

Sonic 2024 Dual Head Survey

Summary

R2Sonic's **Sonic 2024** has recently been tested in Dual Head mode by Stema Systems mounted on a surface vessel. The Test was performed on a 7 meter survey vessel, with goal to survey the fringes of several Dutch rivers and waterways. Measurements were achieved in water depths ranging from 0.5 to 35 meter.

Data-acquisition could easily be done by an off the shelf Laptop with all sensors interfaced via Ethernet and source timing.

Maximum achieved swath width was 120 meter at 4-5 meter water depth: >25 times water depth coverage. Comparison with standard survey lines showed the repeatability of the data and absolute deviation between the two sets was less than 10 cm. At normal survey speed, a swath width of over 14x water depth coverage was achievable. An additional benefit of the tilted sensors was the reduced risk of damage as sailing near groins could be avoided.

The tilted head enabled measurements close waterline (<0.5 meter from waterline).

Introduction

With a 160 degree maximal wedge capability the necessity of dual head configuration is in many cases not strictly necessary. There are however situations when the dual head configuration will have a cost effective and risk reducing effect:

- Increased hit count and path width in very shallow waters
- Horizontally focussed beams for sideways detection of groins and structures (risk reduction)
- Better low angle performance on flat bottom due to better arrangement of receiving array
- Increased detail by overlapping data

To evaluate the technical possibilities and the added value to the survey operations, Stema Systems installed 2 complete Sonic 2024 systems on a small survey vessel for inland and shallow coastal operation. Tests were performed on the River Lek and the Amsterdam-Rhine Channel in the Netherlands.

Sonic dual head functionality and advantages

The **Sonic 2024** has the capability of selecting dual head configuration from the Control software. When the dual head is selected, a second wedge display is enabled and controls such as range, power, pulse length and gain set both sonar heads.



Fig 1: 7 m long survey vessel "Karnic" equipped with 2 R2Sonic Sonic 2024, Ixsea Octans G4, Stema Systems GNSS960, Qinsy8.0

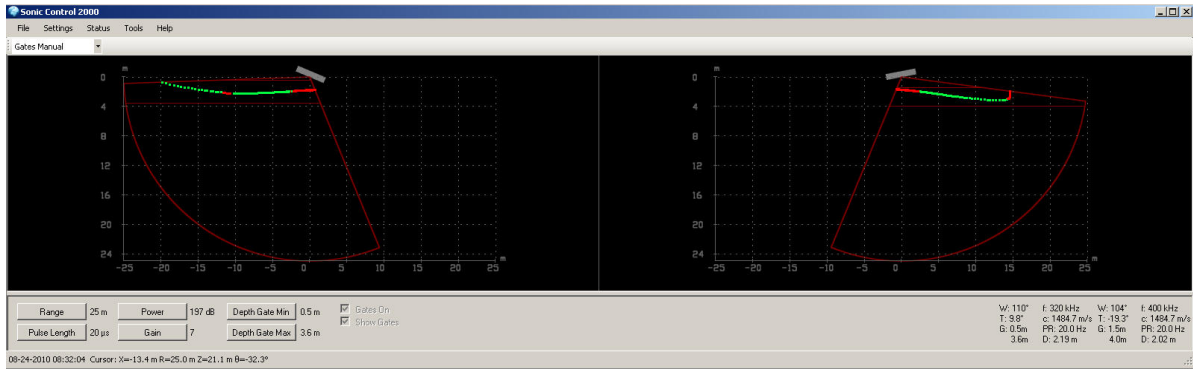


Figure 2: Sonic Control Dual Head Wedge Display

Other high frequency multibeam echosounders are limited to alternating ping in dual head configuration, which effectively halves the ping rate at a given range setting. Depending upon the depth and range selection, a significantly reduced ping rate will provide lower data density when used from a surface vessel. The **Sonic 2024** is unique in that simultaneous ping is possible in dual head mode, providing full ping rate at the given range setting by working on different frequencies.

System setup

The sonar head heads were placed on a bow mounted frame approximately 1 meter apart and tilted outwards at approx 20° tilt angle.

The tilt angle is entered in the Control Software to rotate the wedge and depth gates.

Data-acquisition was done on a laptop PC with all systems (RTK, MB1+2, Attitude/gyro) connected via Ethernet ports. A switch is handling the data streams. Motion sensor and both SIM boxes of the Sonic units are source time stamped.

Depending on the overlap required, the frequency was offset. With minimal overlap both units worked on 400 kHz without interference. With increased overlap some unpredictable interference was noted. To eliminate the interference, Sonar 1 was set to operate at 320 kHz with Sonar 2 at 400kHz. No interference occurred with the offset frequencies selected and with no visible impact on the data results.

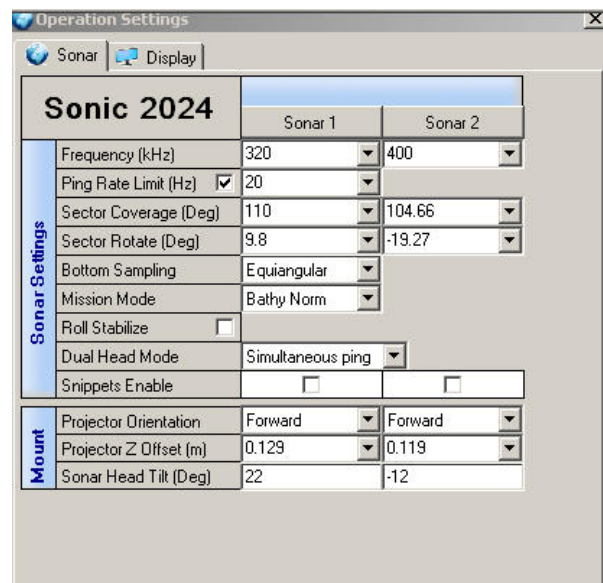


Figure 3: Sonic Control Display Dual Head Mode Simultaneous Ping



Fig 4: Dual Head survey was run on laptop PC with all sensors interfaced via Ethernet port



Fig 5: Required space for 2 SIM boxes is still modest

Alert Gauges	Description
	STEMA-GNSS 960 (UDP 5018) - Timeout (5)
	PPS (UDP 5025) - Timeout (5)
	SONIC 2024 - SB (UDP 5000) - Timeout (5)
	SONIC 2024 - PS (UDP 4000) - Timeout (5)
	OCTANS G4 ATTITUDE (UDP 8111) - Timeout (5)
	OCTANS G4 HEADING (UDP 8111) - Timeout (5)
	STEMA-GNSS 960 - Position mode outside limit (3 - 3)

Fig 6: All sensors on Ethernet Port

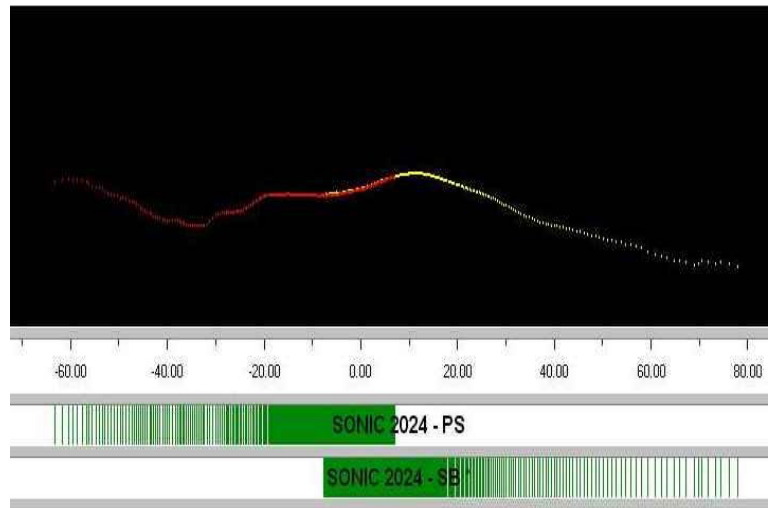


Fig 7: Combined swath display in Qinsy data acquisition window. Real time control on line up and SV at head.

Results

During the tests the systems ran problem free, with minimal processor load. A laptop was clearly sufficient for the task and data routing via a gigabit Ethernet switch proved to be a sound solution.

Several test lines were run to check the maximal coverage and even more important, the repeatability of the low angle measurements.

The survey area was a 120 meter wide channel river with a water depth of 4 to 5 meters. River level was 3 meter above datum during the measurements.

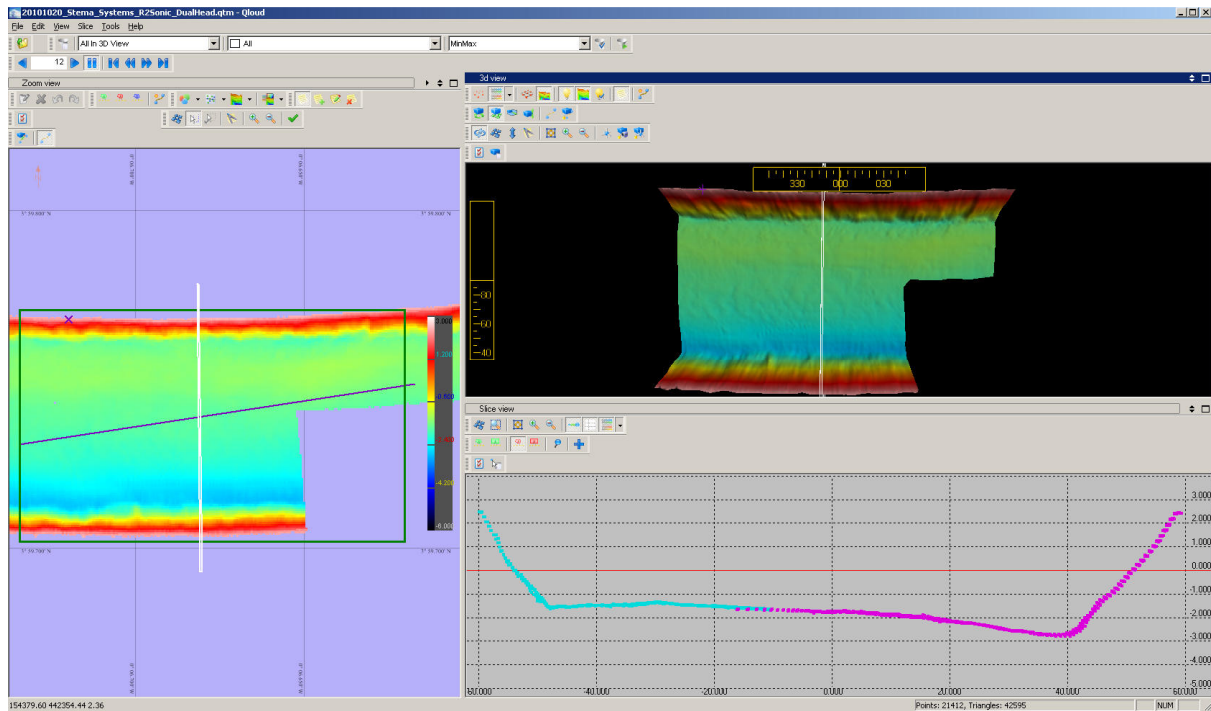


Fig 8: Qloud presentation of 120 meter wide channel of 4-5 meter water depth surveyed in 2 lines at normal survey speed. Horizontal scale lines: 20 m, Vertical scale lines: 1 m

In fig 7, two lines at standard survey speed were sufficient to cover the 120 m waterway. The Survey results comply with the **NL-geonorm A**, which is slightly more stringent than IHO special order. A hit count of minimal 10 validated measurements per square meter was achieved. In the overlapping section the 95% reliability was better than 10 cm. This is evident from the good matching of the lines in fig 8. A 70 meter wide path was achieved: eg. 14x water depth coverage.

In fig 9, a trial line for the shallowest reading is presented. With the head tilted 20° and maximal wedge limit of 80° , the outer beam faces 10° upwards from the horizontal. With a local water level at plus 3.05 meter, it was possible to obtain viable data up till 2.90 meter. The last useable data was measured only 15 cm underneath the water level. Though the target was to measure the slope, a path width of 45 meter was surveyed in a single go: eg. 10x water depth coverage.

When it is possible to survey a 120 meter wide shallow channel in two runs, it should be possible in one. Figure 10 shows the results of the acquired data. It not only appeared to be possible to map the channel in a single run (slow 5 km/hr, 2.7 knots), the data matches. When compared to the data obtained from the other survey runs, differences are very small. While hit count is much less and in sections insufficient, more importantly the data sets have a good match. On flat bottom the maximal deviation in the outer section is 15 cm. However, in most sections it is much less. The data has a very high repeatability, giving confidence in the data quality of the outer beams of the system.

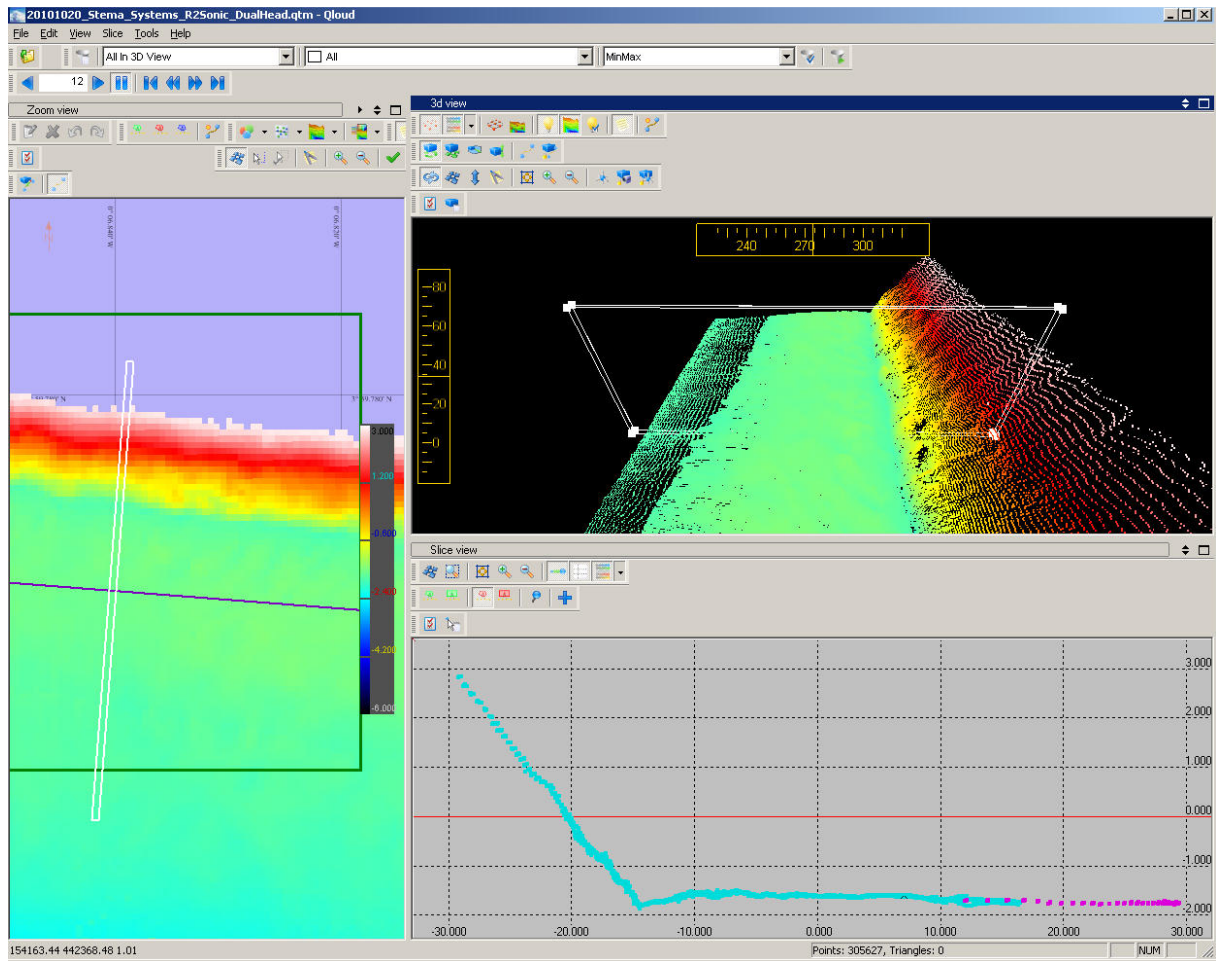


Fig 9: Detail of shoreline measurement. The shore section was surveyed in detail at normal survey speed. Valid readings were obtained up to 15 cm below the water level (3.05 m during survey)

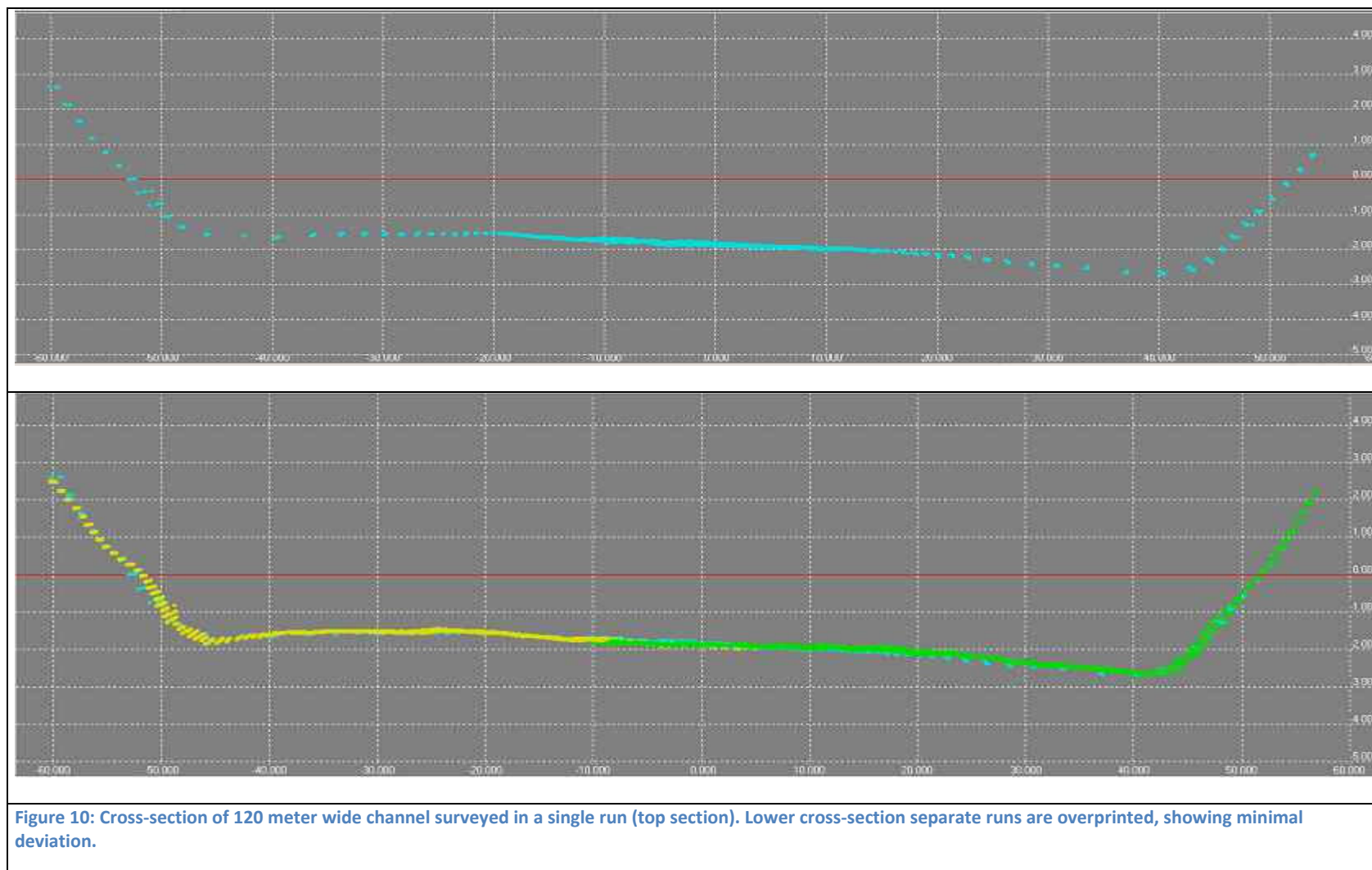


Figure 10: Cross-section of 120 meter wide channel surveyed in a single run (top section). Lower cross-section separate runs are overprinted, showing minimal deviation.