

N/A = Not applicable  
 □ = No information received

## AUVs

The industry has experienced significant growth and the AUV can now boast as being the system of choice for various applications: it is unrivalled in mine countermeasures in very shallow waters, and deep-water offshore oil and gas geophysical mapping.

This product survey reveals a mature industry with established concepts of operations requiring relatively small operational crews. AUV users can now integrate almost any payload sensor and mount it on the world's most stable platforms. The survey also shows how new vehicle concepts are already starting to offer the ability to carry out new tasks, from the inspection of ship hulls to pipelines. With advances in sensor technology, software capabilities, batteries and vehicle design, the future of the industry should present many opportunities for growth.

We define the concept of AUVs for this survey as 'unmanned underwater vehicles with no physical link between them and a surface vessel'. There are some concepts that come close to our AUV definition, but in reality are different – which would make for an illogical comparison with the main products we are looking at in this survey, such as gliders (in this survey, we only received data for the Bluefin Spray Glider) and a semi-submersible underwater vehicle (ISE's Dorado), propelled by a diesel engine. You can find their specifications in the full online edition of this product survey.

Due to space constraints on these pages, we made a selection of the most successful models for each manufacturer. All other models submitted you can find online (1).

For our product surveys, we rely on all data to be provided by the suppliers. We thank all the participating manufacturers for their efforts in collecting the details that make this comparison possible.

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Company	Atlas Maridan ApS	Bluefin Robotics Corporation
Product	SeaOtter MK II	Bluefin-12
Vehicle type	General purpose survey AUV	Free-flooded, torpedo-style AUV
Total number of AUVs built	N/A	N/A
Commercial options	N/A	N/A
<b>Physical characteristics</b>		
Weight of AUV in air (kg)	1,300	213
Maximum payload (kg)	160	Variable, free-flooded system
Freight weight	N/A	Vehicle case (qty 3): 100kg each; battery case (qty 3): 21kg each; plus spares and support equipment
Dimensions (l x w x h) (m)	3.5 x 1 x 0.5	3.77 x 0.32 x 0.32
Maximum depth rating (m)	600, 1,500	200
Number of thrusters: directional/lateral control	5	1
Hover capabilities (Y/N)	Y	N
<b>Operations</b>		
Minimum turning radius (m)	10	3.77 (length of vehicle)
Type of launch & recovery system (LARS) used, how the AUV is recovered	Knuckle boom crane, stinger over aft or A-frame, recovery with release of buoy	A-frame & winch, crane, ramp
Average speed, maximum speed (knots)	Range: 0-8; typical survey: 4; max. 8	3; 5
AUV crew size	4 (1 mission responsible, 1 operator, 2 technicians)	2
Number of surface computers required for operation	1	1
Storage space requirements (size)	N/A	Variable
Other requirements	N/A	Bluefin Operator Tool Suite (GUI) (standard), training course (standard)
<b>Navigation and payload</b>		
Standard navigation sensors	INS, GPS, DVL, CTD, forward-looking obstacle avoidance sonar + camera	IMU, GPS, DVL and compass, pressure, sound velocity
Optional navigation sensors	USBL, LBL, SLBL, secondary INS, secondary DVL	INS, USBL
If an INS is installed, navigation sensors used to update position during a dive	N/A	All others
Standard payload sensors	All payloads are user-selectable (standard complement: side-scan sonar, SBP, MBES, camera, magnetometer)	Empty payload with standard payload interface specification for customer-integration of payload. Various other sensors, sonars and payloads
Optional payload sensors	ADCP, sampling, environmental, tracking	Side-scan sonar, buried object scanning sonar, real-time gradiometer, CTD, SAS, various other sensors, sonars and payloads
<b>Battery and endurance</b>		
Total energy content of battery (kWh)	36	4.5
Nominal battery power (W)	On request	225
Endurance at nominal power (hours)	24	20 hours at 3 knots
Battery modules can be swapped (Y/N)	Y	Y
Recharge time from empty (hours)	On request	6
<b>Telemetry and control</b>		
Acoustic telemetry is fitted (Y/N), baud rate (bits per sec)	Y	Y
Radio telemetry is fitted (Y/N), baud rate (bits per sec)	Y	Y
Ethernet connection for update, maximum speed	Y, 802.11g	100Mb/s
Type of data sent to the surface	On request	Health & status
Control parameters sent to the AUV	On request	Mission abort, mission stop, hardware kill
Emergency recovery procedure in the event of a total system failure	On request	Dropweight, acoustic locator & RDF



1. [www.hydro-international.com/productsurvey/](http://www.hydro-international.com/productsurvey/)

ADCP = acoustic Doppler current profiler; AHRS = attitude and heading reference system; ASW = anti-submarine warfare; CT = conductivity-temperature; CTD = conductivity-temperature-depth; DGPS = differential GPS; DVL = Doppler velocity log; GPS = global positioning system; GUI = graphical user interface; IMU = inertial measurement unit; INS = inertial navigation sensor; ISR = intelligence, surveillance and reconnaissance; ITR = International Traffic in Arms Regulations; LBL = long baseline; MBES = multi-beam echosounder; MCM = mine countermeasures; OAS = obstacle avoidance system; ORP = oxygen reduction potential; RDF = radio direction finder; REA = rapid environmental assessment; RHIB = rigid hull inflatable boat; RIB = rigid inflatable boat; SAS = synthetic aperture sonar; SBL = short baseline; SBP = sub-bottom profiler; SLBL = synthetic long baseline; USBL = ultra-short baseline.



Hafmynd Ehf	Hydroid, Inc.	International Submarine Engineering Ltd
Gavia AUV	REMUS 100	Explorer
Low logistics, man-portable AUV	<input type="checkbox"/>	AUV
17	200+	30
Various	<input type="checkbox"/>	1,000
From 48. Weight can vary depending on configuration	37	Approximately 700
Maximum payload dependent on physical size and power consumption	<input type="checkbox"/>	Approximately 275
Dependent on configuration being shipped. Typically 150kg	38kg no case, 65kg with case	N/A
From 1.7 (length) x 0.2 (diameter)	1.6 x 0.19	Length: 4.5 to 7 depending on payload; diameter: 0.69
1,000+	100	1,000
Single propeller with 4 independent control surfaces	Vertical and horizontal thrusters optional	Single propeller with rear hydroplanes for directional control
Not currently	Option	N/A
A function of configuration. Typically about 10m but can be lowered	<input type="checkbox"/>	10
Typically from the shore, RIB, vessel of opportunity with a simple hoist mechanism used if not recovered by hand	2-person hand launch	Crane or ramp, can also be launched from shore
Typical survey: 3.5, max. just under 6	5	Cruising: 3; max. 5
Typically 1 operator and 1 assistant. Data processing can vary	2	3
1	1	2: surface control computer and mission planning workstation supplied with vehicle
Minimal. Can be shipped in boxes roughly 1.5m x .7m or two larger cases roughly 2.5m in length	N/A	6m (20ft) ISO container (supplied as an option with the vehicle)
<input type="checkbox"/>	<input type="checkbox"/>	N/A
Fluxgate compass, GPS	Compass, yaw rate sensor, DVL, LBL	IXSEA PHINS, Teledyne RDI Workhorse 300kHz DVL, Sound Ocean Systems DGPS, Kongsberg 1007 altimeter, IXSEA GAPS transponder, Paroscientific Digiquartz depth sensor
DVL INS (Kearfott T24 or T16), LBL, USBL	GPS, P-code, digital USBL, INS	Kearfott INU, IXSEA Posidonia transponder, Marine Electronics 6201 Dolphin OAS
LBL, USBL	Transponders, DVL, GPS	USBL, LBL, GPS
OAS, modem	Side-scan sonar, CT probe, depth, bathymetry, system status, multi-vehicle capability	EdgeTech 2200M modular side-scan sonar and SBP, Kongsberg EM2000 MBES, Seabird CTD
Varied including side-scan sonar, swath bathymetry, camera, environmental sensors, autotracker, custom payload modules are available	WiFi, Iridium, ADCP, ECO Puck, CTD, dissolved oxygen optode, pH, ORP, video imaging, DIDSON camera, acoustic communications, gateway buoy, dynamically focused side-scan sonar, interferometric multi-beam, and dual-frequency side-scan sonar	EdgeTech 4700 DFX side-scan sonar, I-3 Klein AUV 5000 V2 side-scan sonar, gravimeter, mass spectrometer, Imagenex Delta T 3D sonar, video and still camera
1.2	1kWh internally rechargeable lithium ion battery	Single battery tray: 17.6kWh; double battery tray: 35.2kWh; triple battery tray: 52.8kWh
<input type="checkbox"/>	Configuration dependent	1.6kWh per module
<input type="checkbox"/>	Configuration dependent	Approximately 28 to 83 hours depending on the number of battery trays installed
Y	Y	Y
5 to 6	8 to 12	5 to 10 hours depending on power supply
Y	80 baud	Yes; up to 300bps (optional second system for mission data up to 9,600bps)
Is being implemented for Gavia Offshore model systems	9,600 via serial comms from base station to comm port in computer	Up to 420kbps
WLAN: 11Mb/s	10 base T	100Mb hardwired ethernet link
Position, health, mission progress, other mission information	Vehicle calculated position status, health, fault messages	Standard: position data, vehicle and mission status; optional: snapshot mission data
Various	Latitude, longitude, depth, redirect commands	Position updates, mission changes, abort commands
Vehicle is positively buoyant, will float to surface. Various components to emergency system	Acoustic and Iridium communications, and the vehicle is positively buoyant to float	In the event of a total power loss, the vehicle will surface and the emergency beacons will activate. An optional parking sphere is available to park the AUV on the sea floor

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Company	Kongsberg Maritime	OceanServer Technology, Inc.
Product	HUGIN 3000	Iver2-580
Vehicle type	AUV	AUV
Total number of AUVs built	30 HUGIN vehicles built/in production	100+
Commercial options	Complete turn-key system for offshore seabed mapping. Alternatively, customers can integrate own systems and sensors	Side-scan, multi-beam, chemical sensors, navigation, communications
<b>Physical characteristics</b>		
Weight of AUV in air (kg)	1,400	18
Maximum payload (kg)	On request	10
Freight weight	On request	35kg
Dimensions (l x w x h) (m)	Length 5.5; diameter: 1.0	1.2 x 0.14 x 0.14
Maximum depth rating (m)	3,000	200
Number of thrusters: directional/lateral control	N/A	1
Hover capabilities (Y/N)	N/A	N
<b>Operations</b>		
Minimum turning radius (m)	20	2
Type of launch & recovery system (LARS) used, how the AUV is recovered	During launch, a hydraulic-operated stinger with the HUGIN AUV is tilted down into the water and the vehicle is released by a disconnect mechanism. During recovery, the ship is positioned 50-100 metres from where the AUV surfaces. The vehicle drops nose with recovery nose is hooked and connected to the LARS. The vehicle is then pulled on to the stinger and the stinger is lifted and retracted	Shore or boat, hand launch and recovery
Average speed, maximum speed (knots)	4	3 to 4
AUV crew size	4 to 6	1
Number of surface computers required for operation	1	1
Storage space requirements (size)	On request	Small
Other requirements	Container with chemical tanks required for aluminium-oxygen semi-fuel cell battery	<input type="checkbox"/>
<b>Navigation and payload</b>		
Standard navigation sensors	Aided INS, DVL, pressure, GPS, USBL transponder	GPS, compass, depth, altitude
Optional navigation sensors	Underwater transponder navigation	DVL, AHRS
If an INS is installed, navigation sensors used to update position during a dive	<input type="checkbox"/>	<input type="checkbox"/>
Standard payload sensors	Side-scan sonar, MBES, SBP, CTD, ADCP	GPS, compass, depth, altimeter
Optional payload sensors	Electronic still camera, hydrocarbon sniffer. Other sensors on request	Side-scan, multi-beam, DVL (4-, 6- and 10-beam), cameras, digital video recorder
<b>Battery and endurance</b>		
Total energy content of battery (kWh)	45	0.6 to 0.8
Nominal battery power (W)	750, all payload sensors operating at 4 knots	15
Endurance at nominal power (hours)	60	> 24
Battery modules can be swapped (Y/N)	N	N
Recharge time from empty (hours)	2 to 3 hours for refill of battery chemicals. 3 to 4 hours for refill of battery chemicals and exchange of anode bars every second dive	4
<b>Telemetry and control</b>		
Acoustic telemetry is fitted (Y/N); baud rate (bits per second)	4,250bps raw rate	WHDI modem
Radio telemetry is fitted (Y/N); baud rate (bits per second)	Yes; RF (radio) link	40Mbps
Ethernet connection for update, maximum speed	Ethernet umbilical: 100Mb/s or 1Gb/s	
Type of data sent to the surface	Vehicle data, payload data	Full with radio-surfaced
Control parameters sent to the AUV	Vehicle control and configuration, mission plan changes, payload control	Remote helm
Emergency recovery procedure in the event of a total system failure	Release drop weight and blow air bladder for AUV to come to surface. HUGIN comes with a range of redundant localisation systems: Iridium localisation system, RF link, acoustic links, acoustic positioning (USBL), flasher light	Patent-pending rescue float

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