Thales Unmanned Systems for Naval Operations

Advanced solutions for mine countermeasures and maritime surveillance

Neuilly-sur-Seine, 20 October 2010 – Maritime unmanned vehicles provide strategic and operational advantages to Navies and security forces by significantly reducing the cost and human risk of mine countermeasures, as well as by extending the reach of surveillance. The unmanned nature of these systems means that they can be supported by multi-role and less expensive vessels and also that they can keep these vessels out of immediate danger zones, thereby further reducing costs for Navies.

These systems, which can be launched off naval platforms, offer significant protection against major threats including naval mines, piracy and submarine warfare. Several vehicle types fall into the category of maritime unmanned vehicles:

- Unmanned Underwater Vehicles (UUVs)
- Autonomous Underwater Vehicles (AUVs)
- Unmanned Surface Vehicles (USVs)
- Unmanned Aerial Vehicles (UAS)

Thales is working with some of the world’s leading research organisations to design and develop unmanned vehicles. It has been carrying out this research for more than 10 years – founding partnerships with manufacturers of underwater and surface vehicles to develop concrete solutions for these systems of the future.

UUVs and AUVs
(Unmanned Underwater and Autonomous Underwater Vehicles)

Thales innovations in unmanned vehicles have extended to the field of UUVs, which can be pre-programmed, or AUVs, which can make decisions based on the situation they encounter to achieve their pre-programmed missions. Among other purposes, UUVs and AUVs are used in mine countermeasures (MCM) and anti-submarine warfare (ASW), as well as in the protection of harbours.

Key Thales AUV and UUV capabilities

**Navigation**
Thales designs AUV internal navigation systems based on an inertial system associated to a Doppler log. This provides high performance localisation accuracy crucial for mine re-localisation during neutralisation or mine avoidance phases.

**Environmental Data Gathering/Rapid Environmental Assessment**
Thales provides the necessary sensor suites onboard UUVs and AUVs to assess environmental parameters. These either confirm the pre-defined mission plan or allow the systems to build a new optimised plan taking into account real environmental parameters.
Communications

Thales designs AUV underwater communications that can be used within a limited range to ascertain the status of the AUV and its level of performance (self-evaluated onboard the AUV). When the AUV is at the water’s surface, a range of standard means of communication can by used (RF, Wifi, etc).

Underwater communications are by nature very restricted in rate and range, and are not compatible with the transfer of very detailed images from the sonar to the operator, situated on the surface or on land. Thales equips AUVs with decisional onboard capabilities that are crucial for averting the effects of this limited communication. UAS can also help to overcome this obstacle by serving as a communications relay between the mother vessel and AUV.

UAS (Unmanned Aerial Systems)

Thales is involved in large-scale naval aerial drone programmes that encompass the design of UAS used for launch at sea. Thales systems allow these UAS to go ahead of a frigate or fleet and to provide early warning for imminent threats. In addition to carrying out surveillance above water, these systems can also be used as a communications relay between AUVs and the dedicated vessel in MCM and ASW operations.

Mine Countermeasures (MCM)

Thales specialises in developing maritime unmanned systems for use in anti-mine warfare, to detect, locate, classify, identify and eventually neutralise mines. As an anti-mine warfare solutions provider, Thales has been a world leader in the supply of conventional solutions based on hull mounted and towed sonars for MCM vessels. The company is now developing capacities to integrate crucial unmanned elements into new and future solutions for anti-mine warfare.

Anti-mine warfare can be conducted either on military and civil harbours in a domestic context, or to support expeditionary forces on amphibious missions and at choke points. Anti-mine warfare missions are managed on a case-by-case basis. Mines can be detected and classified using acoustical subsystems like sonar. The key factor to achieving such missions is sonar resolution and quality.

Autonomy and endurance set Thales naval drone systems apart. Thales, alongside the French Navy, has developed Synthetic Aperture Sonar (SAS) – a technological breakthrough that is used with AUVs. The SAS boasts system autonomy, meaning it is has the capability to make onboard decisions and as such address the challenge of underwater communications.

Thales’s AUV system autonomy (as demonstrated in the ASEMAR and SACM advanced AUV studies) sets these systems apart from the competition, due in large part to its capacity to re-visit objects of interest that could be classified as mines. The system then relays the information necessary to make a good decision (mine neutralisation, avoidance, etc) back to the operator. This re-visit strategy is made possible by very high-quality sonar images, which
avoid scenarios in which an AUV spends too much time re-visiting an object that is not a target and thereby potentially straying from a real threat.

Examples of Thales MCM Programmes

ASEMAR

Thales was selected in 2007 to lead the development work of a sonar system, as part of the ASEMAR study for the design of a surveillance-based AUV for maritime security operations. This project, signed with the Maritime Cluster initiative in the French region of Brittany, involves two industrial partners (Thales and ECA) and four educational institutions in France. It is part of a series of experiments undertaken in conjunction with the NATO Undersea Research Center (NURC) and the DUBM-44 programme for developing high-level AUV payloads.

Thales is responsible for developing the sonar system, as well as the autonomous decision-making capability and the high-resolution synthetic aperture side-scan sonar offering. These capabilities provide the AUV with an unrivalled performance for detecting and identifying underwater objects at relatively high speeds, which provides a high coverage rate. The cutting-edge sonar system features state-of-the-art imaging and mission autonomy technologies.

The VAMA study

*Autonomous Unmanned Vehicle demonstrators*

Thales is supporting the French Defence Procurement Agency (DGA) in preparing technological and algorithmic building blocks for naval mine countermeasures of the future, particularly in the domain of AUVs.

Since 2007, the company has been involved in autonomous mine hunting programmes such as the VAMA** autonomous anti-mine vehicle prototype developed with Norway, and the Autonomous Unmanned Vehicle Upstream study demonstrator. These projects aim to validate the concept of deploying unmanned vehicles for mine countermeasure operations and to improve the operational control of such systems with onboard real time processing capabilities that offer complex decision-making processes, such as target classification, or mission replanning.

The two demonstrator programmes represent an opportunity for strengthening the long-term partnership between Thales and underwater robotics specialist ECA.

In addition, Thales is striving to improve mine detection and classification algorithms and technologies, particularly those that use new piezoelectric materials. The company will draw on its most recent developments, particularly in the area of synthetic aperture sonars, to conduct this research.

** Véhicule Anti-Mines Autonome
ESPADON

ESPADON is an advanced study programme funded by the French defence procurement agency (DGA) with the aim of minimising risks surrounding certain aspects of the maritime drone-based future anti-mine warfare system.

Thales and DCNS were awarded this major study contract in 2009 for a demonstrator of a new MCM solution. This partnership is the first in the world to evaluate USVs deploying AUVs for full-scale MCM. DCNS, Thales and ECA have put forward a joint solution using USVs in preparation for the expected renewal of MCM systems among many Navies in the coming decades. These vehicles offer the key benefit of keeping crews out of harm’s way. MCM operations have typically been performed by dedicated vessels, known as minehunters, and have exposed crews to considerable danger.

The ESPADON solution comprises a dedicated vessel, two USVs and AUVs. The dedicated vessel remains at a safe distance from the minefield and controls the USVs, which are programmed specifically to operate in minefields. The USVs in turn deploy AUVs. AUVs are smaller and completely autonomous types of sub-sea naval unmanned vehicles that are equipped with sensors and robotic devices necessary for detecting and neutralising naval mines. On completing their mission, the AUVs return to the USVs, which then return to the mother vessel.

As part of ESPADON, Thales leads the USV, MCM outfitting and sensor module, as well as communications between the different components. The sensor module consists of an AUV and a towed sonar for mine detection, identification and location. DCNS, in addition to acting as the lead contractor to the DGA for the overall project, is responsible for the USV platform and interface with the mother vessel. ECA will take charge of the design and development of the AUVs, their launch, as well as the recovery and USV remote control system.

ESPADON will initially consist of testing at sea the launch and recovery from a USV of a towed sonar and AUV. A complete mine warfare mission using an AUV, as well as a towed sonar and neutralisation means stemming from a USV, will then be conducted.

Maritime Surveillance

Thales has been developing unmanned systems that can extend the reach of existing platform sensors into previously denied areas, and that can carry out patrol and surveillance, as well as the protection of defence or civil installations such as harbours.

UUVs and USVs can carry out underwater area patrol around critical infrastructure such as harbours and offshore oil platforms. UAS provide extensive aerial surveillance around both critical infrastructure and fleets, thereby improving their detection range in complement with other systems.
High-Sea Area Surveillance

Unmanned systems, in particular UAS, allow Navies and coastal patrol authorities to carry out more effective maritime surveillance. These systems extend the range of a naval platform’s scope for detecting threats as well as for early warning and identification.

Partnership in VTOLS

Vertical Takeoff and Landing Systems, or VTOLS (for rotorcraft UAS), are becoming a must for future naval UAS programmes, as hostile conditions in theatres of operation sometimes result in a lack of proper landing strips especially at sea. These systems make deck-landing a possibility for rotorcraft UAS, thereby giving these vehicles a wider range of applications.

Thales is at the forefront of such innovation in UAS systems at the European level. In France, the company is supporting a series of comprehensive trials to assess the operational advantages of a VTOLS UAS system.

Thales’s MAGIC ATOLS also helps UAS to take off and land at sea. This high-precision and long-range positioning sensor has a non-intrusive standalone architecture and, together with a UAS GPS-based take-off and landing capability, ensures quick and simple integration into the UAS system.

Thales has answered the DALE (Drone Aérien Léger Émbarqué) RFI submitted by the French Procurement Agency (DGA) for the equipment of frigates positioned in the Indian Ocean as part of an anti-piracy operation.

The French Defence Procurement Agency (DGA) has selected Schiebel’s unmanned aerial system Camcopter S-100 for these trials, which Thales will support. French Army and Navy representatives will conduct these trials, set to take place during the first half of 2010 on various sites representative of land/urban and coastal operations.

Examples of Thales High-Sea Area Surveillance Programmes

D2AD

Thales is leading the technical design study D2AD for the design and demonstration of an automatic take-off, landing and deck landing system for rotorcraft UAS, set to be a vital component of future tactical UAS programmes. Demonstrations will start at the beginning of 2011, when trials are set to take place on French Navy platforms.

DVI

The DGA also selected Thales to conduct a further UAS study as part of its DVI (Drone VTOL Interarmées) programme. The aim of this study is to define a VTOLS UAS system to meet the tactical requirements of both France’s Army and Naval forces. Thales presented Boeing’s Unmanned Little Bird VTOL UAS as the platform for this study and subsequent demonstration phase, which includes deck-landing trials.

As part of the DVI study, Thales teams have worked closely with Army and Navy staff to analyse their operational requirements in preparation for functional definition of the system architecture. The study will also investigate commonalities and opportunities for resource
sharing between the two forces and will lay the foundations for the future French SDT* tactical UAS system programme for French Army forces and the SDAM** UAS system programme for Naval forces.

*Système de Drones Tactiques
**Système de Drones Aériens pour la Marine

Harbour protection

Maritime unmanned vehicles offer crucial protection against naval mines because of their capacity to maintain a permanent presence and to immediately inform the authority of new vessels or objects in a harbour. Naval mines are one of the easiest weapons to deploy, particularly where traffic is heavy. This extremely asymmetric threat, when unchecked, allows adversaries to effectively deny control of vital areas such as ports, anchorages, offshore structures or strategic coastal zones to a militarily superior force. Unmanned vehicles, namely USVs, can also help protect harbours against other threats, including terrorist attacks and illegal trafficking, by providing permanent surveillance of the zone at risk.

SECMAR

*Putting harbour protection into practice*

To face the growing risk of terrorism, France has reinforced protection of strategically important infrastructure such as ports. These measures are in line with international regulations (the International Ship and Port Facility Security Code, ISPS, as well as European directives). In 2006, Thales founded SECMAR, a four-year programme that leverages the company’s expertise in dual civil/military technologies and its proven ability to develop and integrate interoperable mission critical information systems.

The SECMAR project, sponsored by the Pôle Mer Provence-Alpes-Côte d’Azur (PACA) maritime cluster in southern France, aims at developing and delivering an innovative multi-sensor surveillance system to the Port of Marseille to ensure security of goods, people and facilities in this key maritime zone. SECMAR offers a significant opportunity for designing operational systems capable of protecting French ports against so-called asymmetric threats coming from the sea – including divers, suicide missions and illegal trafficking.

The key advantages of SECMAR:

- Merging innovative and legacy above water and underwater sensor or system outputs (Radar, Sonar, EOS - Electro Optical System, AIS – Automatic Identification System, PMS – Port Management Systems, VTS – Vessel Traffic Systems, etc) to reveal previously undetectable surface and underwater elements or events,
- Alerting the operator automatically through the Behavior Analysis Module (BAM), which detects all detected units on a permanent basis for safety and security infractions or for deviating from predefined normal behaviour,
- Paving the way for rapid, accurate and suitable reactions, for instance the use of teams and non-lethal weapons.
SECMAR is a unique collaborative programme between the French Government (DGA), Port of Marseille and military port authorities, industry and research institutions, for enhancing the safety and security of the seaward side of any maritime asset worldwide. The project is currently in the integration phase and the handover to the Port of Marseille’s operational team is set to take place by the end of 2010.

The SECMAR sonar
SECMAR draws on a flat planar array for passive sonar detection as part of the port protection system. To this end, Thales developed specific algorithms to closely track fast moving targets in shallow and noisy environments. This compact sensor (one-square-meter), the SeaObserver, is able to detect and track above water crafts, as well as underwater vehicles. According to identified threats, its passive sonar range (fed by a network of hydrophones, linear and cylindrical arrays, etc) can be complemented by active sonar to provide a complete underwater surveillance capability.

Conclusion

The future of Mine Countermeasures and Maritime Surveillance

Thales is committed to the continuous development of innovative mine countermeasures (MCM) over the long term. The company has so far developed an impressive portfolio of the very latest operational sensors and MCM command and control systems, which have greatly enhanced MCM operational efficiency. The ongoing investment from Thales and its partners will soon see innovative unmanned systems, such as USVs and AUVs, operational in protecting harbours and danger zones from the threat of mines.

Thales is actively engaged in the development of sensor systems and intelligent payloads for various types of surface or aerial unmanned platforms for deployment in maritime surveillance. When equipped with these new generation sensors and communications capabilities, USVs and UAS provide fleets with unrivalled area coverage, allowing them to detect and identify potential threats much sooner than with conventional means. Thales systems, such as VTOLS, allow Navies to make of use UAS on small ships, thereby extending coverage with minimum cost and maintenance, with less personnel, and optimum discretion. UAS also provide a communications relay capability that extends their uses for Navies. Thales, together with its partners, is shaping future protection of high value assets, in particular against asymmetric threats.

As a leader in mine countermeasures and surveillance systems, Thales is committed to designing cutting-edge maritime unmanned vehicles of the future for safer waters and coasts worldwide.
About Thales

Thales is a global technology leader for the Aerospace and Space, Defence, Security and Transportation markets. In 2009, the company generated revenues of 12.9 billion euros with 68,000 employees in 50 countries. With its 25,000 engineers and researchers, Thales has a unique capability to design, develop and deploy equipment, systems and services that meet the most complex security requirements. Thales has an exceptional international footprint, with operations around the world working with customers as local partners, www.thalesgroup.com

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