Case Study:

MONITORING CANAL BED MORPHOLOGY AND PROTECTING NAVIGATION LOCKS USING IMPACT SUBSEA'S ISS360 SONAR

Aging Infrastructure vs. Modern Vessel Impact

Navigation locks are vital bottlenecks for canal and river networks. However, many historic lock systems were designed decades ago for smaller vessels.

Today, larger ships navigating these channels introduce severe hydraulic forces:

- **Propeller Wash & Scouring** High-velocity water jets from modern cargo ships erode the protective layers of the canal bed, creating deep scour holes that can threaten the foundational integrity of lock structures.
- **Rolling Stones Hazard** Displaced stones and gravel from eroded bed layers are pushed toward the lock chambers. These obstacles frequently jam the closing mechanism of massive lock gates, risking physical damage and costly downtime.
- **Draft and Sediment** Tracking how a ship's draft interacts with the canal bed is crucial for understanding sediment movement and preventing groundings.

Aerial photo of The Beatrix lock

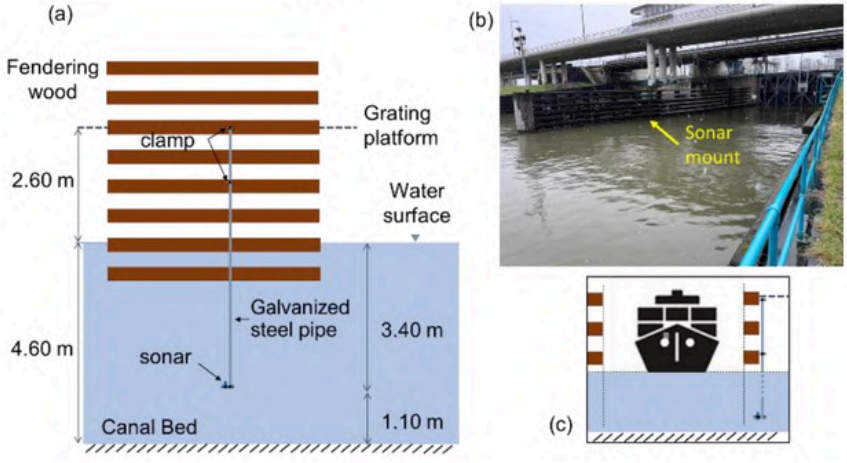
As modern commercial cargo vessels grow larger and carry deeper drafts, inland waterways and aging navigation locks face severe operational challenges.

Propeller wash, bow thruster turbulence and high-velocity water flows during lock operations cause critical structural issues such as local scouring, sediment displacement (often pushing stones into lock gates) and bed morphology changes.

Traditional underwater inspections, relying on divers or manual periodic bathymetric surveys are labour-intensive and heavily limited by poor visibility in turbid waters.

Awarded best paper at the international SHM conferences, SHMII-13, a study by University of Twente researchers Mohsen Bastani and Rolands Kromanis, "2D sonar techniques for monitoring the canal bed morphology of entrances to navigation locks", utilised Impact Subsea's ISS360 Imaging Sonar at the Prinses Beatrix Lock in the Netherlands.

The implementation demonstrates how a compact, high-resolution 2D sonar can automate structural health monitoring, detect hazardous bed changes in real-time and estimate vessel drafts to safeguard critical infrastructure.



A schematic of sonar installation with some principal dimensions (a), the view of sonar location (b) and projection of sonar toward the ship track (c).

ISS360 APPLICATIONS INCLUDE:

ROV & AUV Navigation | Target Identification | Diver Navigation | Port Surveillance | Motion Reference | Search & Recovery |

IMPACT SUBSEA
INNOVATIVE SENSORS

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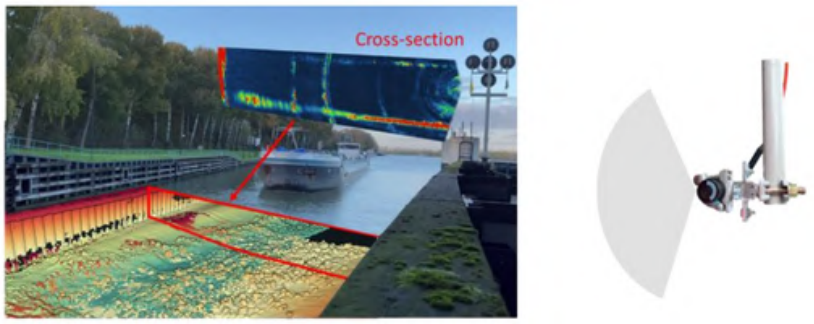
Traditional inspection methods cannot provide the continuous, high-frequency data required to catch these dynamic shifts in real-time.

The ISS360 sonar was mounted securely to monitor the approach channel and bed protection layers of the lock. Connected to a localised processing unit, the sonar system feeds real-time acoustic scan data into a custom image-processing and data analysis pipeline.



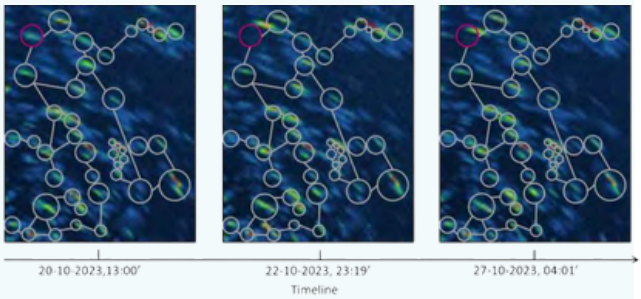
An illustration of a photo combined with 3D point cloud data and the sonar image of the cross-sectional of the canal (left), and the sonar tilted 90° (horizontally mounted) for measuring the ship's draft (right)

Results and Potential Impact

- **Proven Technical Feasibility** Demonstrated that 2D sonar can successfully automate bed morphology tracking as a viable alternative to manual diving.
- **Potential for Disaster Prevention** Showed how acoustic tracking could detect migrating stones to protect lock gates, de-icing pipes and prevent closures.
- **Path Toward Optimised Maintenance** While current incident rates at the Prinses Beatrix Lock do not yet demand continuous monitoring, the study establishes the capability for targeted maintenance when future needs arise.

The system performs three core tasks:

- **Scour & Sediment Detection** Automatically tracks the evolution of bed morphology, differentiating between the initial erosive stage, development stage and equilibrium depth of scour holes.
- **Obstruction Identification** Detects displaced rocks and debris "rolling stones" traveling along the bed before they reach the lock gates.
- **Ship Draft Estimation** Captures acoustic signatures of passing vessels to accurately estimate vessel drafts and correlate them directly with bed disturbance intensity.



A region of interest at three different times, illustrating changes in the fixed pattern of the bed protection.

SHM4SI

Research Team SHM4SI Website

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Specifications subject to change in line with product enhancements

00003185 | Rev. 1.2

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