

Welcome

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FIG Working Week 2011 Bridging the Gap between Cultures

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The development of a multiple transducer MBES for very shallow waters

1. Basics

- Requirements and Implementation Concept

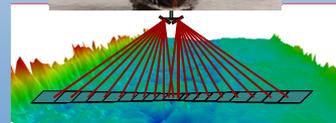
2. Suitability tests

- Surveying vessel type
- MBES Investigation and Development

3. Performance in Operation

- Combined System accuracy and efficiency
- Examples of high resolution DTM

4. Summary



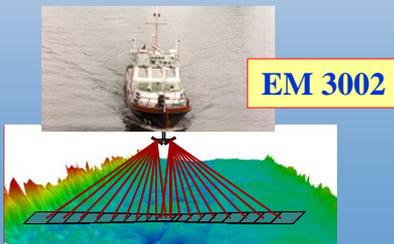
Implementation Concept

Basis requirements:

-Increase of efficiency and suitable for water depths 2 to 4m.

Increase of efficiency by

- critterion 1: maximizing the area covered by one sounding,
- critterion 2: maximizing speed over ground during data acquisition,
- critterion 3: minimizing overlap of swathes.



Requirement:

MBES with equal-distance beamforming, => homogenous distributed measurements in each ping

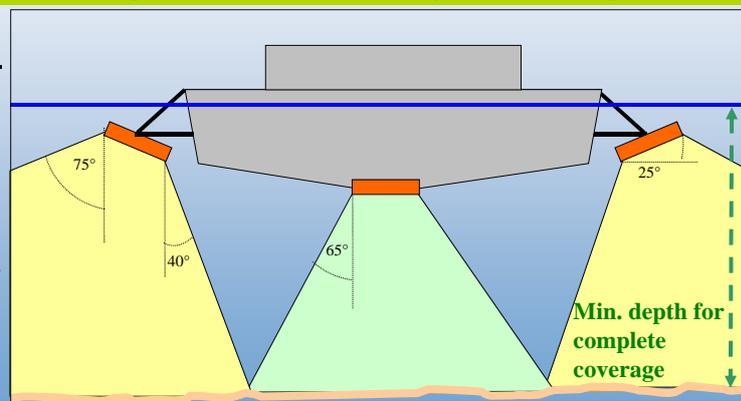
Implementation Concept

Criterion 1: maximizing the area covered by one sounding

maximizing the swath width by combining 2 MBES

Complete coverage if:

- distance between outer transducers > 8m and depth > 1.8m
- transducers are mounted at a depth of 0,5m



Survey vessel type test

Criterion 2: maximizing speed over ground during surveying

Criterion 3: minimizing overlap of swaths

Both criteria are governed by the selection of the appropriate vessel type.

➡ 5m overlap: roll angles should be $< 3^\circ$, navigation precision of 2-3m, speed of 12 Km/h against the current (limit in canals).

- The monohull boat rolls up to 8°
- The catamaran meets the requirements:
 - roll angles $< 3^\circ$,
 - Easy and precise navigation along survey routes.

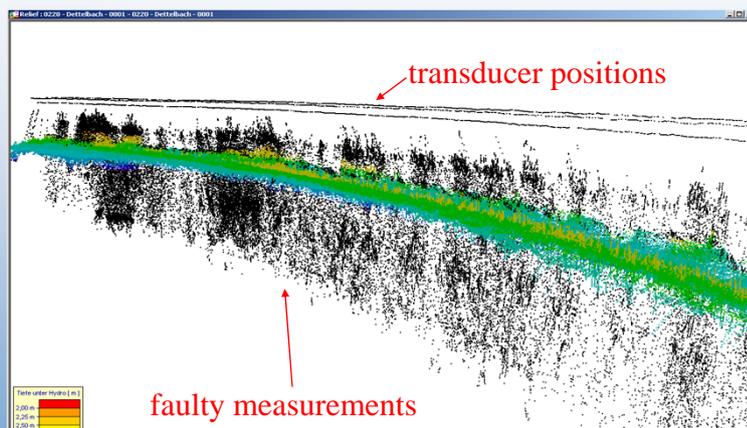


MBES investigation and development

General suitability check of EM3002

Results:

- excessive number of outliers,
- no correlation between the errors and the mounting angle,
- errors occurred even using one MBES.



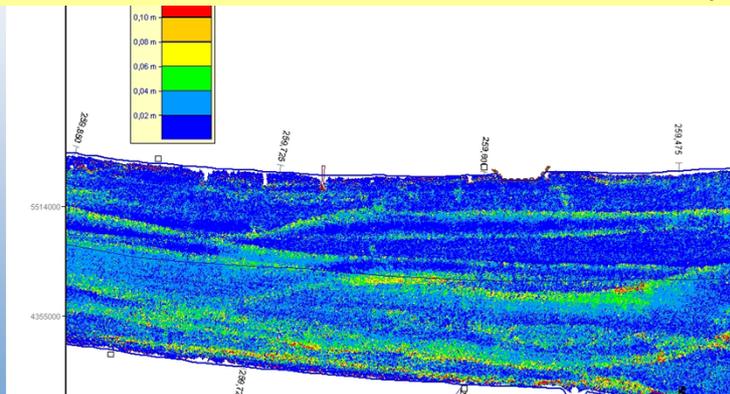
after improvement of bottom detector by Kongsberg:

The general suitability of the combined system based on the EM 3002 by Kongsberg was proven.

Accuracy

Sensor eccentricities and transducer alignment angles were measured directly by tachymeter.

=> More accurate than field calibration in waters with depth < 4 m

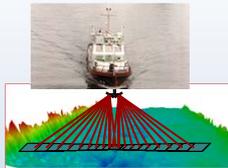


- average standard uncertainty of the model surface is 2-3 cm
- std.U. of 4-15 cm in areas with beam angles > 75°

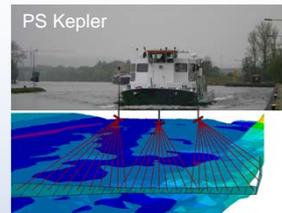
Efficiency on rivers

Comparison of systems

Conventional equal angle system
(e.g. EM 3000)



combined system
(e.g. EM 3002)



Disadvantages:

- Time and effort for calibration + 30%
- surveying system is + 35% more expensive
- higher procurement costs for vessels in the future + 150%

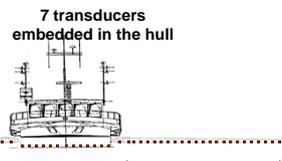
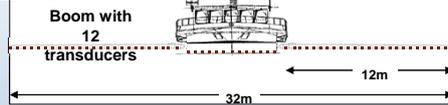
| River, average fairway-width of 150 m | | | |
|---------------------------------------|--|--|---|
| Depth [m] | No. of lines equal angle system, 50% overlap | No. of lines combined system, 5m overlap | Increase of efficiency (including 33% higher SOG) |
| 2,0 | 23 | 11 | 142% |
| 3,0 | 14 | 7 | 133% |
| 4,0 | 10 | 5 | 133% |

The new system will survey the same area in less than half the time.

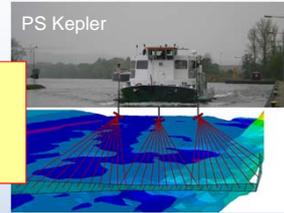
Efficiency on canals and small impounded rivers

Comparison of systems

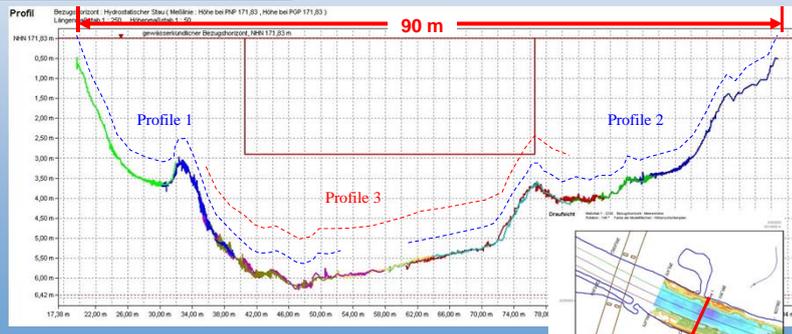
multi-channel sweep echo sounder



combined system (e.g. EM 3002)



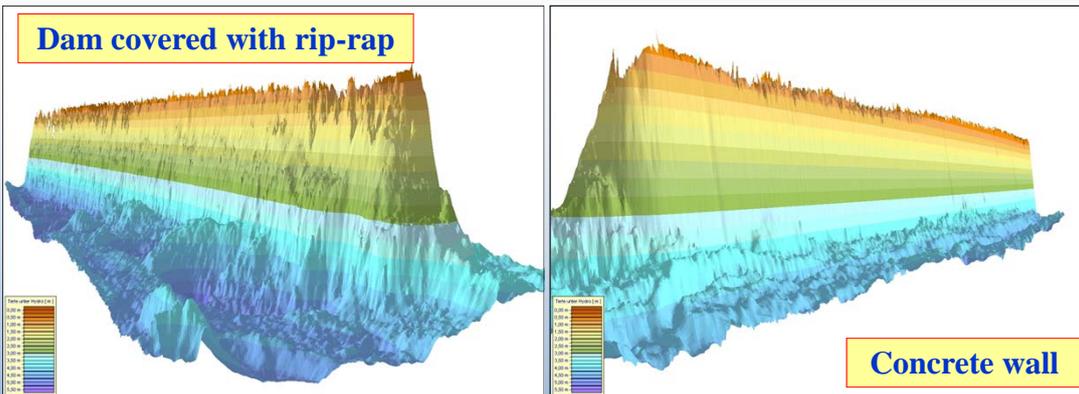
- Faster (10km/h versus 6km/h)
- Increase of efficiency 67%



The new system will survey the same area in 60% the time.

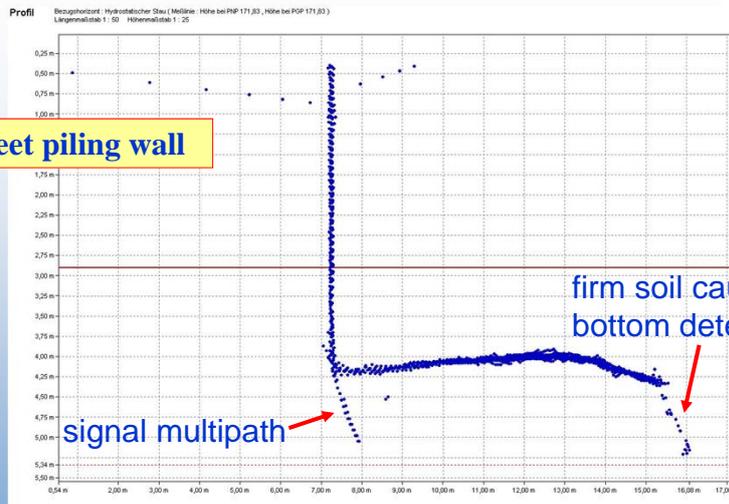
Inspection of underwater constructions

Dam covered with rip-rap



- homogeneous data density in equidistant mode => model resolutions of 0,25 m are possible.
- small objects (rip-rap-stones) can be distinguished

Inspection of underwater constructions



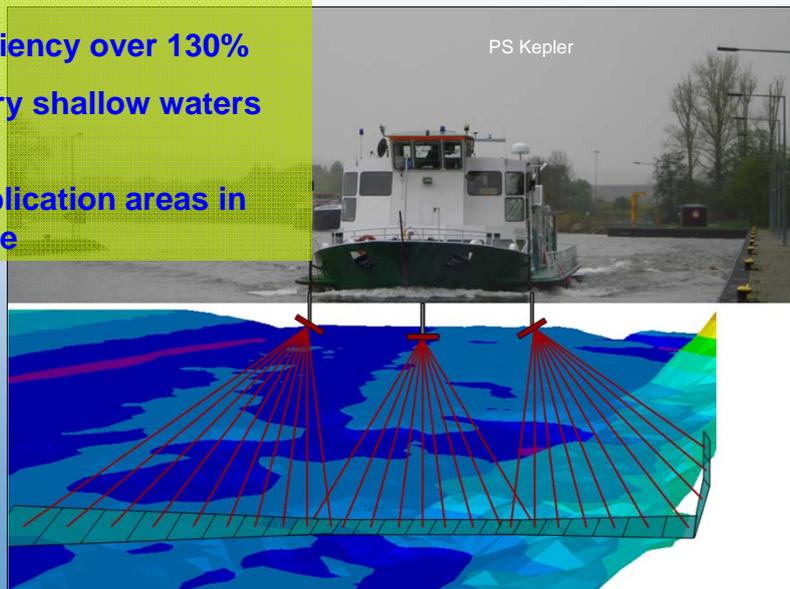
Sheet piling wall

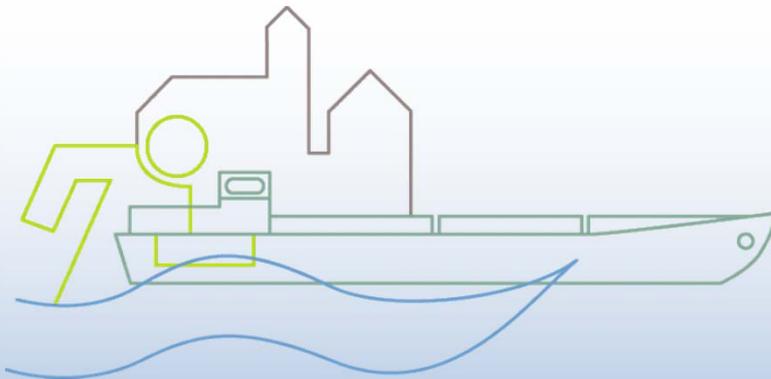
- Kongsberg still works for improvement of the bottom detector algorithms

Summary

A combined triple head MBES:

- increases efficiency over 130%
- is a must in very shallow waters (depth > 2m)
- opens new application areas in equidistant mode





Thank you for your attention

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