

Modern multibeam technology

Beyond accurate depth measurements

An article by PETER GIMPEL and CHRISTIAN ZWANZIG

Every 50 years there are new developments in hydroacoustics. Hundred years ago, Alexander Behm invented the echo sounder, round about fifty years ago General Instruments developed a Sonar Array Sounding System. Today everyone talks about high-resolution Water Column Imaging. The aim is to detect all objects in the water column. However, it's a hard job for the survey operator to observe the screen. The question is: What is the next big thing? The industry works on an Automatic Object Detector. The article gives an insight in the stage of development and points out the challenges.

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Introduction

We are celebrating the 100th issue of *Hydrographische Nachrichten*, a milestone for the official publication of the German Hydrographic Society as well as for the German hydrographic community.

Not long ago we celebrated another important date for hydroacoustics as well – 100 years since the invention of the echo sounder by Alexander Behm in Kiel, Germany. On several occasions, amongst others with articles in the *HN* and two exhibitions, supported by the German Hydrographic Society, the birth of modern echo sounding and the ingenious inventor Behm have been honoured.

Inspired by the tragic accident of the »Titanic«, Behm's intention was to develop an apparatus to detect icebergs well ahead of a vessel. After initial thoughts he realised that the echo response of icebergs was very difficult to detect, to measure the reflection of acoustical energy from the sea-floor instead was much more promising. Starting with this idea of using the variation in signal reflections to measure the depth of the sea-floor, Behm quickly realised after first disappointing experiments in Kiel bay, that this approach would not lead to success. Instead, he had to invent an accurate timer in order to measure the echo travel time with sufficient accuracy.

This invention started the age of modern hydrography and revolutionised the depth measurements at sea. Until today, single-beam echo

sounders are the »workhorse« of hydrographic surveying.

Speaking of anniversaries: 1963 – around 50 years ago – the installation of the first multibeam sonar sounding system marked another huge development step ahead. Who would have thought that the downing of the U2 US air force spy plane in May 1960 by Russian forces triggered the development of a new generation of mapping sonars? Here is the answer: At that time engineers of the US company General Instruments were in the planning phase of a new system for radar land mapping for the U2 plane, based on the »Mills Cross Technique« developed by the Australian radio astronomer Bernard Mills. The concept existed, but suddenly no more application on a spy plane. Instead, General Instruments presented this concept as »BOMAS-1« to the US Navy and within shortest time the Sonar Array Sounding System (SASS) was developed. With a frequency of 12 kHz, sixty-one 1 degree preformed beams stabilised for roll and pitch and a swath with of ± 30 degrees from the vertical, the water depth could be mapped with unprecedented accuracy. This technology was later commercialised as SeaBeam System and used by almost all leading marine research institutes worldwide. Fig. 1 shows the specifications of this system and as an example the mapping of the Mariana trench by the Japanese Research Vessel »Takuyo«.

Today, high-resolution depth charts, »calibrated backscatter strengths« and side-scan images are »standard« results of a multibeam survey. In addition, new applications have been developed by the sonar industry. »Water Column Imaging« (WCI) uses backscatter data from the water column of multibeam sonars. Modern data recording and processing systems allow the storage of raw data for further processing. Fig. 2 shows an example of this integrated data acquisition and processing approach. Data were recorded with a 50 kHz multibeam sonar SeaBeam 3050 installed on RV »Poseidon« (Cruise POS 469 – data provided by Jens Schneider von Deimling, Helmholtz Institute for Marine Science GEOMAR, Kiel).

Fig. 1: Data sheet SeaBeam System (General Instruments, today L-3 Communications ELAC Nautik GmbH)

