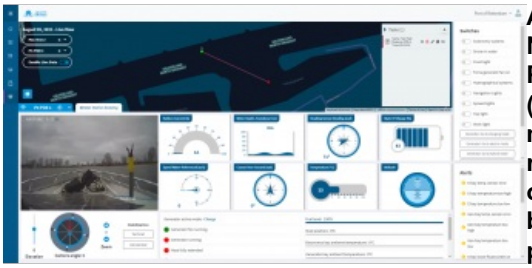
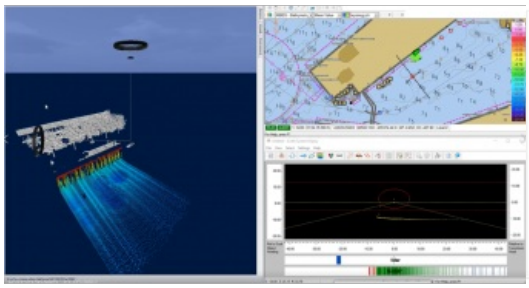
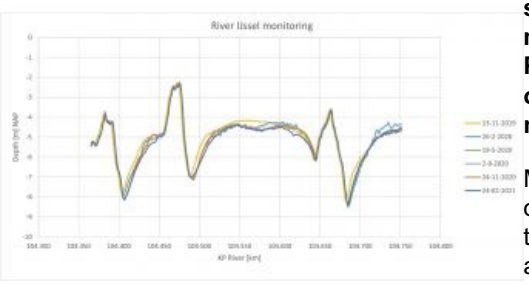
Phoenix 5: A Versatile, Stable Survey ASV







Aquatic Drones, based in the Netherlands, recently introduced the Phoenix 5 Autonomous Surface Vessel (ASV). The unit, with a length of five metres, provides a stable platform for a range of survey and inspection operations. It can be deployed for bathymetric surveys, sub-bottom profiling, inspection of civil engineering structures, safety and security surveillance, water quality monitoring and other applications. Phoenix 5 is designed for operations on inland waterways, in ports and nearshore.

Maarten Ruyssenaers, founder and CEO of Aquatic Drones, explains the history of the Phoenix: “I worked on marine robotics at the RDM Campus in the Port of Rotterdam, where industry, SMEs, research institutes and government bodies cooperate on innovation projects. I could see great opportunities for autonomous vessels so I set the company up in 2016 to develop these as commercial products. We worked with partners such as the Dutch Ministry of Infrastructure and Water Management, the Port of Rotterdam, Deltares and Boskalis to analyse their requirements and test the pre-production vessels. We learned a lot over a period of five years, surveying ports and large rivers in the Netherlands and supporting dredging operations. And now we are expanding our field of operations towards the sea.”

Phoenix 5 ASV

Although earlier models were catamarans, Aquatic Drones has now adopted an aluminium monohull design. This proved to provide the highest stability at survey speeds of 4 to 5 knots and makes it easier to integrate the propulsion and control systems and survey sensors. The length overall is 5m, the beam 2m and the draught 0.55m, and it can be launched by a single operator. The vessel is powered by lithium-ion batteries and the propulsion system has two ducted propellers driven by electric motors with a combined power of 8 or 20kW, depending on the model. Up to 2kW, at several DC and AC voltages, is available for payloads. Solar panels on deck recharge the batteries during deployment.

Phoenix 5 models:

- E: standard model with an endurance of up to 20 hours
- EP: higher capacity battery model for operation at higher speeds
- HP: diesel generator hybrid model for surveys lasting several days

Autonomy and situational awareness

Autonomous operation is based on a sophisticated situational awareness system which receives input from radar, Lidar, forward looking sonar, video cameras and an AIS receiver. Positioning relies on GNSS-RTK, providing an accuracy of approximately two centimetres, and an inertial measurement unit. The communications links to the operator station include Marine Broadband Radio, 4G and WiFi, all securely encrypted. The remote operator, onshore or on a nearby vessel, has displays for hydrographic data and for vessel status and control. Aquatic Drones also provide a cloud solution to give personnel at the operator’s base immediate access to the data gathered, anywhere in the world.

Safety and reliability

The vessel has an automatic fire suppression system, bilge pumps and back-up power for essential systems. Redundancy of essential control, propulsion and steering systems ensures safety in the case of component failure. The remote operator can always monitor the health of the systems, intervene and even control the vessel manually. If the communications links are interrupted, the Phoenix will loiter at its current position or return to a predefined home point.

The Phoenix 5 is an Autonomous Survey Vessel for surveying ports, large rivers and nearshore.

Survey operations

One of the key applications of the Phoenix is undertaking bathymetric surveys using a multibeam echosounder. The high stability of the vessel and optimized sensor position minimize the impact of waves and the wake of other vessels on the survey operation. Ruyssenaers notes: “During a survey of the IJssel river in the Netherlands, we were still able to obtain valid measurements at gale force 8, which was much higher than we had expected.”

The operator defines the survey area, after which the Phoenix control system determines the optimum survey grid and route to the area. During operations, the grid is automatically refined, depending on the water depth and bottom profile. If data acquisition is disturbed by external influences, the vessel automatically goes back and rescans the area.

The ASV can be fitted with a range of sensors, tailored to the application. Examples include single or multibeam sounders, side-scan sonar, turbidity and nutrient sensors, and so on. The onboard winch is used to lower sensors, for example to obtain a vertical temperature and conductivity profile for sounder and sonar calibration.

In addition to bathymetric and environmental surveys, Phoenix ASVs can be used for surveillance operations when fitted with low light and thermal imaging cameras. Lidar can scan above-water structures such as quay walls, to supplement side-scan sonar data.

Control Centre showing live camera feed, system health monitoring, water map with line planning, screen alerts and more.

Survey screen using Teledyn's PDS - data acquisition software

Case study: River IJssel (by Jeroen van Reenen, BSc Hydrography, HydrographX)

The advantages of ASV surveys were demonstrated when the riverbed morphology of the River IJssel in the Netherlands was repeatedly measured following the construction of temporary breakwaters of a new design. The stable platform provided by the Phoenix ensured excellent repeatability of the measurements. Furthermore, the low noise and vibration of the platform with electric rather than diesel propulsion greatly improved the performance of the multibeam echosounder. The raw data required little postprocessing, only the correction of a few outliers associated with steep slopes. This was automated and a clean dataset was available within an hour of the completion of each survey. Weather conditions varied significantly between surveys; however, the stability of the Phoenix meant that this did not affect the results.

Periodic surveys of the IJssel riverbed morphology

Partners and markets

Ruyssenaers concludes: “Undertaking surveys and other operations was essential when developing the product, and we will continue to offer those services in the Netherlands and surrounding countries. We will serve other international markets by supplying Phoenix ASVs to researchers, survey companies, dredging companies, marine contractors and ship leasing operators. Public authorities such as port operators, river authorities and the police and coastguard are also a key market. Aquatic Drones has a network of agents and dealers in Europe, Asia, North Africa, the Middle East and South America who can support their customers with maintenance and advice. We are currently preparing several international projects.

Our company focuses on listening to customers, building up good relationships and optimizing our products for their applications – we work closely together with them. We are currently also supporting the Netherlands Ministry of Infrastructure and Water Management, which is developing regulations for uncrewed vessels.

Customers are concerned about their environmental impact. A Phoenix has a fully electric propulsion system and operates with zero emissions at the point of use when running on batteries. That avoids the CO_2 emissions of a larger, crewed survey vessel with diesel engines. In the future, we would also like to replace the diesel generator on our HP model with a hydrogen fuel cell.”

For more information, please go to www.aquaticdrones.eu