KONGSBERG

HISAS 1030

High resolution interferometric synthetic aperture sonar

www.kongsberg.com

HISAS
High resolution Interferometric Synthetic Aperture Sonar

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 utlilising 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.

What is HISAS 1030?

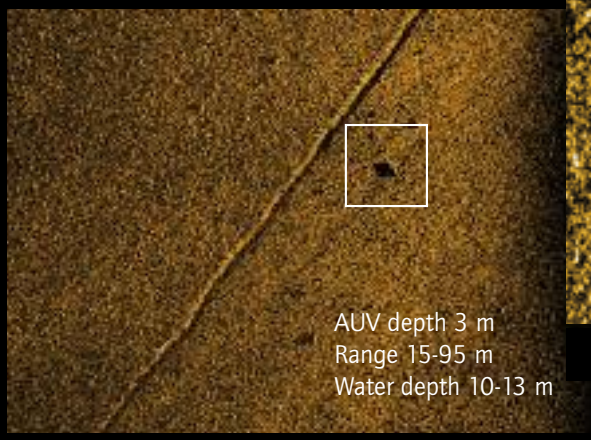
Search for objects

Rapid Environmental Assessment (REA)
High area coverage rate
High resolution

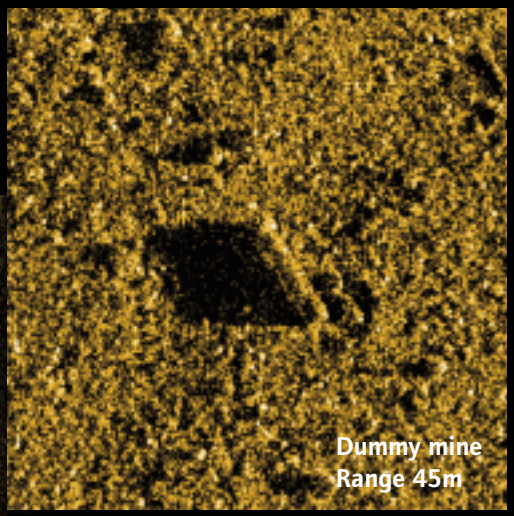
Wreckage of Heinkel He 115 sea plane.
Courtesy of the Royal Norwegian Navy

Mine countermeasures (MCM)

HISAS 1030 imagery of cluttered seafloor with a 2 m long, 53 cm diameter cylindrically shaped exercise mine.



AUV depth 3 m
Range 15-95 m
Water depth 10-13 m



Dummy mine
Range 45m

10x10 m detail around the exercise object

HISAS 1030

- HISAS 1030 is an interferometric synthetic aperture sonar system capable of providing very high resolution images and detailed bathymetry of the seabed.

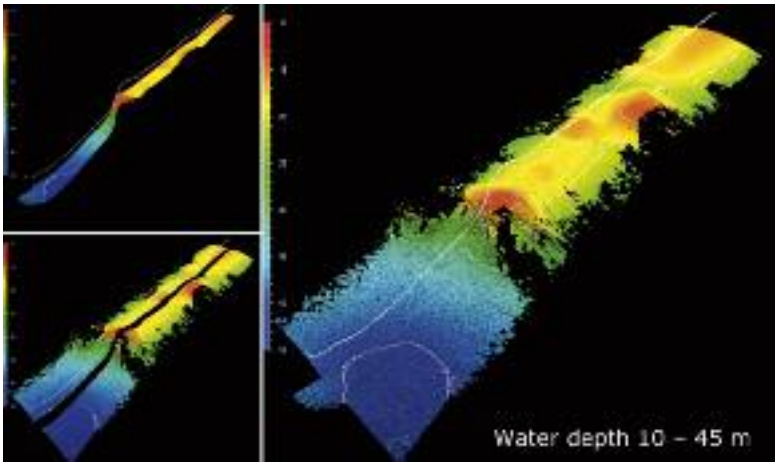
- Originally developed for demanding military mine countermeasures (MCM) operations, where there is a need to detect and classify small objects on the seafloor in a challenging clutter filled environment. The sonar is installed onboard HUGIN 1000, a medium size AUV in Kongsberg's family of AUVs.

- Range-independent resolution of approximately 3x3 cm out to a distance of more than 200 m from both sides of the AUV at a speed of 2 m/s, this allows for detection and correct classification of mines and other small objects even in challenging, cluttered environments and with a typical area coverage rate of 2 km^2/hr.

- Full-swath side-scan bathymetry and very high resolution SAS bathymetry for 3D object rendering. As the height map is generated at near image resolution, it is possible to generate bathymetric estimates both at side-scan and full SAS resolution. This allows rapid collection of large swathes of bathymetric information at low processing cost, while simultaneously allowing extremely detailed bathymetric imagery to be generated for selected regions.

- HUGIN 1000 is equipped with an EM 3002 multibeam echo sounder (MBE). Merging HISAS 1030 side scan bathymetry with data from the EM 3002 MBE, a single swath of up to 20 times the altitude of the AUV above the seafloor can be generated, compared to only 3-4 times the altitude with MBE.
  The example given below is of medium resolution bathymetry (about 1 x 1m) from HUGIN 1000 in shallow water. Upper left: EM 3000 multibeam bathymetry. Lower left: Sidescan bathymetry from HISAS 1030. Rightmost image: Merged bathymetry.

Kongsberg Maritime develops and manufactures the AUV, the aided inertial navigation system and the synthetic aperture sonar in-house. The result is smooth system integration and a balanced approach to achieving optimal performance from the SAS system.



Main features

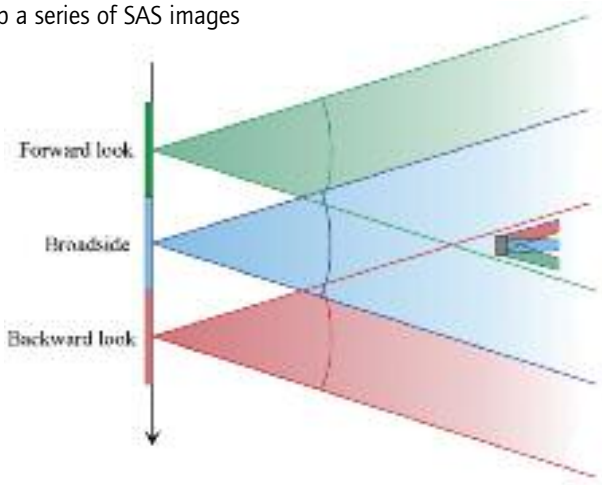
- A transmitter array and two multi element receiver arrays fitted to both sides of the vehicle enable co-registration of images with slightly different geometry of the same scene. This allows for very high resolution bathymetry and at the same time adds to the systems robustness.

- The transmitter beam direction and coverage is controllable in the vertical plane, and this feature is used to minimize the influence of surface and seabed reverberation. This is particularly important when operating close to the surface and in shallow water, where the achievable range can be limited by multipath and direct surface returns.

Multi-aspect imagery

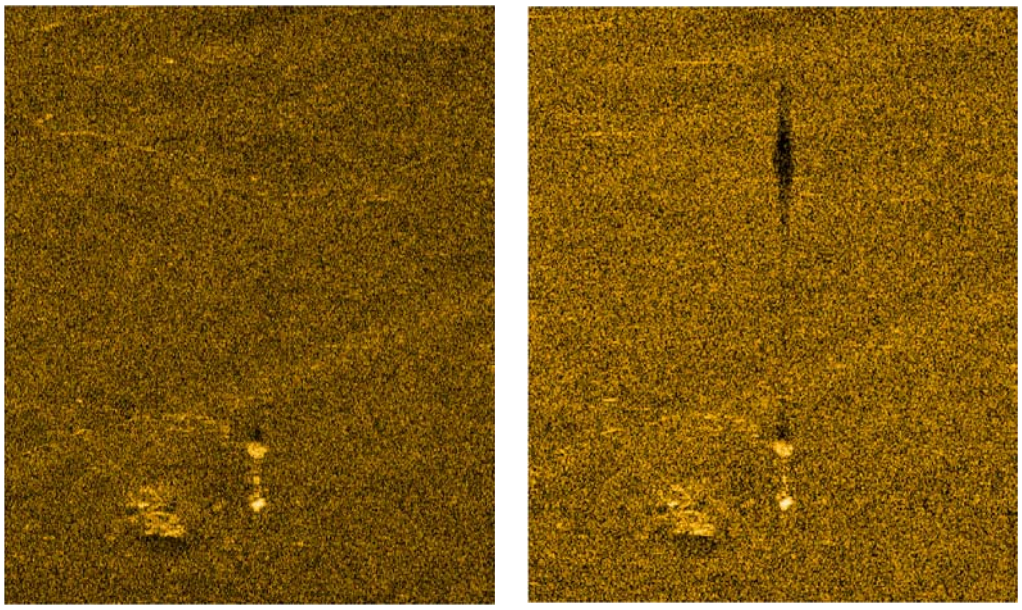
- HISAS 1030 makes it possible to build up a series of SAS images representing different observation angles as illustrated in the figure ro the right.

- Multi-aspect imaging gives the operator an extra dimension in the data set, as many complex objects have a highly aspect dependent echo and shadow structure.



Shadow enhanced SAS

- Shadow classification is an important tool when examining small objects such as mines.
- Processing for maximum shadow contrast makes use of the same data set as that used for processing SAS images. Increasing the "shadow resolution" gives the operator an extra valuable dimension to examine in the data set.
- With HISAS, shadow processing is available as a fast, low-cost post-processing step after standard SAS imaging.
- The figure below shows an example of a normal SAS image of a moored transponder together with the shadow enhanced image. Since the object is moored, the shadow appears some distance behind the echo of the object itself.

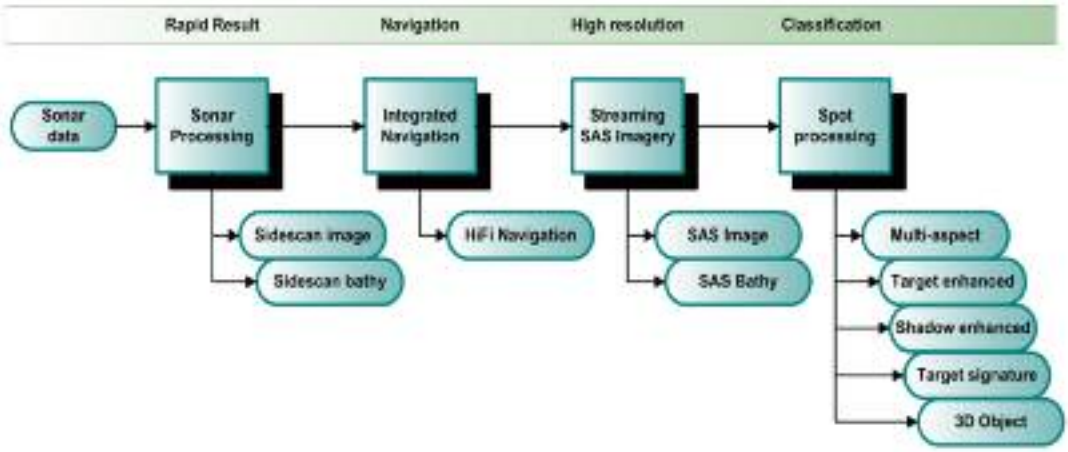


Bathymetry

- The two vertically separated arrays on each side of the vehicle allows very high resolution interferometric processing to be performed on SAS data.
- The spatial resolution of the bathymetry for HISAS 1030 lies between 5 x 5 cm and 50 x 50 cm out to full range depending on the degree of filtering applied. This order of relative bathymetric resolution is sufficiently good to allow 3D imaging of both large objects and small objects like mines.

Post Mission Analysis (PMA)

• A complete SAS post processing toolbox named "FOCUS" is delivered with HISAS 1030.

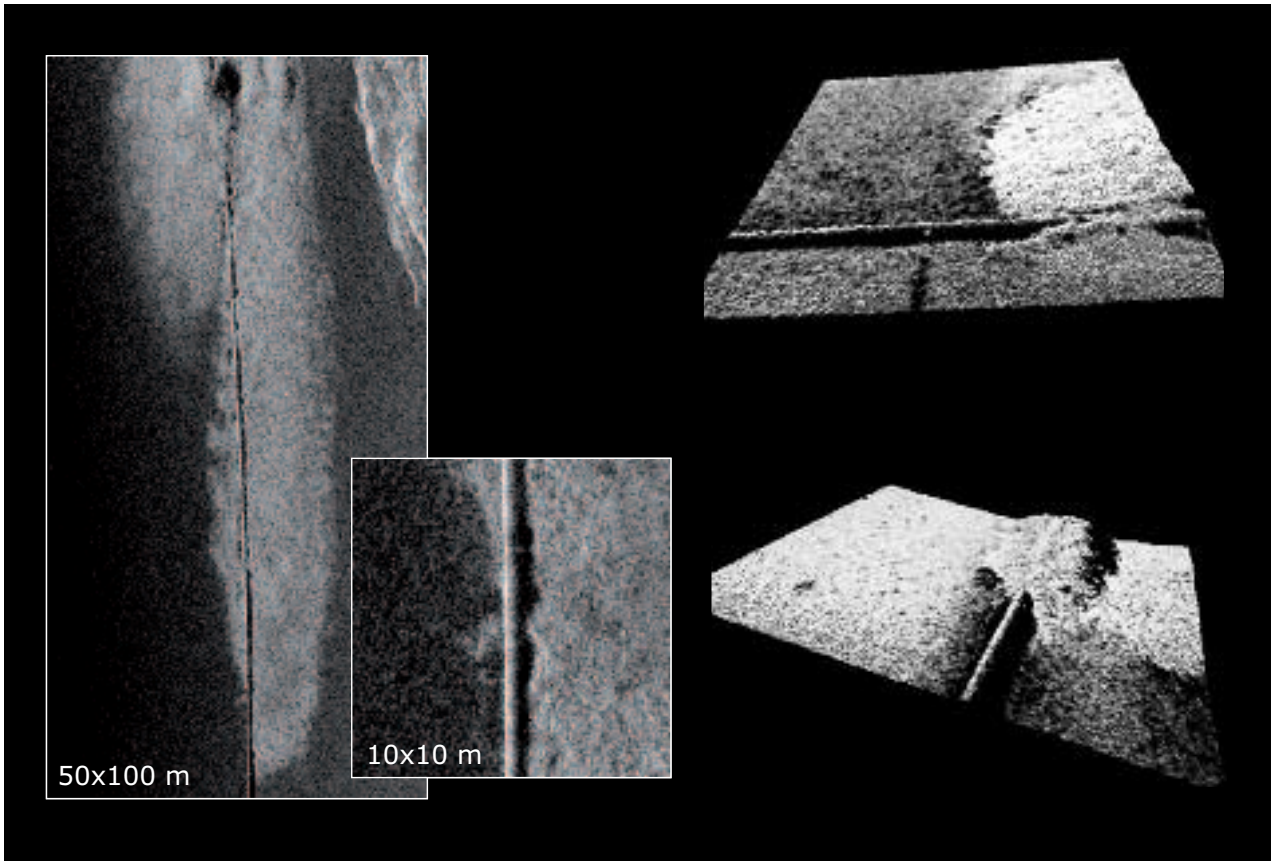


The FOCUS toolbox system provides multiple layers of processing, each with separate sets of products.

• Rapid result - dynamically focused side scan images, side scan bathymetry.
  - Dynamically focused side scan imagery from HISAS 1030 typically has an along-track resolution of 40-100 cm and can be generated in real time during the AUV mission, for use in quality control and rapid availability after AUV recovery.
  - Side-scan bathymetry is currently generated as a rapid product in post processing.
• Navigation
  - Accurate navigation is a valuable by-product of the SAS processing and can be used to increase the AUV's navigation accuracy and reduce position error drift

• High resolution – streaming SAS imagery and relative bathymetry of configurable resolution.
  - High resolution products such as streaming SAS imagery at very high resolution is normally generated for the entire recorded data set. This product has sufficiently high resolution to detect even small objects of interest such as modern mines or Improvised Explosive Devices (IEDs). Streaming SAS imagery is typically generated at 2 x 4cm resolution.

Standard FOCUS streaming SAS image (20 m x 20 m) of torpedo at 90 m range.



Example of SAS images from pipeline survey operation. 2 nmi x 500 m covered in one hour, with heavy overlap and one pass at each side of the pipeline

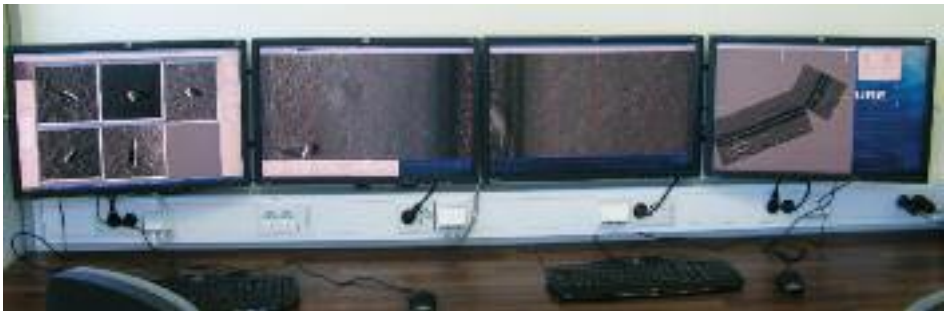
- Classification – full resolution imagery, SAS bathymetry and other advanced products.
  - Highest resolution, highest quality end products from the sonar. They require extra processing time and take up a lot of disk space and are therefore usually only generated for areas centred around objects of special interest. Spot processing may generate a movie clip, a 3D representation of the object and even higher resolution images than normally generated in streaming SAS.

- The FOCUS toolbox includes integrated SAS micro navigation and inertial navigation, time and wavenumber domain beam forming, phase gradient autofocus (PGA) and seafloor height estimation by cross-correlation and interferometry.

- Data is made available in standard file formats (XTF sonar files, XTF and/or Kongsberg. ALL bathymetry data, AVI movie clips, GeoTIFF mosaics, etc).

- Typical processing speed is 2 – 5 times faster than real-time for high resolution SAS streaming imagery depending on the topside processing hardware platform the Focus SW is running on.

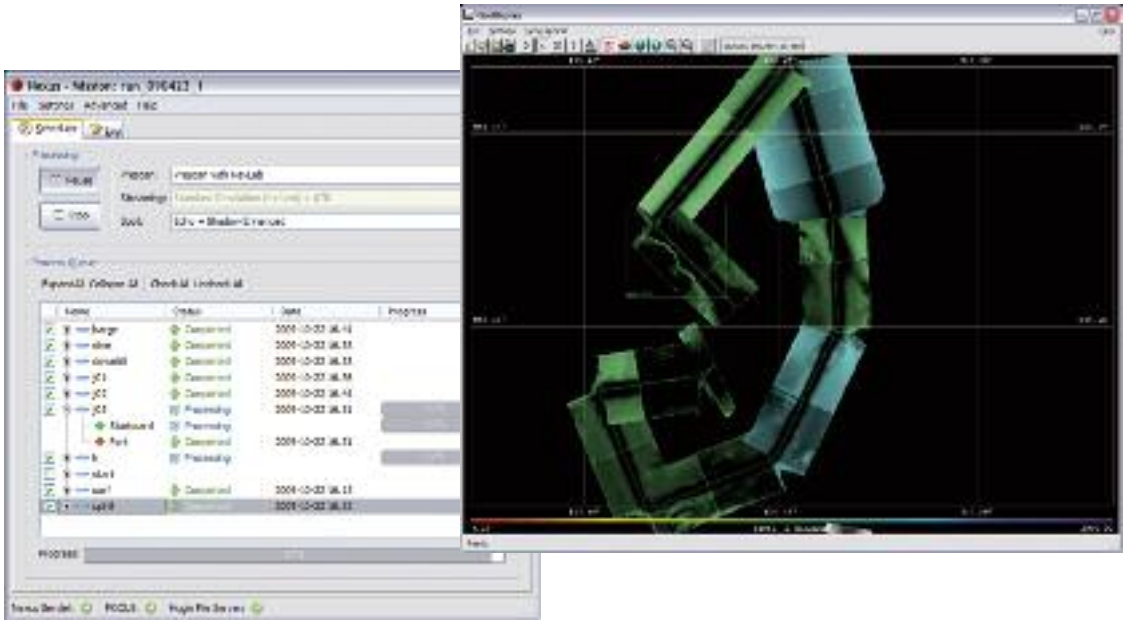
- A typical configuration consists of two powerful computers each with two quad core CPUs running FOCUS software, and connected to a post mission analysis (PMA) computer with four screens.



- During the AUV mission, HISAS data is stored in a removable hard disk container.

The hard disk container is removed after completion of the AUV mission and is placed in a docking station connected to the two computers running FOCUS SW.

- Solutions are available for integrating FOCUS with third party post-mission analysis and display software such as "Triton AUV Suite" from Triton Imaging®. The Nexus application provides a simple and powerful user interface to the FOCUS SAS processing.



- The FOCUS SAS processing can be performed in real time inside the underwater vehicle, but such a feature will be at the expense of added volume, weight and power consumption.

HISAS 1030 main specifications

Frequency range..... 60 - 120 kHz
System bandwidth.....Up to 50 kHz

On each side of the AUV:

Transmitter array: 0.32 m long/0.18 m high.
Primary and secondary receiver arrays (each): 1.27 m long/0.11 m high.

Data rate: typically 60 GB/hr.

Removable 1.2 TB data storage unit in separate pressure container with optical fiber channel interface for data, and electrical interface for power/status.

Interface to HUGIN control system (100 Mb Ethernet).
HISAS Topside Payload Operator System.

Post Mission Analysis (PMA) system

FOCUS Synthetic Aperture Sonar Signal Processing Toolbox.
Nexus interface to FOCUS and Triton.
Triton AUV Suite or other third party display and analysis software.

Desktop PMA Workstation computer.
Two HISAS FOCUS Workstation computers.
Four 20" displays.
HDD Container Docking Station.

Operational performance

Maximum range (each side of vehicle): 200 m @ 2 m/s and 260 m @ 1.5 m/s AUV speed.
Maximum instantaneous area coverage rate (operation geometry dependent): 730 m^2/s.
Theoretical resolution (across-track x along track): 2 x 2 cm.
Practical resolution: < 5 x 5 cm at all ranges.
Multi-aspect field of view: up to 30°.
SAS bathymetry resolution (cell size): 5 x 5 cm to 50 x 50 cm.

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.

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