

# Integration of USV with high-resolution multibeam echosounder for complete automation of bathymetric measurements



*mKurs USV with iWBMS*

Imagine you are a surveyor, comfortable seated by a lake or a sunny beach observing a small, autonomous boat performing a bathymetric survey. Your only responsibility is to monitor the screen where bathymetric data is covering more and more of your survey area and to signal other boats with a honk if they cross your path.

Is it just a naive surveyor's dream? We may be closer to such a solution than you think.



*mKurs running autonomous survey*

**The beginning**

It was a fortunate occurrence when representatives from the Polish company K2sea and NORBIT (Norway) started to chat and share their experiences. They both felt that it would be valuable to try integrating the small uncrewed surface vehicle (USV) mKurs with the NORBIT iWBMS multibeam sonar. The outcome of this collaboration was highly successful and worth the effort.

The purpose of the integration is not only to mount the multibeam sonar on the USV to provide a simple way of operating them both simultaneously. To fully understand issue's complexity, one must consider that the USV is an independent system with its own power supply, propulsion, suitable user interface, and communication method. Similarly, the multibeam echosounder has its own dedicated software for handling settings and data acquisition. How can we effectively integrate these programs and requirements without relying on multiple screens and computers in a control room? Can we accomplish this task with just a laptop and a tablet?

**The meeting place**

Following extensive discussions and preliminary tests, both teams opted for a crucial final trial, intending to validate our concepts and technical skills. Our destination was Lake Drawsko in north-central Poland. It has a post-glacial character and is the second-deepest lake in the country (79.7m deep). We were warmly welcomed by the local historical and cultural association Tempelburg, which guards the mysteries associated with the lake. It's not a huge secret that the famous Templars had their castle by the lake, but modern times also ignite the imagination. During World War II, this site was likely a training centre for Kriegsmarine cadets, and perhaps small submarines of the 'Seehund' type were tested here, with one of them supposedly remaining forever in the waters of Drawsko. We decided to explore the

lakebed hoping it would reveal more secrets.

**The Integration**

NORBIT iWBMS multibeam echosounder with narrow transmit is a part of NORBIT curved array, bathymetric integrated systems family. It has 512 true beams (0.9°x0.9°, at 400kHz), a high-end navigation system and a very compact deck unit with small power consumption. All those features and light weight make this sonar perfect for integrating onto, especially for medium and small size, unmanned vehicles.

The NORBIT user interface has recently been enriched with a straightforward Data Acquisition software (DCT) operating within a web browser window. It can be remotely accessed from any browser, anywhere worldwide, through VPN connectivity. Specifically tailored for autonomous vehicles, an Autopilot application has been developed to link the data acquisition program with the controlling and navigating system of the USV.

These programs constitute a part of the NORBIT Open Hydrographic Platform (OHP), which enables visualization and redirection of the collected echosounder data streamed into any open-source software or GIS.

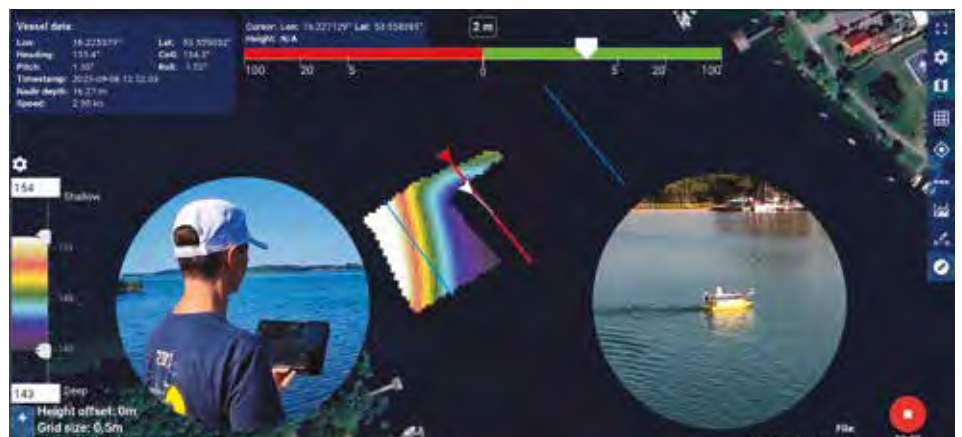
The Autopilot application assists in autonomously planning survey lines based on the already measured bathymetry to keep full data coverage and transmitting information to the USV about subsequent waypoints and alterations in the planned route, making this setup a real autonomous surveying platform (ASV).

The USV by K2sea is a compact, highly versatile, small, uncrewed surface vessel of 1.6m in length. Engineered for various survey tasks, especially bathymetric measurements, it features a dynamic shape which ensures stability and high-quality hydrographic operations. The USV has two efficient electric motors with Kort-nozzled propellers, guaranteeing high manoeuvrability and an independent power source for critical vessel systems. The attached gondola carries the NORBIT iWBMS echosounder. To mitigate potential communication issues via WiFi or LTE, the boat's control system and multibeam echosounder computer were placed onboard, ensuring data integrity. A web browser on a tablet allowed remote access to the Data Acquisition software (DCT), enabling setup and monitoring of the progress during autonomous data acquisition. Additionally, the mKurs was outfitted with an automatic winch for conducting sound velocity casts using a small profiler.

**The survey**

The survey was conducted during two hot summer days. We were monitoring from the shore how the ASV was doing the job. We confirmed the deepest point in Drawsko Lake for more than 79m (depending on the water level). We also mapped a shallower part where some interesting artefacts were expected to be found. However, despite the high-resolution data (10cm), we saw only a small wreck of 2.5m long boat and some stones.

*Autopilot in use, Surveyor observes Real time updates on the tablet.*

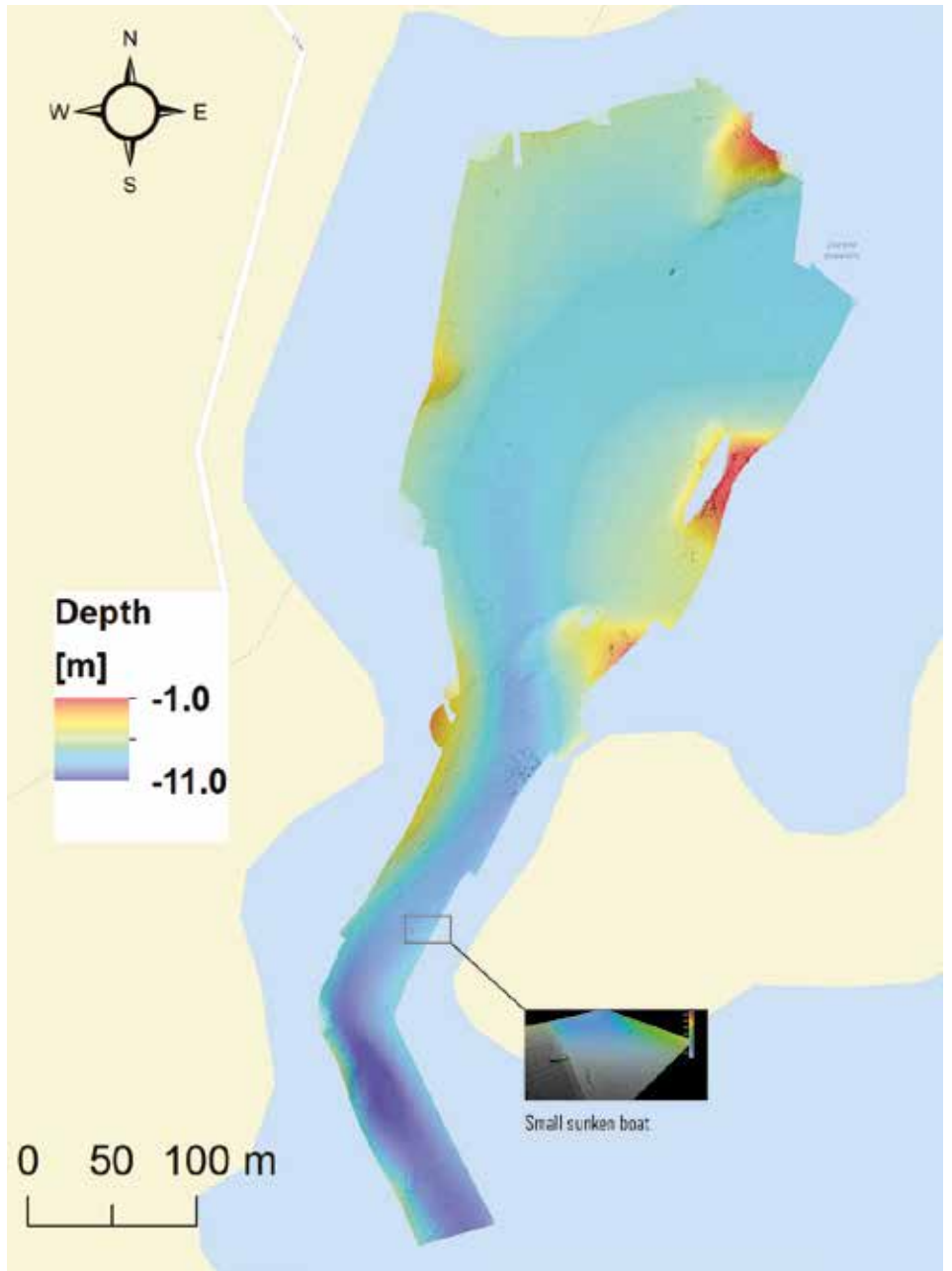


The autonomous hydrographic system created by this collaboration has passed the exam and demonstrated its capability to operate with minimal assistance from a hydrographer on land. The operation was seamless, and the data quality obtained was excellent.

.We would like to thank the members of the historical and cultural association Tempelburg for their outstanding hospitality, open-mindedness for high-tech solutions in exploration and understanding of the specificity of field data collection.

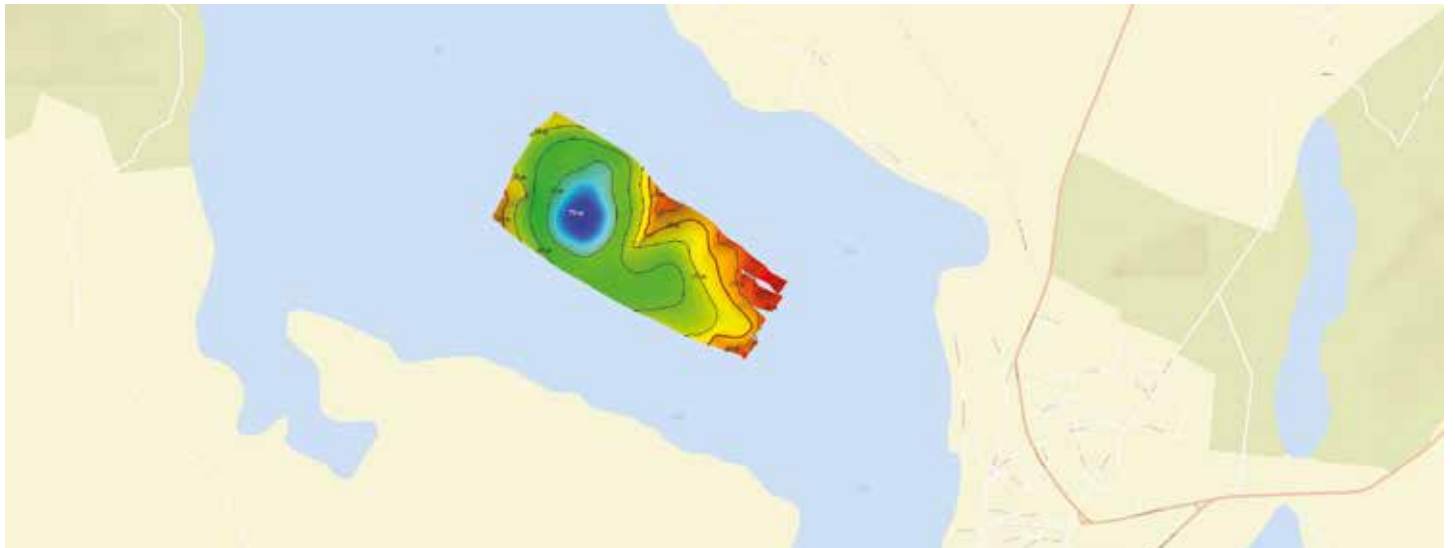
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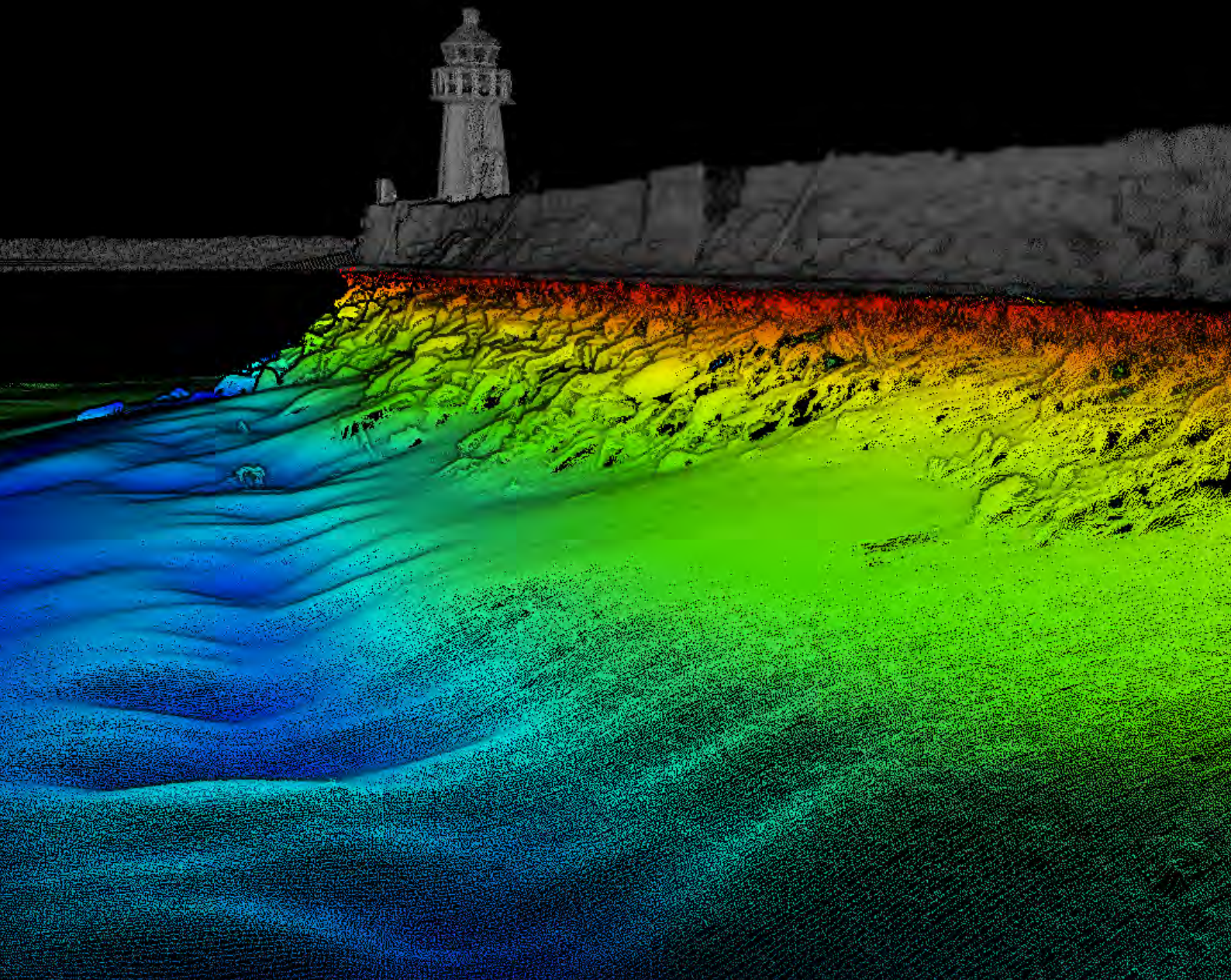
*Shallow Water Survey*

*Deeper Water Survey*





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