Small and attractive

by Hanna Klimek, Beata Szymanowska, and Anna Salomon, *Port of Gdynia*

Innovation is about qualitative change, the much-needed novelty and originality that pushes organisations, markets, and agendas forward. Concepts and processes (of technical or other nature) replace the status quo, bringing about progress. Some of the 'breaking news' solutions are grand indeed, think the use of green hydrogen. It, however, doesn't mean that small innovations cannot result in huge advancements. The Port of Gdynia has been testing one such inconspicuous novelty: an autonomous floating drone conducting water research, also known as a hydrodrone.

Satellite applications are among the many (technological, social, political, or economic) industrial innovation trends identified by the European Commission. Various sectors, including transport, can use these new solutions developed by the space industry to increase efficiency thanks to, e.g., data-driven process optimisation. Equally important, space-enabled applications can contribute to increasing people's safety or improving the protection of property and the environment. They are already used, among others, in flying and floating drones, road and rail vehicles, and vessels.

The Port of Gdynia is tapping into the global tech innovation trend by trialling a robotic floating platform to conduct water and seabed research in port basins. This device can work fully autonomously, following a planned trajectory, or remotely, which is particularly handy in bodies of water that are impossible or difficult to access by larger vessels and their crews.

On 18 November 2021, in one of the port's basins, the first tests of the robotic unit were held. As part of the trial, the correct functioning of all automated mechanisms used for taking water samples from various depths, bottom sediment probes, and measuring the water pH was verified. Communication systems were tested, too, while safety protocols were checked. The hydrodrone will begin cyclic testing of port waters as of March this year.

The technicalities

The floating drone tested in Gdynia is a catamaran: 4.0 m-long, 2.0 m-wide, and 1.0 m-tall (1.4 m with the antenna gate raised), having 0.5 m of draft. The hull is constructed of acid-resistant steel, while the floats are made of laminate. The unit weighing 300 kg can develop a maximum speed of 14 knots (about 26 km/h), but the measurement speed is best at 3-4 knots (5.5-7.4 km/h). It can be used for hydrographic surveys in port areas, rivers, lakes, lagoons, or bays. The set of installed batteries (two Torqeedo Cruise 4.0RL 0-4KW motors) allows it to carry our measurement works for up to 12 hrs. The hydrodrone is additionally equipped with two photovoltaic panels. It is environmentally friendly as it emits no harmful substances. Remote control of the device is possible up to 40 km, while transmission of onboard data is up to 6.0 km.

The hydrographic equipment of the drone consists of an in-water sound velocity profiler (AML SVP Base X2), an in-water sound velocity sensor (AML SV Xchange), an inertial navigation system (SBG Ekinox2-D), an interferometric echo sounder (PING 3DSS-DX-450). All of these provide highly accurate measurements of water depths and 3D side images.

The drone's navigation sensors were installed on an automatically folded mast, ensuring the safety of transport of the vessel and access to the measurement area. These include two LW20 laser rangefinders of the UMRR 0C Type 42, a 24 GHz radar (weather insensitive and sunlight independent), a Velodyne Puck VLP-16 LiDAR (used in autonomous vehicles), a Hikvision camera (the water- and dust-proof model DS-2CD2025FWD-I), a Hikvision PTZ camera (model DS-2DE3304W-DE with high quality 3.0 Mpix resolution imaging), an Airma weather station (WX Ultrasonic Weather Station), and two vertical echo sounders (EchoRange 200 kHz).

In addition to typical navigational data, the drone records video (pan and tilt), stores data from the weather station, and measures the battery voltage level and the mast and hydrographic head actuator position. These data sets are transmitted to a shore station, while hydrographic data from the multibeam probe and LiDAR are recorded on in-vehicle industrial computers.

The ashore operator has two control consoles and one hydrographic console with a computer. A dedicated navigation console protects from dust, water and shock, while a small manoeuvring

console is used to steer the vessel close to shore, including mooring. Also included is the radio mast required to communicate with the vessel.

Water samples collected by the hydrodrone will be analysed in a laboratory so that the physicochemical profile of the port basin waters can be established during the project. The data obtained during the research, especially the results of observations and analyses, will be included in the final report containing recommendations and indications for the state administration on the use of floating robotic platforms in research work in port waters.

Part of something bigger

The Polish Gdynia-based Marine Technology is the owner and developer of the hydrodrone. Since its inception in 1998, the company has been conducting research & development in the field of technical sciences. Among others, it employs experts in navigation, hydrography, geoinformatics, geodesy and cartography, oceanography, remote sensing, photogrammetry, automation and robotics, computer science and electronics. Marine Technology has carried out many research projects (on modern technologies, including Artificial Intelligence) and filed several patents. In October last year, it won a tender announced by the Port of Gdynia Authority and is now responsible for executing the necessary measurements using the hydrodrone.

The robotic craft for port water research in Gdynia is part of the Monitoring and Observation System for Port Areas Using Floating Unmanned Mobile Research Platforms international R&D project. Its consortium consists of the Port of Gdynia Authority (the Project Lead), Gdańsk University of Technology, Gdynia Maritime University, the Norwegian Institute of Water Research, and the Asker-headquartered Miros AS (a tech company that specialises in measuring the ocean surface). The €1.6m project is sponsored by the Polish National Centre for Research and Development, with the funding support (€1.25m) from the Norwegian Mechanism in its current perspective. The project's main objective is to determine the possibility of obtaining accreditation from state administration units for all research carried out using robotic surface platforms and creating recommendations for technical standardisation in this area.

The deep dive

The essential benefits expected to result from using the hydrodrone include an increase in the effectiveness of research work through the implementation, in cooperation with the Maritime Office and the Harbour Master's Office in Gdynia, of unified rules for the use of robotic platforms in port waters.

With the help of the hydrodrone (hopefully, an entire fleet in the future), we hope to ensure constant surveillance of port waters, including places difficult to access or dangerous for humans. We also want to expand the scope of observations of the marine environment thanks to measurements of water currents and waves together with their modelling, increasing the intensity of performing environmental research (even 24/7). The research will result in reports that will be an important contribution to the emerging legislation on floating robotic crafts.

The hydrodrone innovation fits the EU's policy on climate protection, including the sensitive Baltic waters, through implementing a pro-ecological monitoring system. It will also certainly boost the Port of Gdynia's know-how in ecology and innovation. This small, robotic vessel has truly proven to be an attractive alternative to the solutions used so far, especially concerning water research in difficult and dangerous to access places. ■



Photos: Port of Gdynia





