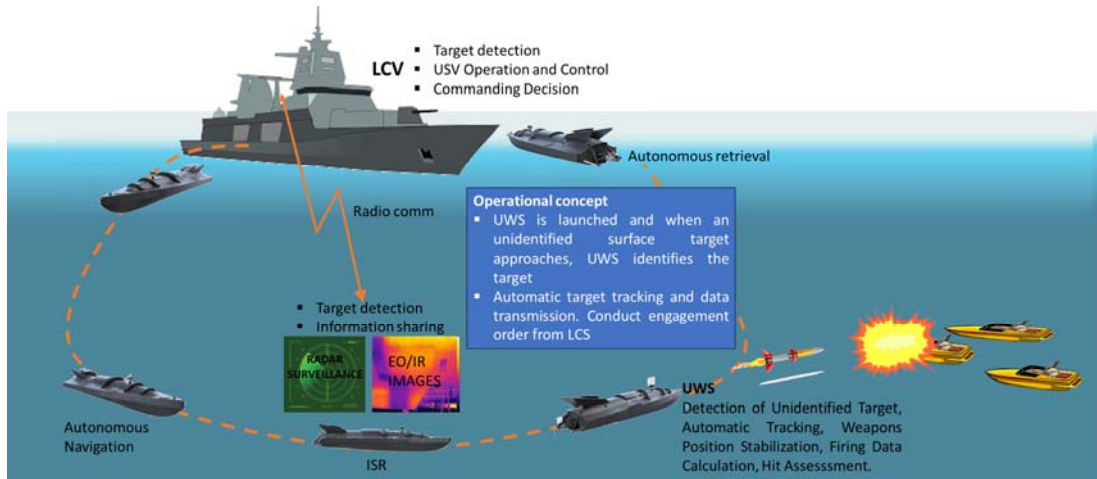


FIG. 5 The use of Naval Autonomous Systems within a mission to combat a swarm of naval drones [9]

At the present time, the possibility of creating a manned ship team - autonomous systems under the MRCV (MultiRole Combat Vessels) concept is being analyzed, presented in FIG. 6. This represents a new generation of military vessels, characterized by versatility, advanced technology and the integration of autonomous systems. These ships are designed to perform a wide variety of missions, from combat operations to humanitarian interventions, and are essential to the modern navy.

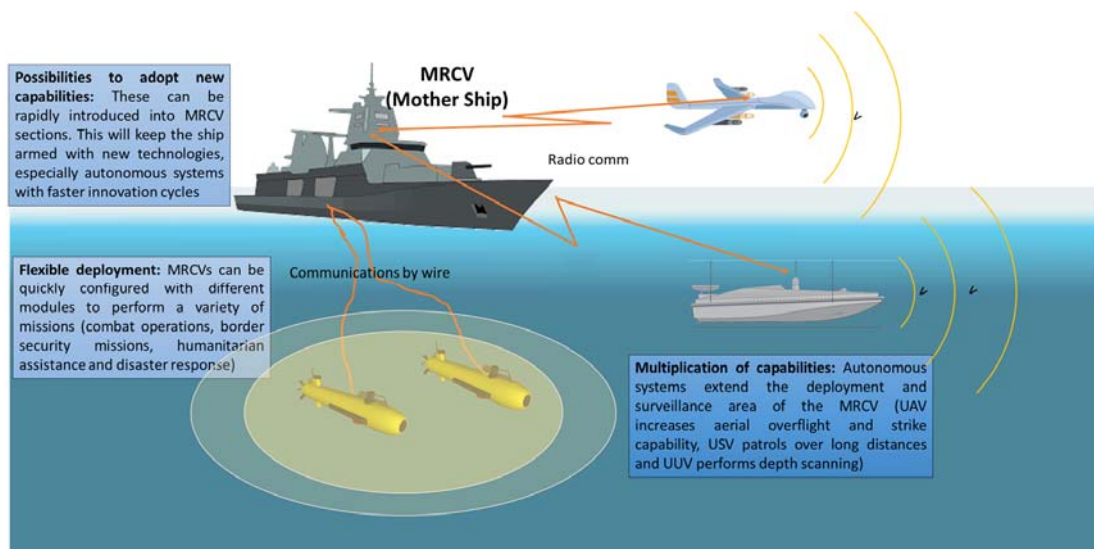


FIG. 6 Possibilities of the MRCV system [10]

CONCLUSIONS

UWSs are an advanced technological solution that redefines naval operations, providing efficiency, safety and flexibility. They are essential for adapting maritime forces to the requirements of modern warfare, contributing decisively to maintaining global maritime security. The use of autonomous naval vehicles presents the following advantages:

Challenges and future directions: Integrating UWSs into existing command structures and addressing cyber security issues are major challenges. The continued development of these systems will fundamentally influence the dynamics of modern warfare.

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