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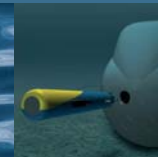
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Saab Underwater Systems 2008-1

AUV 62

A versatile system for autonomous missions



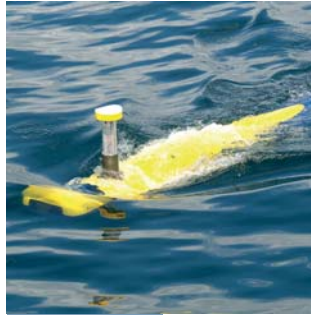
SAAB UNDERWATER SYSTEMS



Saab

Saab develops high technology underwater systems for a wide range of civil and military applications. We supply our products and services nationally and internationally for various areas such as mine detection and neutralisation, direct engagement, maritime security, underwater sensors and unmanned underwater vehicles.

A hundred years of developing and manufacturing underwater systems for such severe acoustic environments as the Baltic Sea have ultimately resulted in the creation of a national centre of excellence at Saab Underwater Systems – a company within the Saab Group.



AUV 62 with the surveillance and communication mast in raised position.

System overview

Designed for autonomous long-term missions, the AUV 62 is the second and latest generation of the highly acclaimed Saab AUV system. Incorporating equipment for mission planning, post-mission analysis and Launch and Recovery, the AUV 62 can easily be adapted for a variety of missions.

For each kind of mission there is a specific system configuration defined primarily by the types of sensors installed in the Payload Module of the AUV 62 vehicle [as shown in brackets below]:

- Mine Reconnaissance [high resolution side-looking sonar]
- General Reconnaissance and Surveillance [high resolution side-looking sonar]
- Seabed Mapping [bathymetric sonar]
- Sub-bottom Mapping [sub-bottom profiler]
- Environmental Monitoring [CTD-sensors, etc]
- Artificial Submarine Acoustic Target [transmitters and transponders]

Only the Payload Module needs to be exchanged when changing from one kind of mission to another. The relevant software for each kind of mission is integrated at the mission planning and post-mission stages. Apart from the system configuration, most of the other system components are the same. Since components are interchangeable between configurations upgrading is smooth and straightforward.



Sonar image of seabed.

Mine Reconnaissance

The AUV 62 vehicle can be adapted to perform mine reconnaissance missions by equipping the payload module with a dual Flank Array Sonar (FAS) together with a high resolution Forward Looking Sonar (FLS) for gap-filling and obstacle avoidance. On-board Synthetic Aperture Processing (SAP) enables rapid evaluation and provides a firm basis for real-time Computer Aided Classification (CAD) using the Post-Mission Analysis system. Images of any Mine-Like Objects (MLOs) detected are regularly transferred back to the launching platform for on-line pre-classification.

Configured with a high performance power source (i.e. Lithium-ion batteries) warranting long endurance, the AUV 62 vehicle is a very cost-effective alternative to conventional mine-hunting vessels. In contrast to traditional mine reconnaissance, missions undertaken by the AUV 62-based mine-hunting system are cost and time efficient thanks to the inherent autonomy characteristics.

Key facts about the AUV 62 System adapted for Mine Reconnaissance:

- Area Coverage Rate: 2 km²/h
- Sonar Resolution: better than 5x5 cm*
- Swath Width: 200 m

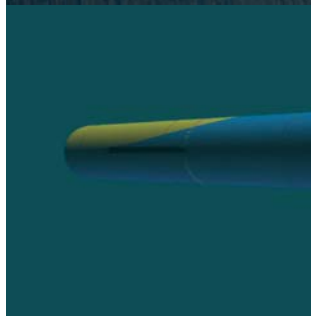
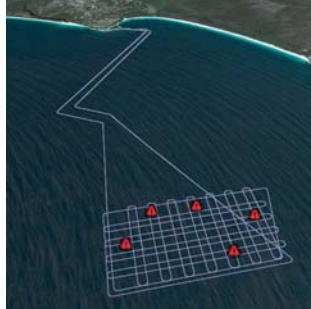
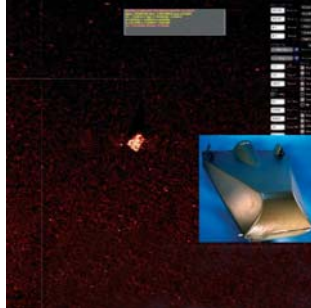
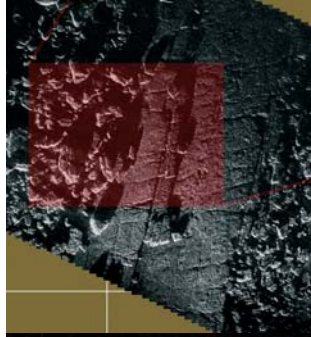
* Range independent within the swath width.

General Reconnaissance and Surveillance

Not only military missions can be undertaken with the AUV 62 using the same high-resolution sonar system for mine reconnaissance. The system is equally suitable for performing more general reconnaissance and surveillance missions, such as searching for small objects and recording their positions as well as generating the corresponding sensor raw data for further action or information purposes.

Artificial Submarine Acoustic Target

The AUV 62 vehicle can easily be adapted to an Artificial Submarine Acoustic Target configuration using a payload module with a noise transmitter and an echo transponder. It can then be used to resemble a true submarine for operator training as well as an onboard Anti Submarine Warfare (ASW) sonar and command system check-up.



Seabed Mapping

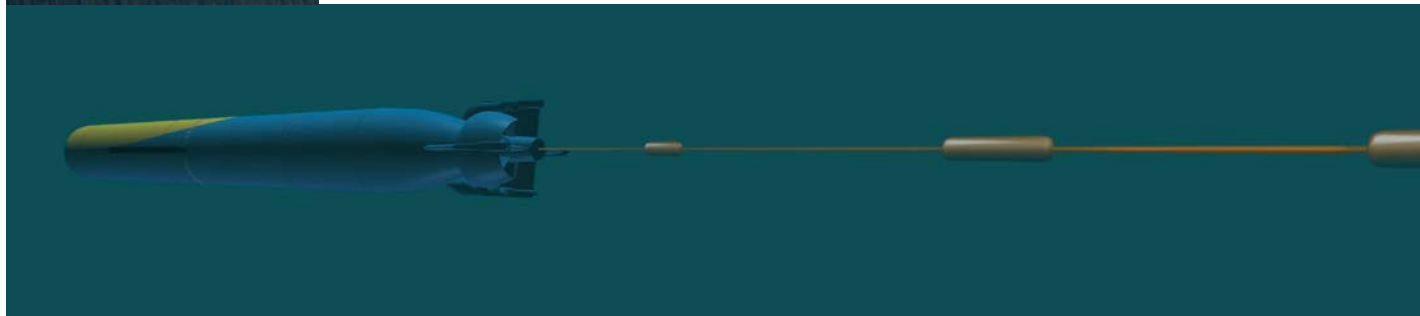
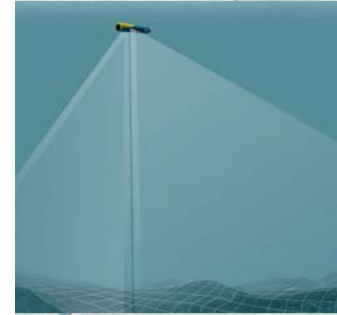
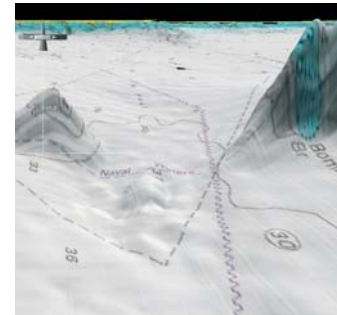
Using a Payload Module equipped with a MBES (Multi Beam Echo Sounder), the seabed profile scanned by the AUV 62 vehicle is continuously recorded during the mission and serves as a basis for subsequent seabed map generation. The accuracy of the mapping data fully complies with IHO standards (International Hydrographic Organization).

Sub-bottom Mapping

By supplying the Payload Module with a Sub-bottom Profiler, the structure of the sediment layers below the seabed can be categorized and documented. The addition of a MBES to the same module enables studying the change of the seabed structure over time, relative to the firm basement.

Environmental Monitoring

The Payload Module for Environmental Monitoring is equipped with a number of different sensors for physical, chemical and biological monitoring of the underwater environment. The AUV 62 System can perform autonomous, long endurance environmental monitoring over large areas without supervision. Physical data such as conductivity, temperature and density are measured as a standard, while sensors for other parameters can be added on request. The sensor for dissolved oxygen, that can be an important indicator for environmentally benign conditions, is one example, while a water sampler for biological monitoring is another.



Mission Planning

Mission Planning and Post-Mission Analysis can be undertaken using the Mission Planning & Analysis Unit (MPAU). The operator performs Mission Planning and the launch of the vehicle, as well as communication during the run and evaluation of the run from this unit.

The Mission Planning & Analysis Unit is initially used for preparation of the AUV 62 vehicle before launch. The vehicle can subsequently be operated either in manual or autonomous mode. In the autonomous mode it is programmed to follow a route of pre-defined waypoints, or adapted for sensor-interaction while operating rule-based to solve a specific task within a pre-defined volume. In addition, a combined mode can be used, meaning that the vehicle itself optimises the route to achieve maximum performance out of the payload depending on the surrounding environment. The vehicle can also be pre-programmed to automatically return and take a closer look at any suspicious objects found by the CAD/CAC-algorithms.

Communication

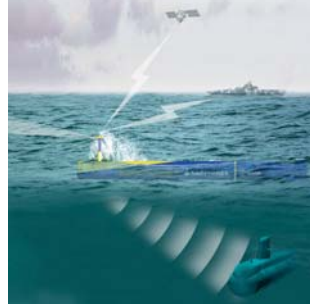
There are different means of communication:

- WLAN is the normal communication method used immediately after launch that allows full manual control of the vehicle as well as real-time transfer of sonar data. The maximum operating range is 500 m.
- When surfacing at longer distances, the standard radio communication link can be used for transferring information - including compressed images - from targets detected during the run. The range is 4-8 km but it can be substantially extended using an optional satellite telephone link,
- Once submerged, the standard acoustic underwater communication link can be used for transferring position and status information from the vehicle, as well as sending short form control data to it. The typical range is 3-5 km but this can be extended to 10-15 km using an optional, more advanced link.
- An optional gateway buoy is also available for relaying radio communication to the standard acoustic link in order to enhance range.



Mission Planning & Analysis Unit (MPAU) with transport case.

Mission Planning HMI.



Launching

The AUV 62 vehicle can be launched from stationary platforms at sea, as well as from surface ships and submarines, or from the shore.

Recovery

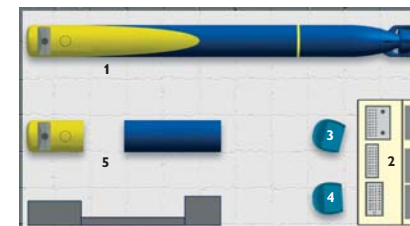
The AUV 62 vehicle is normally recovered in the same way it is launched, i.e. from a stationary platform, surface ship, submarine or shore-based launcher. It can however be recovered by any of these, regardless of how it is launched.

For surface ship recovery, a specially designed docking device retrieves the vehicle in the water and winches it back to the launching chute. When recovered by a submarine, a specially designed ROV – the Subrov – is used to insert the vehicle correctly into the launching tube.

On completion of recovery, the turnaround time to relaunch the vehicle for the next mission is normally 4 hours for a total recharge cycle. Without total recharge, the turnaround time is cut to approximately 30 minutes.

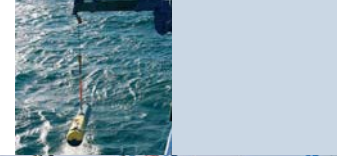
Container System

To meet customer requirements for optimized flexibility in MCM or other operations, the AUV 62 and necessary auxiliary equipment are put into a standard 20-foot container that can be placed on and operated from any craft of opportunity (COOP), e.g. a multi-role vessel or a quay.



Layout of the container

1. AUV 62
2. Console
3. Sonar operator
4. AUV operator
5. Payload Modules



The docking device is reeled in, entering the chute, during recovery.



The AUV 62 System

The AUV 62 System is a complete system, including Integrated Logistic Support package components, configured to achieve cost-effective operation of the system for each kind of mission.



A complete AUV 62 System consists of the following separate components:

- The AUV 62 vehicle (adapted for the mission)
- Mission Planning & Analysis Unit (MPAU)
- Battery Recharging System
- ILS package
- Launch and Recovery System

The AUV 62 vehicle

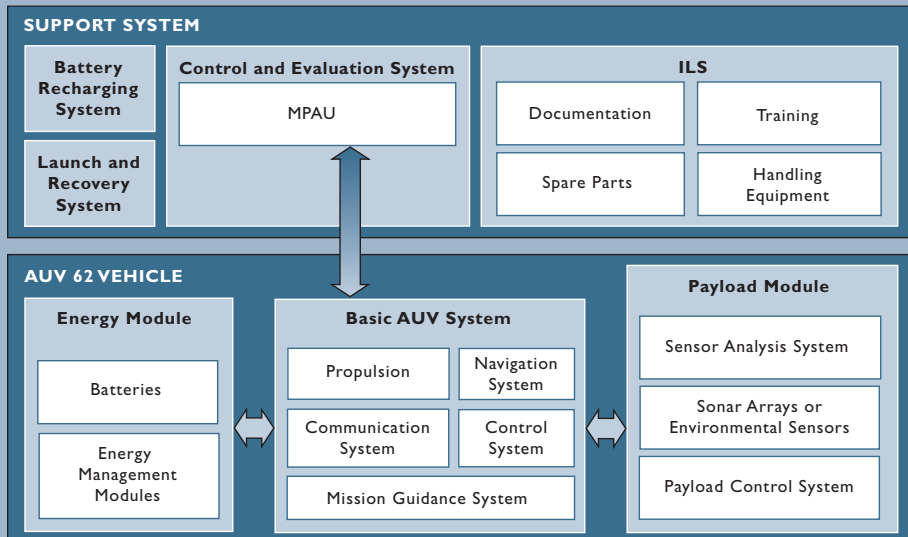
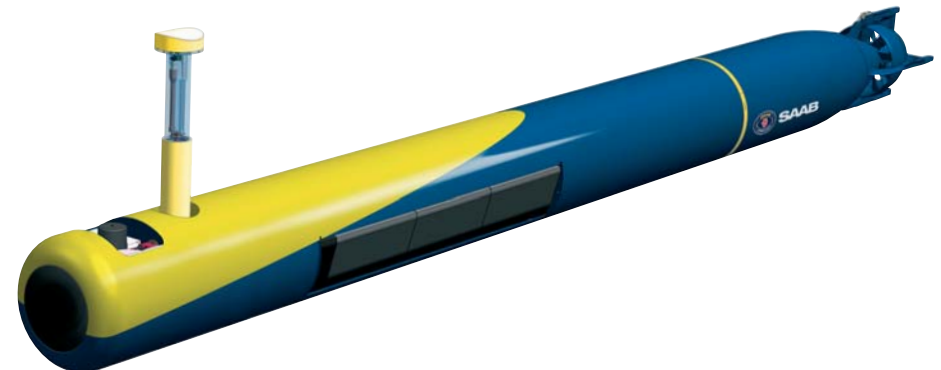
Featuring a modular design that enables easy adaptation to different kinds of missions, the AUV 62 is a cost-effective solution offering maximum flexibility superior to conventional alternatives such as vessels with a hull-mounted or towed sensor.

The Basic Configuration consists of the following sub-systems:

- Propulsion system, together with engine, engine control and vehicle control systems.
- Underwater Acoustic Modem, Sound Velocity Meter and Doppler Velocity Log.
- Retractable mast with antennas for GPS, radio link, WLAN and camera.
- An optional satellite communication link is also available.
- Ballast tanks and pumps for density adjustments.
- A high frequency, short-range Forward Looking Sonar (FLS) used for obstacle avoidance. For Mine Reconnaissance, this sonar is replaced by a more advanced FLS, to achieve gap-filler functionality.

The Energy Module contains the batteries together with the battery charger and control electronics. The number of Li-ion batteries installed can easily be varied depending on the endurance needed for each designated mission. The batteries are rechargeable from outside the vehicle and can be retained in the vehicle during normal transport.

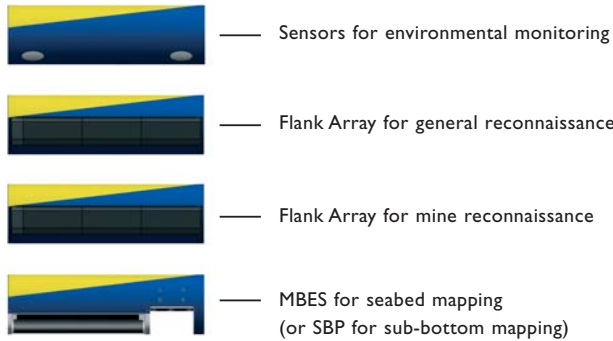
The Payload Module contains Sonar Arrays or Environmental Sensors, together with the corresponding electronics, dependent on configuration. A mirror image of most analysis functions is available in the land-based Mission Planning & Analysis Unit (MPAU) and is also implemented in the vehicle. This also includes Computer Aided Detection and Classification (CAD/CAC), which make use of both simple and more sophisticated methods for sonar image operations in real-time, including background characterization as well as highlight and shadow analysis.



Vehicle configurations

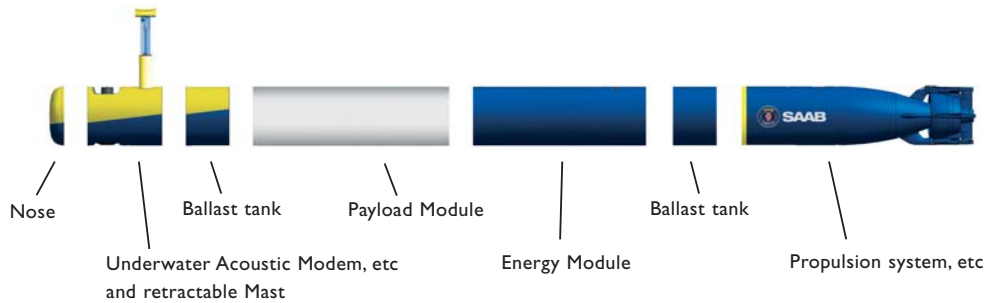
Payload Modules

10 – 11

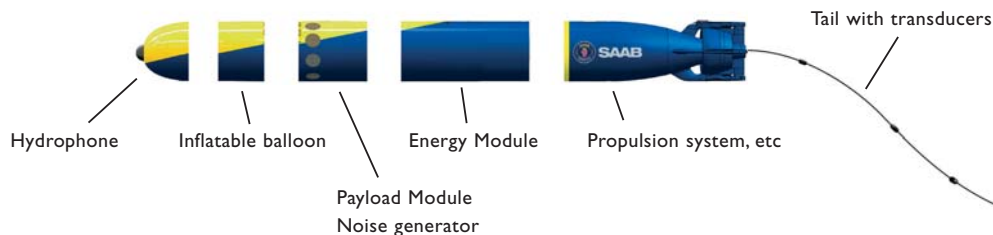


Forward looking sonar

Basic Configuration

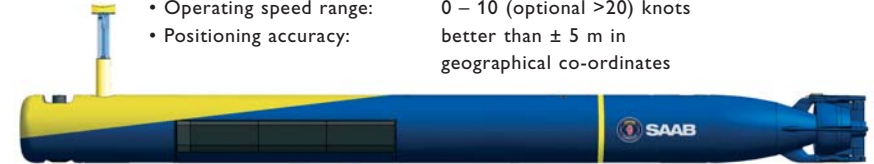


Artificial Submarine Acoustic Target Configuration



Vehicle Characteristics

- Overall length: 3-7 (optional 10) m
- Cylindrical module diameter: 21" (53 cm)
- Total weight in air: 700-1500 kg
- Maximum depth rating: 200 m
- Operating speed range: 0 – 10 (optional >20) knots
- Positioning accuracy: better than ± 5 m in geographical co-ordinates



Post-Mission Analysis

In addition to Mission Planning, Post-Mission Analysis is carried out using dedicated software running on the Mission Planning & Analysis Unit (MPAU). This enables the unit to be used for the transfer of sonar and vehicle data from the AUV after recovery as well as post-mission analysis and presentation of the data. The unit also processes the sonar data transferred during run.

Training

An advanced set of simulation software accompanying the MPAU provides enhanced opportunities for operator training with real or simulated launches of the AUV 62 vehicle. Using the simulator, a complete mission can be set up and performed in real-time, if necessary including generation of live sonar data that can be processed in the same way as in real conditions.

