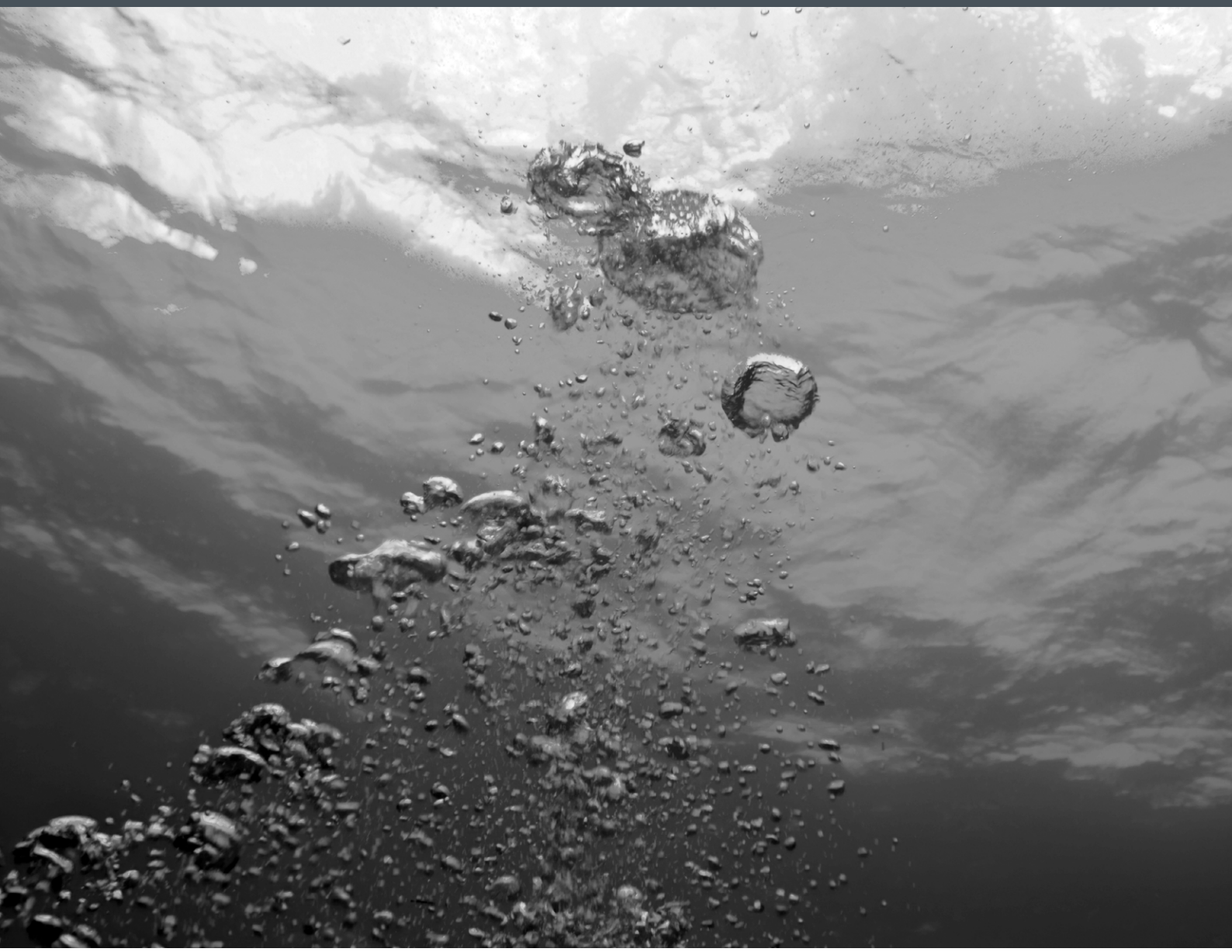


AUTONOMOUS UNDERWATER VEHICLES: BENEATH THE WAVES

When it comes to autonomous marine vehicles, the focus in the press over the last two years or so has been on Maritime Autonomous Surface Ships (MASS). This is likely owing to the proliferation of MASS and the widespread reporting of the regulatory scoping exercise that is being carried out by the International Maritime Organization (IMO) on how MASS will be regulated[1].

"AUVs can come in various sizes and are capable of carrying out a vast range of tasks, including high resolution seabed mapping and imaging; pipeline and subsea structure inspection; oceanographic surveys; environmental monitoring; search operations; mine countermeasures operations; geological surveys; and intelligence, surveillance and reconnaissance."

But what about Autonomous Underwater Vehicles (AUVs)?

AUVs appear to receive little press coverage when compared to MASS, being out of sight and operating, as it were, beneath the waves. Yet AUVs have been around longer than MASS and are already in widespread use across the maritime, defence and offshore industries.

While the defence sector is likely to remain the greatest user of AUVs for the foreseeable future with over 70% of market share, the offshore sector is expected to continue see a growth in usage. According to Westwood Global Energy's World AUV Market Forecast 2018-2022, the offshore industry in particular is expected to increase its demand for AUVs as operators continue to expand into deeper waters which requires more complex and expensive vessels and ROVs, increasing costs. In the dangerous and unforgiving offshore environment, using AUVs to support and carry out tasks such as site surveys, pipeline inspections and life of field inspections is therefore inevitable.

So what type of work are AUVs carrying out today?

AUVs can come in various sizes and are capable of carrying out a vast range of tasks, including high resolution seabed mapping and imaging; pipeline and subsea structure inspection; oceanographic surveys; environmental monitoring; search operations; mine countermeasures operations; geological surveys; and intelligence, surveillance and reconnaissance.

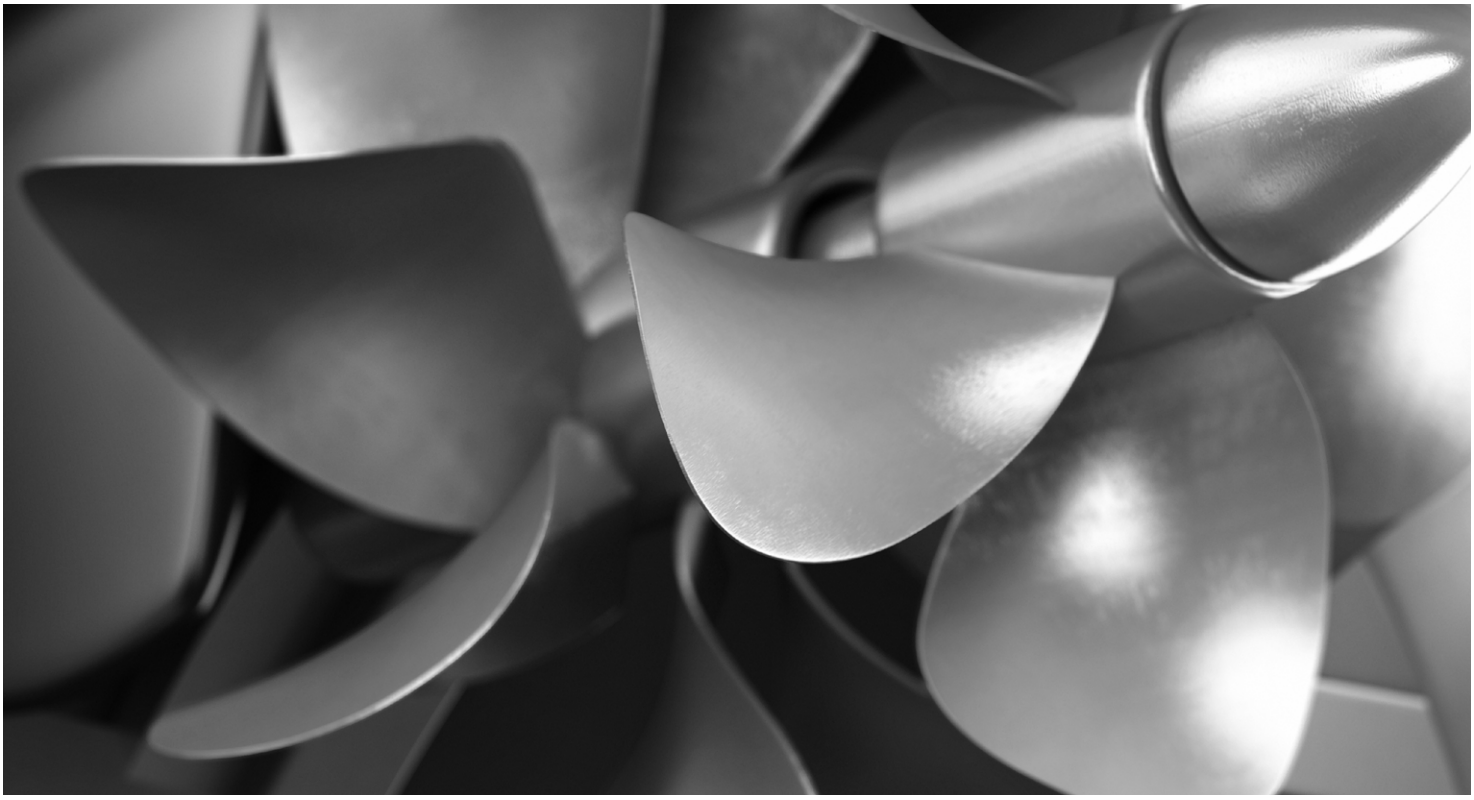
Kongsberg has developed a number of AUVs and marine robots which have been used by a number of survey companies in high profile search operations. Variants of Kongsberg's HUGIN AUV, which can operate to depths of 6,000m, were used by Fugro and Ocean Infinity to search for the Malaysian Airlines Boeing 777 (MH 370) which went missing on 8 March 2014. By deploying 8 AUVs, Ocean Infinity had the ability to survey an average of 1,100 km^2 per day, and by June 2018 had searched and collected 120,000 km^2 of data from the ocean floor which was donated to the Nippon Foundation and Gebco Seabed 2030 project[2]. Such results in a short timescale would not have been achievable by a surface vessel carrying out traditional seabed surveys.

Ocean Infinity has also been appointed by the Argentine authorities to search for the Argentine submarine *ARA San Juan* which was lost during a routine patrol in the South Atlantic in November 2017 and the Argentine Type S-42 submarine was located after a year long search on 15 November 2018[3].

Fugro is also using its AUVs and specialised seafloor sampling equipment to carry out site characterisation surveys to support seabed polymetallic nodule mining exploration project deep sea mining under a contract. This will take place in depths of up to 4,500m over a 400 km^2 area.

Endurance is still a limiting factor for most AUVs. For example the HUGIN AUVs have an endurance of up to 60 hours and require a dedicated support vessel for launch and recovery. However, there are a number of other AUVs which can operate without the support of a dedicated support vessel.

1. See HFW's thought leadership articles commenting on the IMO scoping exercise: http://www.hfw.com/Autonomous-Ships-Shipping-4-0-Dec-2018, http://www.hfw.com/Autonomous-ships-successfully-navigating-through-the-shallows, http://www.hfw.com/Autonomous-vessels-are-regulations-keeping-up-with-innovation-November-2017
2. https://oceaninfinity.com/ocean-infinity-donates-120000-square-kilometers-data-missing-malaysian-airliner-gebco-seabed-2030-project-2/
3. https://oceaninfinity.com/ocean-infinity-commences-search-operations-for-the-ara-san-juan/



At the smaller end of the scale, underwater gliders use buoyancy-based propulsion with a very low power consumption to propel themselves forward and can be deployed for months at a time. They have a variety of uses ranging from environmental monitoring, current profiling, to intelligence, surveillance and reconnaissance.

At the larger end of the scale, Boeing is testing its extra-large unmanned undersea vehicle *Echo Voyager* which can be used for scientific, defence or other purposes. Powered by a hybrid of battery technology and diesel generators it is expected to have a range of around 6,500 nm.

How are AUVs regulated?

Unlike a MASS, an AUV is unlikely to be considered a "ship" under English law, and the Society for Underwater Technology (SUT), probably the leading body in this field and for whom we are their legal advisers, agrees[4]. An AUV is also unlikely to be considered a ship for most of the international conventions. As such the maritime standards set out in the Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGs) are unlikely to apply to the types of AUV described above, although the regulating authorities might be reluctant to exclude larger AUVs such as the Echo Voyager from the ordinary application of the Rules when operating on the surface in the vicinity of other vessels.

HFW has advised a number of companies on the implications and operation of AUVs in the marine and oil and gas sectors, and has previously provided pro bono advice to the Autonomous Marine Vehicle Working Group, a cross-industry initiative organised and sponsored by the Society of Underwater Technology.

4. SUT, "The Operation of Autonomous Underwater Vehicles Volume One: Recommended Code of Practice for the Operation of Autonomous Marine Vehicles" Second Edition

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