



KONGSBERG

Autonomous Underwater Vehicle - AUV
The HUGIN Family



The HUGIN Family:

HUGIN 1000 (1000 meter version)

HUGIN 1000 (3000 meter version)

HUGIN 3000

HUGIN 4500

Maximizing performance by providing The Full Picture

Our mission

We shall earn the respect and recognition for our dedication to provide innovative and reliable marine electronics that ensure optimal operation at sea. By utilising and integrating our technology, experience and competencies in positioning, hydroacoustics, communication, control, navigation, simulation, and automation, we aim to give our customers The Full Picture. The Full Picture yields professional solutions and global services that make a difference enabling you to stay ahead of the competition.

Our philosophy

Our success depends on the success of our customers. Actively listening to our customers and truly understanding their needs, and then translating these needs into successful products and solutions is central to achieving our goal.

Our people are the key to our success and we empower them to achieve. Working together in a global network of knowledge, guided by our values, engenders innovation and world class performance. Every day we have to think a little differently, because every client is unique. We aspire to translate the imagination and dedication of our staff into successful technologies and solutions. Our commitment is to add value to your operations by providing you with The Full Picture.

Commercial off the shelf

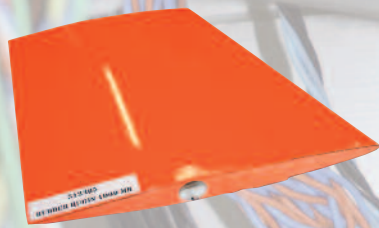
Kongsberg Maritime is one of the major suppliers of high quality marine electronics in the world, with products ranging from cameras for underwater vehicles to triple redundant dynamic positioning systems for oil drilling rigs, sonars and instrumentation systems for scientific research vessels. The products are designed, tested and produced to be reliable over a long time in the tough marine environment.



Kongsberg Maritime designs and manufactures commercial off the shelf (COTS) autonomous underwater vehicles (AUV) and related equipment. The various HUGIN vehicles share the same basic technology. The innovative designs have been refined and improved over the last 15 years. HUGIN AUVs boast exceptional operational experience from both commercial surveys and naval operations. HUGIN operations have taken place in all parts of the world, in shallow water to deep water, in arctic waters and tropical waters. This vast experience is continually drawn upon to improve the quality and robustness of the vehicles, ensuring that customers benefit from the very latest technology developments.

As a COTS manufacturer, Kongsberg Maritime runs a 24 hour on-site support service all year round. Our first priority is to support HUGIN customers and ensure that HUGIN AUVs are always operational. We also offer operational personnel.

Kongsberg Maritime invests heavily in AUV research and our COTS products are continually refined and improved. Cutting edge developments are turned into standardized AUV components and functions and as a COTS customer you are regularly offered system improvements, upgrades and new functionality.



Introduction

The HUGIN Autonomous Underwater Vehicle (AUV) program started early 1990 with a dual civilian and military application strategy. Since 1997 the HUGIN vehicles have been successfully used for civilian applications and from 2001 for military applications. The HUGIN AUVs have been developed jointly by Kongsberg Maritime and the Norwegian Defence Research Establishment (FFI).

For the offshore oil and gas industry the HUGIN 3000 class AUVs have accumulated more than 150.000 km (per 2007) of survey world wide, ranging from shallow water down to 3000 meters. The vehicles run survey missions of up to 2.5 days with all payload sensors (SSS, SBP, MBE and CTD) in operation simultaneously.

The HUGIN AUVs



- Simrad AUV (1987)



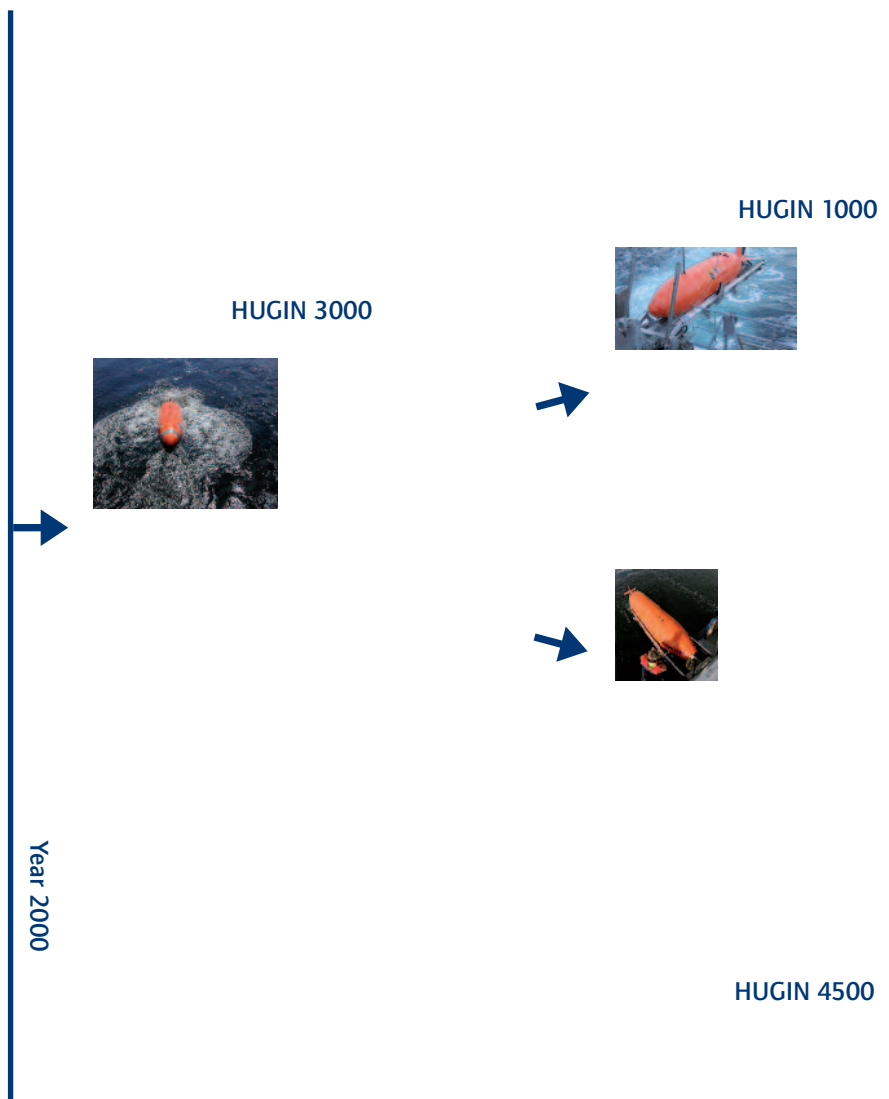
- FFI AUV-Demo (1992)



- HUGIN I (1996)



- NUI Explorer (HUGIN II) (1998)



A long term research program has introduced the HUGIN AUV technology to military applications. In particular, within the HUGIN Mine Reconnaissance Program (HUGIN MRS), FFI, Kongsberg Maritime and The Royal Norwegian Navy (RNoN) have successfully carried out a range of military AUV operations including route surveying, rapid environmental assessment (REA) and mine countermeasure (MCM).

To meet the requirements of various applications, HUGIN AUVs have integrated a wide range of advanced acoustic payload sensors – multibeam echosounders (MBE), sub-bottom profilers (SBP), sidescan sonars (SSS), synthetic aperture sonars (SAS) and fishery research sonars. Equipped with a state of the art integrated inertial navigation system, the HUGIN AUVs provide high quality, high resolution data with excellent position accuracy.

The HUGIN AUVs are equipped with two advanced pressure tolerant battery technologies, namely aluminium oxygen semifuel cell and chargeable lithium polymer, which enable long endurance and high payload power draw.

Additionally, a proven launch and recovery system allows safe and efficient operation in high sea states.



FIELD EXPERIENCE

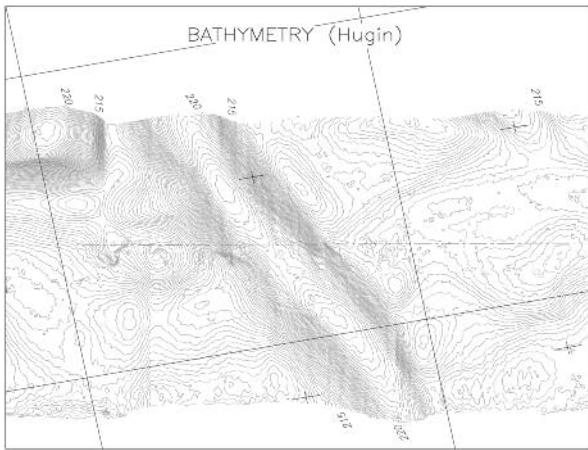
HUGIN AUVs have surveyed most of the major deepwater offshore oil and gas fields world wide. The precise positioning of an exceptional stable payload sensor carrier being operated close to the sea bottom at high speed has revolutionized deep water surveying with respect to survey efficiency and data quality. Based on high quality HUGIN data, significant higher precision and cost savings are obtained in the engineering of major subsea developments in deep water and rough terrain.

Field operations have taken place world wide from arctic to tropical areas. More than three times around the equator in line kilometres of commercial work was already accumulated by 2006.

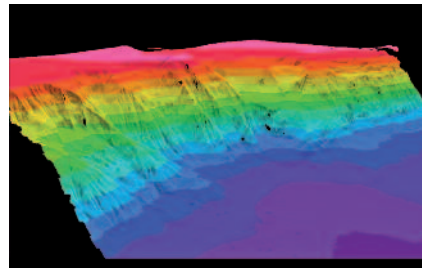
The application of the HUGIN AUV in naval applications for mine counter measures (MCM) and rapid environment assessment (REA) has introduced a new performance level of efficiency and safety. The high resolution data from the synthetic aperture sonar (HSAS) operated close to the sea bottom significantly improves object detection and classification performances. Additionally, operating the HUGIN AUV autonomously and at a remote distance provides a high level of safety for the mother-vessel and its personnel.

The opposite page shows some historical examples from HUGIN field data.

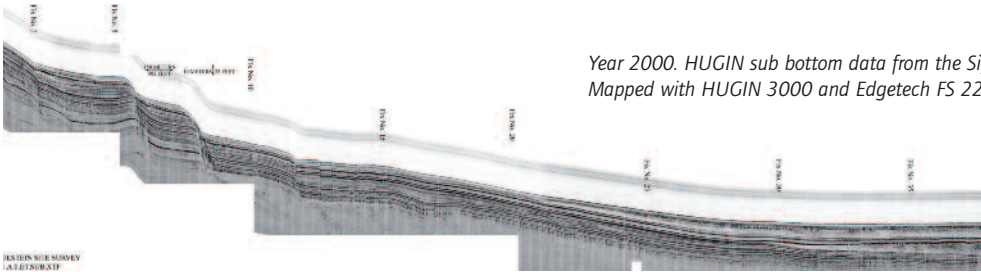




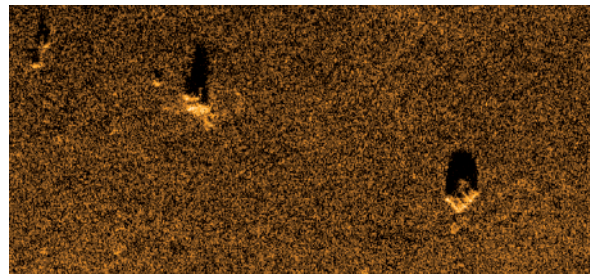
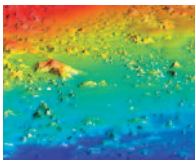
Year 1997. An important milestone: The first commercial survey operation with the HUGIN I AUV for the Åsgard Gas Transport Pipeline Route. The survey confirmed the expected improvements in efficiency and data quality by the use of AUV. Mapped with the EM 3000 multibeam echosounder.



Year 2000. HUGIN bathymetry data from the Sigsbee Escarpment, GOM. Mapped with HUGIN 3000 and EM 2000 multibeam echosounder. C&C Technology Inc.



Year 2000. HUGIN sub bottom data from the Sigsbee Escarpment, GOM. Mapped with HUGIN 3000 and Edgetech FS 2200 SBP. C&C Technology Inc.



Year 2006. HUGIN sea bottom SAS imagery data. Surveyed with HUGIN 1000 and the HISAS 1030 SAS sonar.

Year 2002. HUGIN bathymetry from the Ormen Lange field. Mapped with HUGIN II and EM 3000 multibeam echosounder. NUI AS.

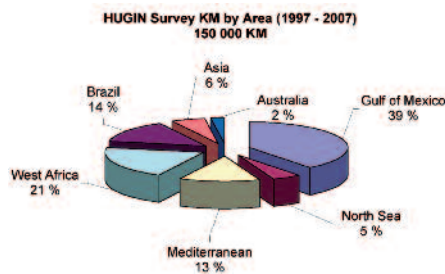


Figure: HUGIN has surveyed most large offshore oil and gas fields around the world (line km by area accumulated up to 2007)



THE HUGIN FAMILY

Today the HUGIN Family of AUVs constitutes three basic models:

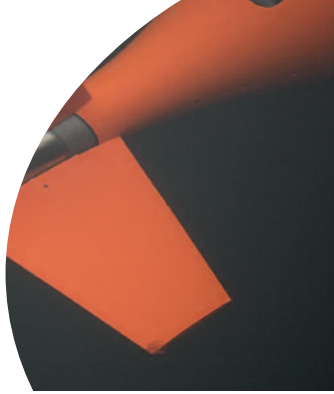
- HUGIN 1000 (1000 and 3000 meter depth versions)
- HUGIN 3000
- HUGIN 4500

HUGIN AUVs build on a common and well proven technology base. This is especially true for the navigation, control, payload, communication, propulsion and emergency systems. The main vehicle differences are size, battery technology and endurance, and payload sensor configuration. The larger the vehicle, the more comprehensive and capable sensor suite can be fitted.

Since the first commercial operation in 1997, HUGIN AUVs have found application within:

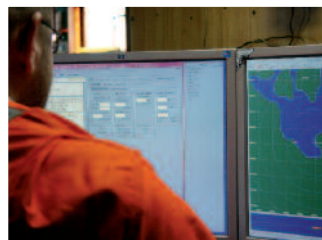
- Offshore surveying for the oil and gas industry
- Naval MCM and REA operations
- Marine research
- Hydrography





Important highlights for the HUGIN vehicles are:

- Commercial field work since 1997
- > 150 000 km of commercial survey (2007)
- Autonomous, semi-autonomous and supervised operational modes
- DVL aided INS system with a toolbox of position aiding techniques
- Flexible payload system
- Pressure tolerant power sources for up to 60 hours operation at four knots with extensive payload suite.
- Safe launch and recovery system for use up to sea state 5



HUGIN 1000

HUGIN 1000 is 75 cm in diameter and is available with 1000 m and 3000 m depth ratings. HUGIN 1000 is built with a three module structure – standardized aft and front sections and one or two modular midsections. The midsection(s) can be configured with a wide range of payload sensors like sidescan sonar, synthetic aperture sonar, multibeam echo sounder, sub-bottom profiler, fishery sonar, laser plankton counter, etc.

The power source is a pressure tolerant lithium polymer battery providing an endurance of approximately 24 hours at four knots (speed and payload configuration dependent). The HUGIN 1000 battery is designed to be air freightable and the vehicle can be delivered with special containers for convenient transportation and mobilization.



HUGIN 3000

HUGIN 3000 is the offshore AUV workhorse with 1 m diameter and 3000 m depth rating. Major survey companies use HUGIN 3000 for detailed seabed mapping for offshore oil and gas companies.

HUGIN 3000 is powered by a novel semi fuel cell battery providing more than 60 hours endurance at four knots speed with multibeam echo sounder, sidescan sonar, sub-bottom profiler and CTD running. The long endurance allows higher operational efficiency, as well as reduced number of recoveries and thus reduced operational risk.

Important features of HUGIN 3000 include unparalleled navigation accuracy, flexibility in payload sensors and a robust and reliable launch and recovery system for use up to sea state 5.



HUGIN 4500

HUGIN 4500 has 1 m diameter and 4500 meter depth rating.

HUGIN 4500 is longer than HUGIN 3000. It is powered by a larger version of the semi fuel cell battery, providing 30% increase in battery capacity compared to HUGIN 3000. The increased size and battery capacity allows HUGIN 4500 to be equipped with even more capable payload sensors, such as higher resolution sub-bottom profiler and sidescan sonar systems.





DESIGN PHILOSOPHY

The HUGIN development has focused on both civilian and naval applications.

The strategy has been to:

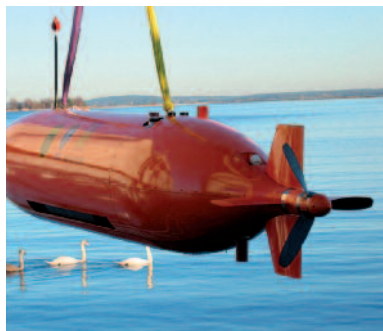
- Develop common technology for civilian and military markets
- Gain invaluable first hand and extensive field experience through civilian offshore operations
- Run military research and demonstration programs to meet naval requirements
- Rapid industrialization of leading edge technology into civilian and military markets

HUGIN design goals have been:

- Maximum data quality
- High operational efficiency
- Robustness and operational reliability
- Complete AUV concepts for civilian and military applications

Maximum data quality is obtained by operating advanced payload sensors from a very stable and low noise platform close to the sea bottom. Integration of simultaneously working acoustic sensors is a key expertise in the HUGIN team. All sensor data is accurately time stamped. The payload data is georeferenced with accurate position and attitude data from the HUGIN aided inertial navigation system. Optimal navigation post-processing using the NavLab package provides unparalleled positioning accuracy.

Contributing factors to the *high operational efficiency* are the robust and efficient launch and recovery system, the ability to fly at constant altitude above the sea bottom, even in rough terrain, advanced payload sensors that allow for high area

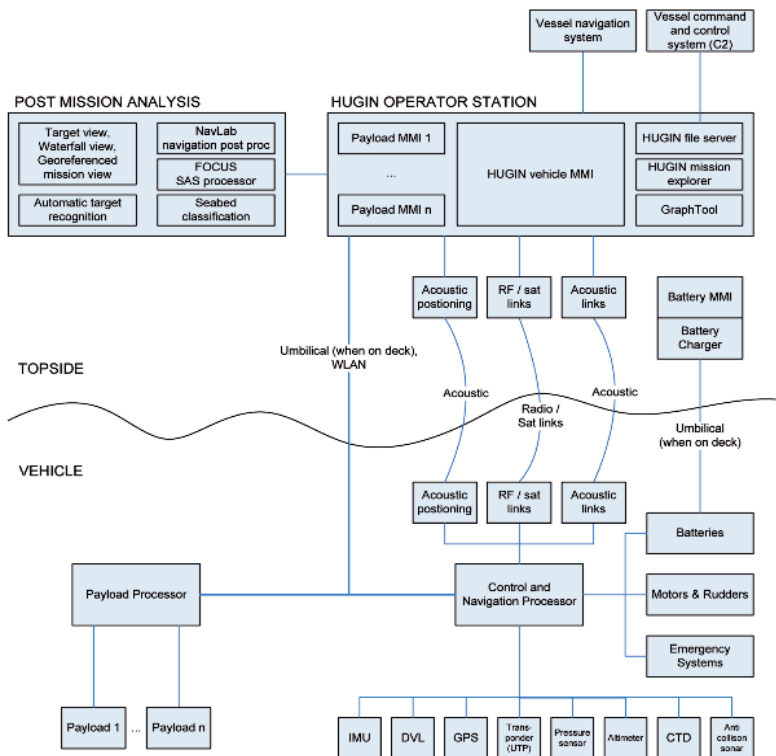




coverage rates (the HISAS 1030 is an extreme example of a sensor that provides high accuracy and high area coverage rate), high battery capacity and long endurance with short charging time (especially the case for the semi fuel cell battery).

Robustness and operational reliability is obtained by ruggedized vehicle design, well proven launch and recovery system for open rough sea, built in redundancy and comprehensive error handling and emergency systems. Robustness and reliability is continuously improved through the immense operational experience with the HUGIN vehicles.

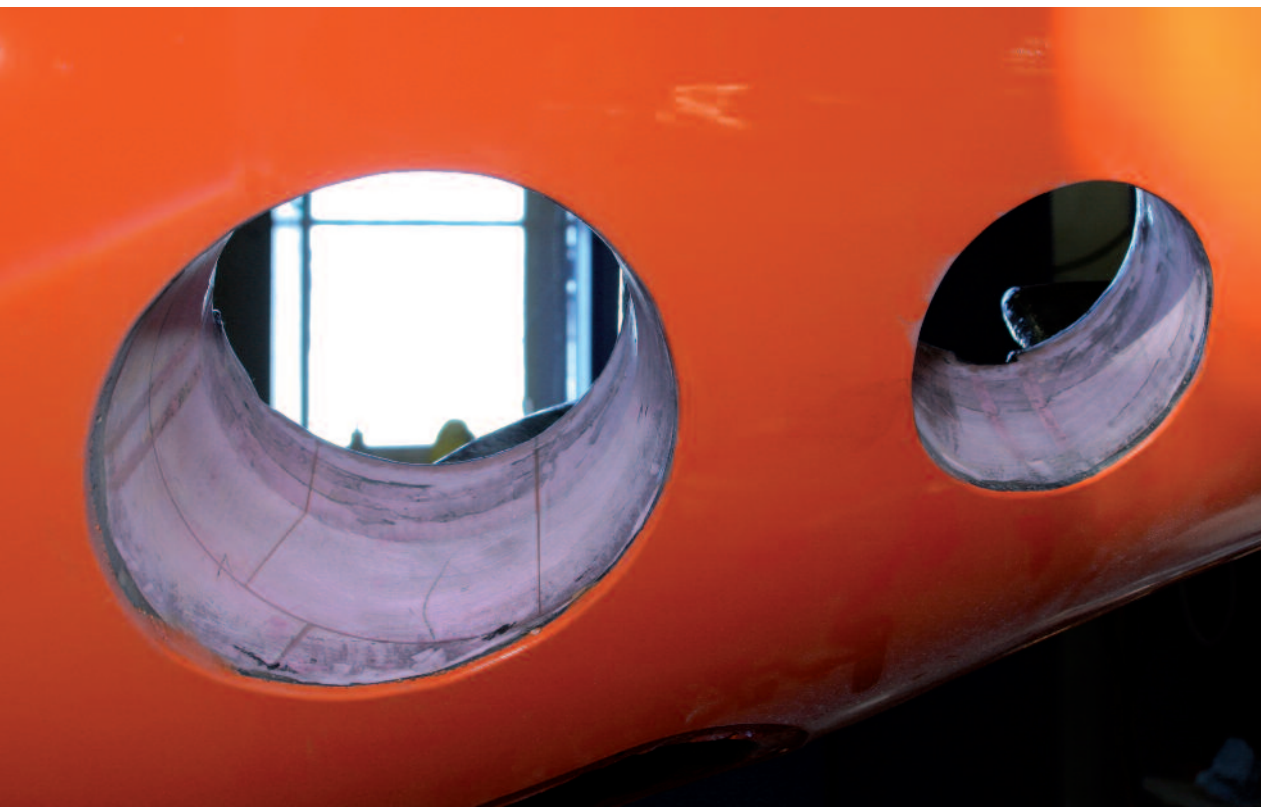
HUGIN AUVs are a complete surveying concept covering a wide range of payload systems (SSS, SAS, SBP, MBE, CTD, etc) with flexibility in configuration, pre-survey calibration/qualification procedures, data synchronization and storage, real time data monitoring, position tracking, sensor and position data post-filtering and payload sensor data post-processing.



MECHANICAL

The HUGIN AUVs body shape is designed for low water drag, combining minimum water resistance with high hydrodynamic stability, high manoeuvrability and low acoustic noise.

- The vehicle body is made from carbon fibre laminate material and syntactic foam.
- The vehicle body is extremely stiff, which ensures constant orientation between payload sensors and the navigation system. HUGIN has steering pins for accurate and repeated mounting of navigation sensors and payload sensors. These features ensure accurate seabed mapping.
- The pressure containers are made either from titanium or sea-water resistant aluminium depending upon depth requirements.
- The propulsion motor is designed for direct drive low speed and high efficiency. The large blade propeller is optimized for high electrical to hydrodynamic efficiency and low acoustic noise.
- HUGIN AUVs have a modular construction. The HUGIN 1000 is made up of three to four main sections making it easier to adapt the vehicle to different payloads and battery configurations. HUGIN 3000 and HUGIN 4500 have a versatile payload bay for easy integration of payload sensors.



BATTERY SYSTEMS

The HUGIN power sources are based on two different pressure tolerant battery designs. Pressure tolerant batteries eliminate the need for pressure containers and thus the inherent risk for explosions due to battery hazards. Especially in deeper waters, the pressure tolerant designs allow for higher battery energy and endurance.



The two battery technologies in use for HUGIN AUVs are:

- Lithium Polymer Battery

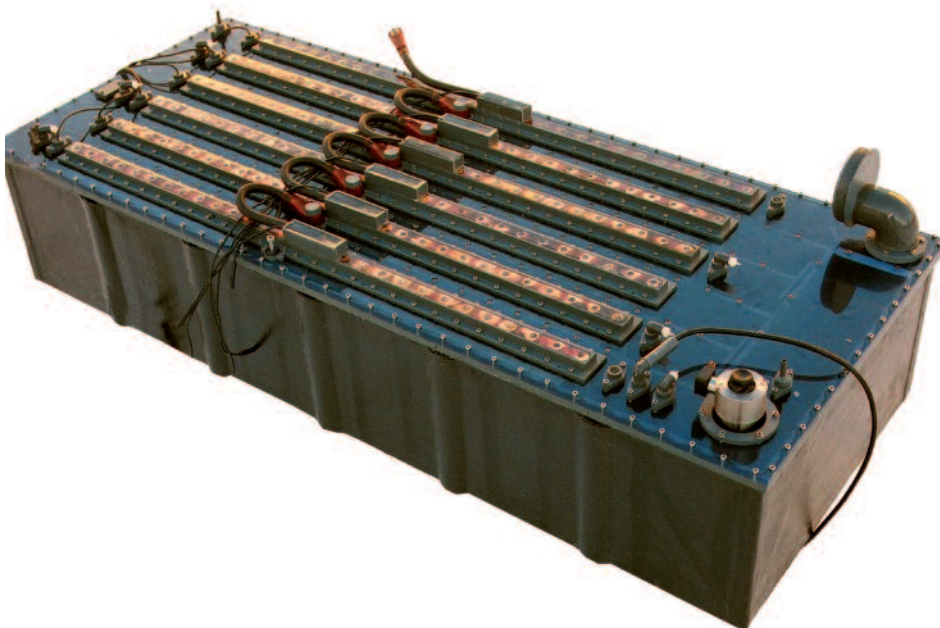
The lithium ion polymer battery is electrical rechargeable and pressure tolerant. The battery is built up by commercial poached cell batteries gathered in battery blocks that are assembled into complete batteries for the HUGIN AUVs.

Significant built in safety systems are implemented to avoid any hazards related to overcharging, discharging, and use in general.

The battery blocks are designed and qualified for air transport according to UN regulations for air transport of hazardous material.

- Aluminium Oxygen Semi Fuel Cell (ALHP FC battery)

The ALHP FC is a unique energy source that produces electrical power from aluminium and oxygen. No other power source can drive an AUV like the HUGIN 3000 with all payload systems running for 60 hours at 4 knots. The ALHP FC is developed by FFI (the Norwegian Defence Research Establishment) and Kongsberg Maritime and is only available for the HUGIN AUVs.



CONTROL AND COMMUNICATION

HUGIN AUVs can operate in three modes:

- Supervised mode
Provides operator supervision, ability to reprogram a mission and unmatched position accuracy through USBL position updates.
- Autonomous mode
HUGIN operates autonomously and independent of a support ship.
- Semi-autonomous mode
Combines supervised and autonomous mode of operation.

The highly robust and precise vehicle control and navigation systems build on the many years of field experience with HUGIN AUVs in rough offshore environments and in demanding military operations. Operational sustainability is obtained through:

- Robust design
- System redundancy
- Built-in integrity control
- Extensive pre-mission hardware-in-the-loop testing and simulation.

The HUGIN communication system consists of an internal Ethernet network directly connected to the surface control system when on deck. While in operation the vehicle can be controlled acoustically, via radio or WLAN link, or by Iridium satellite communication.





NAVIGATION

AIDED INERTIAL NAVIGATION

HUGIN is equipped with an advanced real-time aided inertial navigation system (AINS), the HUGIN NavP system. The inertial navigation system (INS) calculates position, velocity and attitude of the vehicle using acceleration and angular rate data from an inertial measurement unit (IMU). A Kalman filter utilises, in a mathematical optimal manner, the vehicle navigation sensors for aiding the INS. The Kalman filter is based on an error-state model and provides a much higher total navigation performance than that obtained by the independent navigation sensors. The structure of the aided inertial navigation system is shown in Figure 1.

Though the Doppler velocity log is very efficient in limiting the error drift, regular position updates are necessary to bind the position error drift in the navigation system. When the AUV is operating close to the mother ship (supervised mode), the AINS regularly receives combined GPS-USBL measurements from the mother ship on the acoustic command link.

In autonomous mode, GPS provides position measurements when the AUV is in the surface.

In some AUV applications, GPS surface fixes are not an option, due to covertness, or efficiency in deep water missions. HUGIN is optionally delivered with a terrain referenced navigation system for submerged position updates. The terrain navigation system compares bathymetric measurements with an a priori map.

Submerged, position updates can also be obtained by range measurements to one or more underwater transponders. This function is called NavP UTP (underwater transponder positioning) and works similar to a long baseline (LBL) system, except that no more than one underwater transponder is required to find position error draft. Any number of transponder ranges is optimally utilized and more than one transponder range provides increased accuracy and integrity.

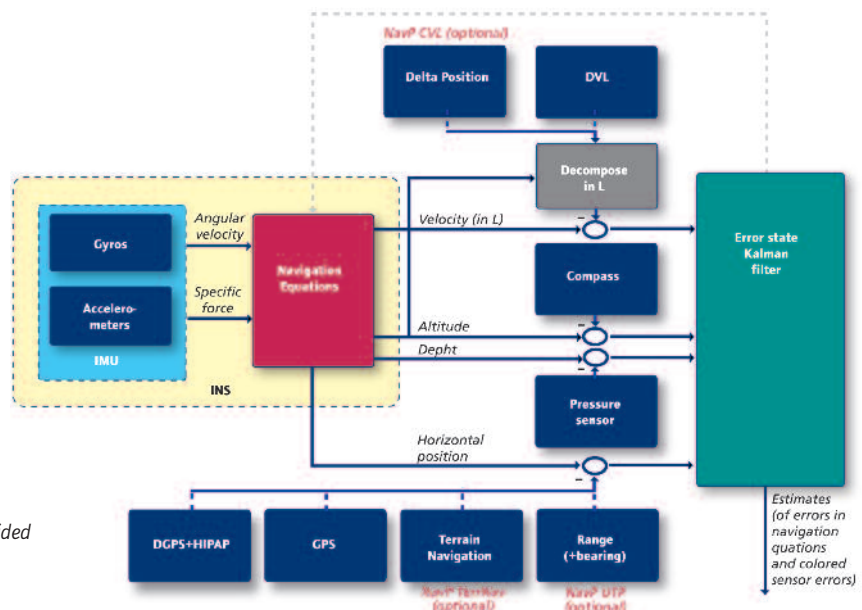


Figure 1. Structure of the HUGIN aided inertial navigation system

NavLab

Whilst the Kalman filter in the HUGIN navigation system is the optimal real-time estimator, for post-processing the best algorithm is Optimal Smoothing, which also utilises 'future' measurements. Optimal Smoothing is implemented in the NavLab package. The smoothed estimate of position, attitude and velocity has several important advantages compared to the real-time solution:

- The navigation result is more accurate. An example in case of 2 hours without position measurement is shown in the figure to the right. Also in supervised mode, where position measurements are continuously available, the position accuracy improves significantly.
- In cases of sensor degradation or failure, accurate navigation can often be obtained (no need for a new mission). This is due to the increased robustness of the smoothing;
- The navigation results have maximum reliability (critical sensor errors are detected).
- For autonomous missions NavLab post-processing reduces the number of required GPS surface fixes and adds robustness in meeting the accuracy specification.

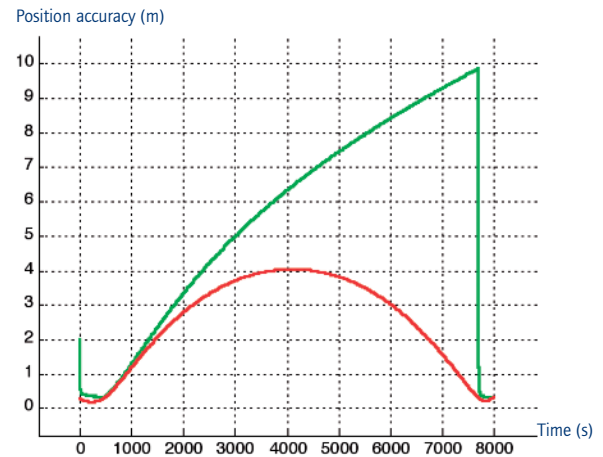


Figure 2

ACCURACY

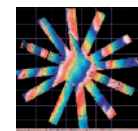
Generally, navigation accuracy is dependent on IMU accuracy, DVL accuracy and mission plan pattern (trajectory). For instance a lawnmower pattern is effective in cancelling out slowly varying errors in velocity and heading. Accuracy of the position updates is also of importance. HUGIN can be tailored with required IMU, DVL and position measurement systems. In Table 1, typical navigation accuracies are shown.

Scenario	Navigation error (1σ)	
	Real time	Post-processed
No position updates, straight line	0.25% of distance travelled	<0.25% of distance travelled
No position updates, lawnmower pattern	0.025% of distance travelled	<0.025% of distance travelled
Regular pos updates from HiPAP USBL (option)	2 m (200 m water depth)	1 m (200 m water depth)
NavP UTP (option)	5 m	2 m
Terrain referenced navigation (option)	10 m	5 m

Table 1
Typical navigation accuracy

For a seabed mapping vehicle, accurate positioning of the final digital terrain model (DTM) is essential, and estimates the vehicle's 6 degrees of freedom (position and attitude) are used to position the bathymetric data.

In 2000/2001, HUGIN 3000 demonstrated high deep water navigation accuracies in the Gulf of Mexico. HUGIN run above a well head in a 'wagon wheel' pattern. By comparing the well head observations in the multibeam echo sounder data from each passing, the global accuracy of the DTM was estimated as shown in shown in Table 3.



AUV depth	DTM accuracy
1300 m	2.0 m (1σ)
2100 m	4.0m (1σ)

Since then, HUGIN positioning accuracy has been verified numerous times.

Table 2
Accuracy of digital terrain models (DTM) made by HUGIN data.



PAYLOAD SYSTEM

SUBSEA PAYLOAD SYSTEM

Payloads can be integrated by Kongsberg Maritime, the customer or a third party vendor.

The payload system is built around the Payload Processor. The Payload Processor kernel provides basic services such as time synchronization, geo-referencing of payload data, centralised data storage, and interfacing with the HUGIN Control Processor and navigation system. To integrate a new payload, all that has to be done in terms of software, is to create a new driver (plug-in). The communication between topside Payload Operator Station and the payload plug-in is generic, i.e. new payloads can be added without the need to change any basic system software.

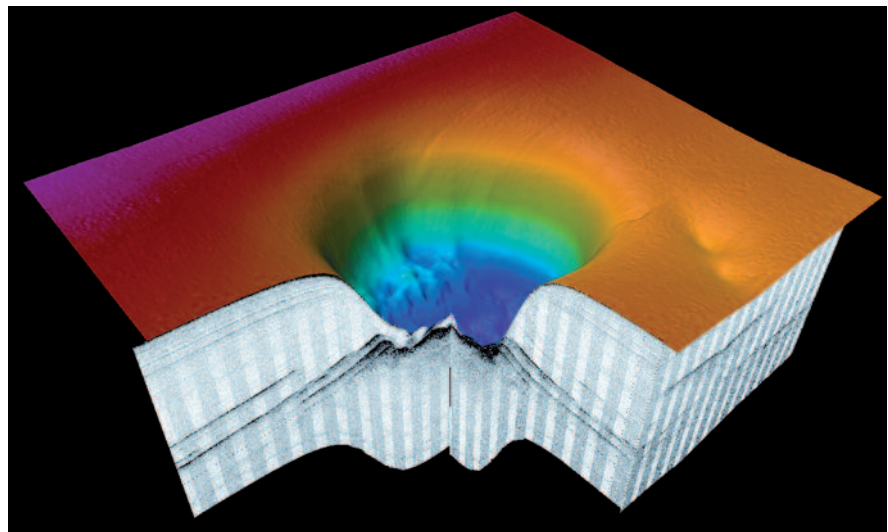


HUGIN 3000 and HUGIN 4500 have a versatile payload bay for easy mechanic integration of payload sensors. HUGIN 1000 can accommodate different midsections for various payloads. Standard offered signal interfacing for payloads includes Ethernet and RS-232 and RS-422 serial lines.

A standard HUGIN payload suite includes:

- Multibeam echosounder
- Sidescan or synthetic aperture sonar
- Sub-bottom profiler
- Conductivity temperature density (CTD)
- Turbidity sensor
- Acoustic Doppler current profiler (ADCP)

As discussed above, it is easy to integrate payload sensors for specific applications. For instance for fishery research, HUGIN has been equipped with fishery echo sounder and laser optical plankton counter.



Overlay of MBE and SBP data.

TOPSIDE PAYLOAD SYSTEM

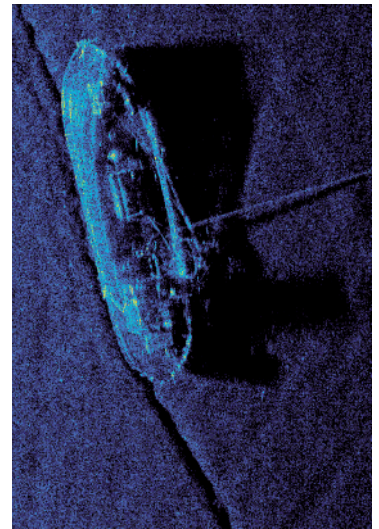
The topside payload system allows the operator to initialise the payload sensors prior to mission and to operate and supervise the sensors during the survey. In supervised mode, compressed payload sensor data is transmitted acoustically from the vehicle in real time for operator supervision and data quality assurance.

Most payload sensors come with a dedicated Payload Operator Station (POS).

A typical POS includes:

- Graphic user interface (GUI) for sending commands to the payload
- GUI elements for displaying errors, events and command responses from the payload plug-in
- Display of payload state information

Similar to the subsea payload system, there is a generic architecture for easy integration of new POSes with the HUGIN operator station.

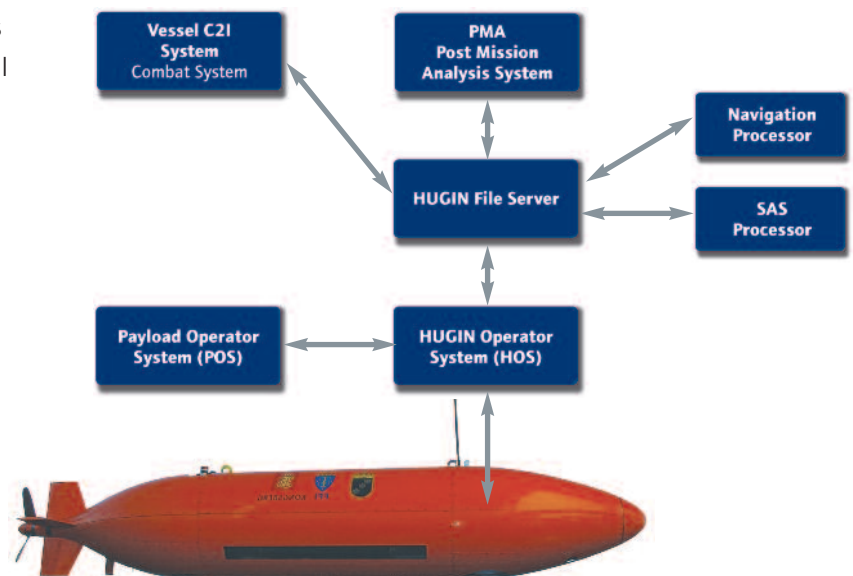


POST-MISSION ANALYSIS

The HUGIN vehicle generates a large amount of data that can be processed in various ways dependent on user requirements. Some users have custom payload processing software. For other users, Kongsberg Maritime offers the HUGIN post-mission analysis system (PMA). The PMA software suite provides a wide range of options, essentially covering:

- Navigation post-processing for increased position accuracy (NavLab)
- Bathymetric processing, quality control, mosaicing, layering to charts, 3D view generation
- Sidescan sonar processing
- Synthetic aperture sonar processing
- Automatic target recognition and other specialized functions for naval mine counter measures and rapid environmental assessment applications

The figure illustrates the PMA system and its environment. The HUGIN file Server stores all relevant data, raw and processed, in standardised file formats and makes data available to authorised users through standardised file transfer protocols. This makes integration with, for instance, a naval command and data handling system simple and straightforward.



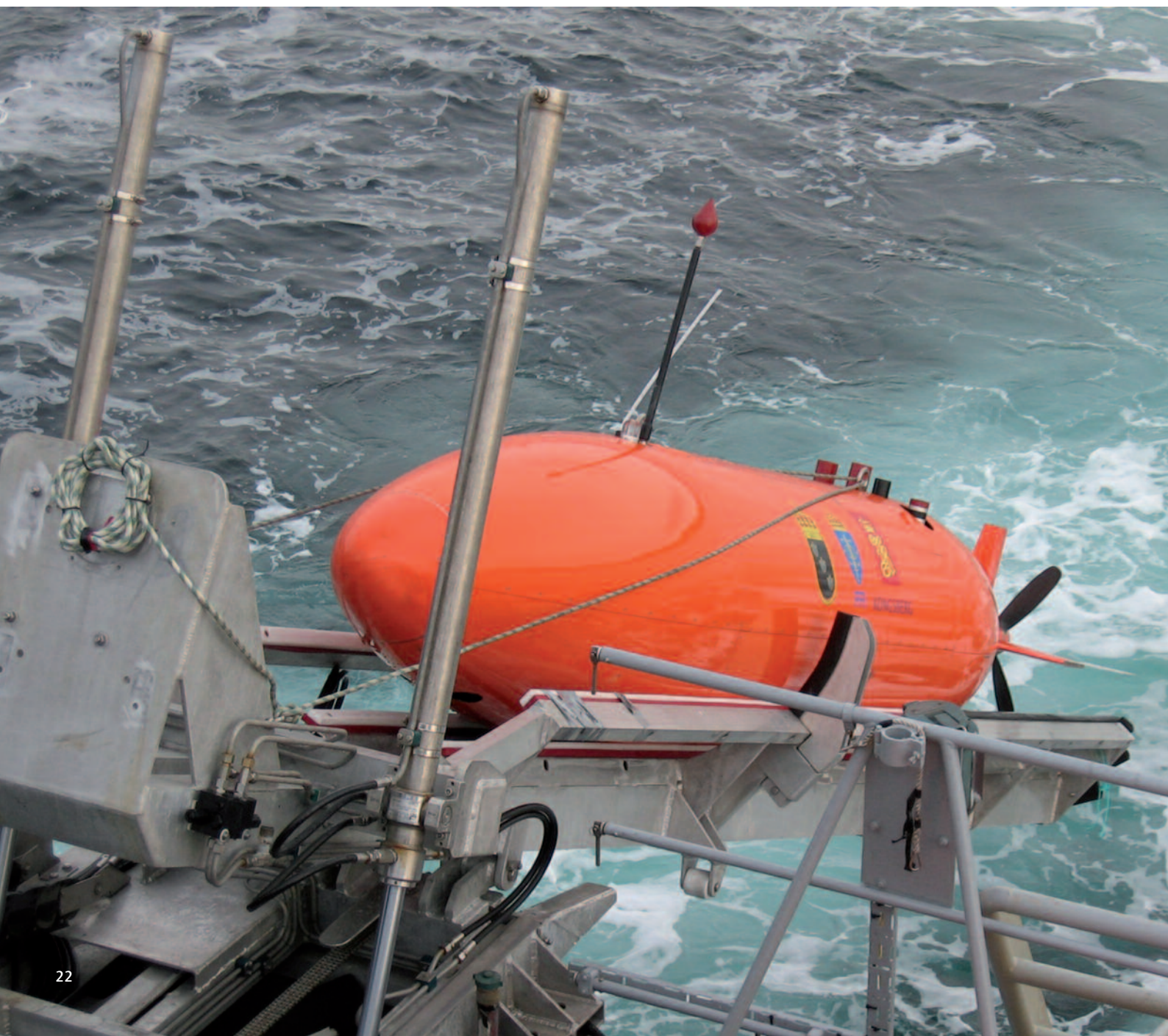
LAUNCH AND RECOVERY

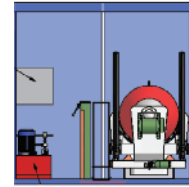
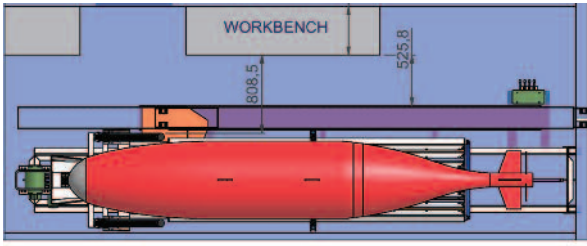
One of the main challenges with AUV operation is recovery in open and rough seas. The launch and recovery system for the HUGIN AUVs is a stinger based system for ship stern installation. This system has proved its efficiency and reliability in several thousand launch and recoveries over the years.

During launch, the hydraulically operated stinger with the HUGIN AUV is tilted down into the water and the vehicle is released by a disconnect mechanism while the ship is heading against the wind with a speed of 2-3 knots.

During recovery, the ship is positioned 50 - 100 meters from where the AUV surfaces. The vehicle drop nose with the recovery line is hooked and connected to the L/R system winch. The vehicle is then pulled onto the stinger and the stinger is lifted and retracted. During recovery the ship moves forward at 1 to 2 knots.

HUGIN 1000 L/R system for open deck installation.





HUGIN L/R system for custom designed container installation.



HUGIN 3000 L/R system in custom designed container.



HUGIN AUV recovery sequencer.

THE FUTURE

Since their introduction to market in the 1990s, AUVs have found use in several application areas; naval, oceanography, research and the offshore industry. This success is mainly because AUV offers improved data quality and mission efficiency compared to traditional technologies. Important AUV characteristics include:

- A very stable and low noise platform for payload sensors and instruments
Operation of sensors and instruments close to objects of interest (sea bottom, mines, fish shoals, etc.)
- Stand off distance between AUV and mothership, enabling for instance autonomous operations in hostile areas (e.g. mine fields), over the horizon operations and under ice operations
- Efficiency due to the higher survey speed (no umbilical cable)
- Efficiency multiplier to costly surface ships by operating one or more AUVs in parallel to surface ship operation.

Based on established capabilities, HUGIN AUV developments will be along the following lines:

- Enhanced operational autonomy, adaptivity and sustainability
- Further improved navigation accuracy and flexibility
- Extended endurance through improved battery technology
- More advanced sensors designed for AUVs, like the new HISAS 1030 synthetic aperture sonar (providing cm resolution at long range and full speed)
- New vehicle functionality for inspection, maintenance and repair of subsea installations.



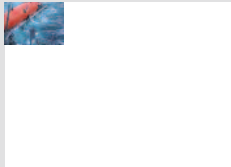
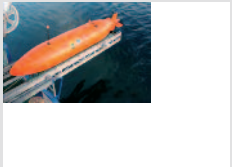
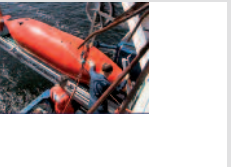
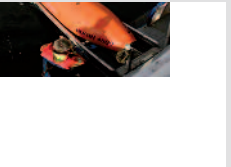
...as a part of subsea environment, close to nature.



HUGIN 4500

Person in red jacket and high-visibility vest on the boat deck.

HUGIN AUV Product Range

	HUGIN 1000	HUGIN 1000 for 3000 m	HUGIN 3000	HUGIN 4500
Weight	650-850 kg	650-850 kg	1400 kg	1900 kg
Length	4.5 m	4.7 m	5.5 m	6.0 m
Diameter	0.75 m	0.75 m	1.00 m	1.00 m
Speed	2-6 kts	2-6 kts	2-4 kts	2-4 kts
Depth	1000 m	3000 m	3000 m	4500 m
Battery	LiPolymer pressure tolerant. 15 KWh	LiPolymer pressure tolerant. 15 KWh	Al/HP semi fuel cell, 45 KWh	Al/HP semi fuel cell, 60 KWh
Endurance	24hrs @ 4kts (with MBE, SSS, SBP and CTD)	24hrs @ 4kts (with MBE, SSS, SBP and CTD)	60hrs @ 4kts (with MBE, SSS, SBP and CTD)	60hrs @ 4kts (with MBE, SSS, SBP and CTD)
Navigation system and sensors (main + options)	NavP AINS: IMU, DVL, Depth, USBL, NavP TP Ranging, GPS, TerrNav	NavP AINS: IMU, DVL, Depth, USBL, NavP TP Ranging, GPS, TerrNav	NavP AINS: IMU, DVL, Depth, USBL, NavP TP Ranging, GPS, TerrNav	NavP AINS: IMU, DVL, Depth, USBL, NavP TP Ranging, GPS, TerrNav
Communication (main + options)	Acoustic command and data links, RF, Iridium, Ethernet, WLAN	Acoustic command and data links, RF, Iridium, Ethernet, WLAN	Acoustic command and data links, RF, Iridium, Ethernet, WLAN	Acoustic command and data links, RF, Iridium, Ethernet, WLAN
Payloads (main + options)	MBE, SSS, SBP, SAS, CTD turbidity sensor, ADCP, camera+ others	MBE, SSS, SBP, CTD turbidity sensor, ADCP, camera + others	MBE, SSS, SBP, CTD ADCP, camera + others	MBE, SSS, SBP, CTD, ADCP + others
Main applications	Naval, research, offshore, hydrography	Naval, research, offshore, hydrography	Offshore, research	Offshore, research
				

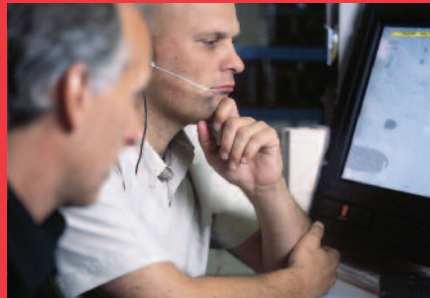
We are always there, wherever you need us

KONGSBERG customer services organisation is designed to provide high-quality, global support, whenever and wherever it is needed. We are committed to providing easy access to support and service, and to responding promptly to your needs. Support and service activities are supervised from our headquarters in Norway, with service and support centres at strategic locations around the globe – where you are and the action is.

As part of our commitment to total customer satisfaction, we offer a wide variety of services to meet individual customers' operational needs. KONGSBERG support 24 is a solution designed to give round-the-clock support. For mission-critical operations, Kongsberg support 24 can be extended to include remote monitoring. We can adapt the level of support needs by offering service agreements, on-site spare part stocks and quick on-site response arrangements.

Global and local support

We provide global support from local service and support facilities at strategic locations world wide. Service and support work is carried out under the supervision of your personal account manager, who will ensure that you receive high-quality service and support where and when you need it. Your account manager will ensure continuity and work closely with your personnel to improve and optimise system availability and performance. Under the direction of your account manager, and with a local inventory of spare parts, our well-qualified field service engineers will be able to help you quickly and effectively.



Solid competence reduces cost

We have always recognised the importance of supporting our products and systems with professional training.

A wide range of courses are therefore offered to ensure that you achieve the goal of full system utilisation with safe and efficient operation.

Upgrading that pays

Product and system upgrades can improve your vessel's operations and reduce your overall maintenance costs. We will ensure that existing products and systems can be extended or upgraded based on standard upgrade kits.

Tel: +47 8153 5355
Direct Tel: +47 9920 3830
Email: km.auv.support@kongsberg.com

www.kongsberg.com

E-mail: subsea@kongsberg.com
Telephone: +47 33 03 41 00