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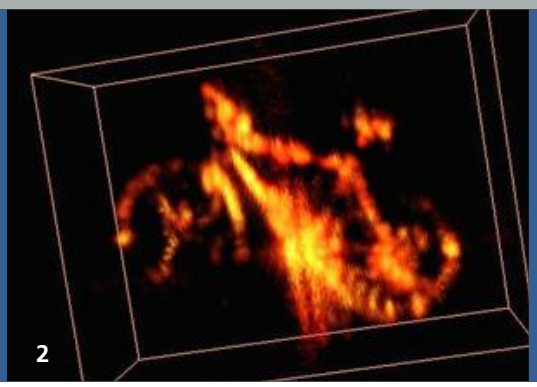
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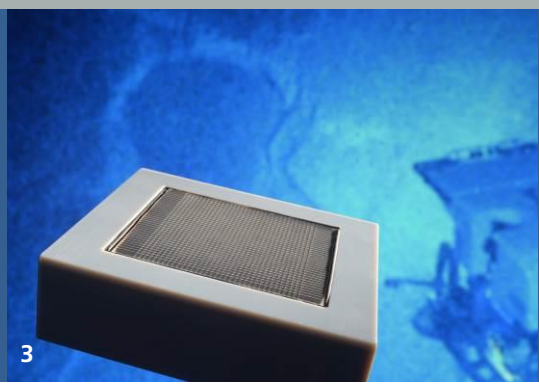
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1 *1 MHz compact Multibeam Echo Sounder (MBES) for underwater vehicles (AUVs, ROVs)*
2 *3D reconstruction of bicycle shown in figure 6*
3 *1024-element 2D matrix array for sonar applications*

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SONAR TRANSDUCERS AND SYSTEMS

Mapping, Detection, Identification

Modern oceanology and maritime traffic needs a plurality of sensor systems. Researchers as well as ship captains depend on the availability of reliable and accurate underwater measurement data.

Mapping, for example, is one of the basic measurement methods that needs to be performed in oceanology. Mostly Multi-beam Echo Sounders (MBES) or Side Scan Sonars are widely used for this measurement task. The success of such a measurement depends on many different parameters. If one single parameter of the measurement system does not meet the requirements, the results cannot be ideal. Thus, a huge amount of time and money can be lost.

Therefore, it is very important to precisely adapt a system to the current application.

Transducer Technology

Concerning the requirements for range and accuracy, single or multibeam sonar systems at different frequencies are developed at IBMT.

Applications like echo sounding, floor mapping, fish finding or even mine hunting can be handled by combining appropriate piezoelectric transducer technology (bulk or composite material) with IBMT's advanced electronic hardware (e. g. DiPhAS, USS or TRM) as well as fast and robust signal analysis.

Sensitivity, bandwidth and the sound opening angle are the most important acoustic parameters influencing the quality of an acoustic system for underwater measurements.

IBMT uses the complete development chain from transducer simulation and construction (CAD) over material tests and prototyping up to testing on phantoms and calibration targets to provide customer-specific solutions for underwater

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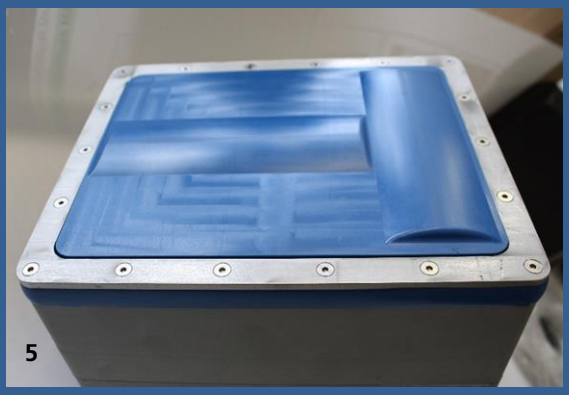

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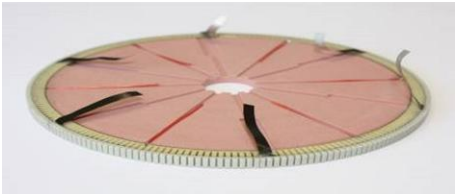
applications with excellent acoustic parameters.

It is IBMT's core competence to build highly customized transducers and antennas. If large sound opening patterns in combination with high transmit coefficients are demanded, IBMT can use its patented technology to build special curved transducers.



Circular test transducer for antenna calibration.

2D and 3D Sonar Imaging

IBMT's compact beamformer system is now available for sonar applications. The system works together with phased-arrays, array combinations like Mills Cross antennas or fully populated 2D matrix arrays. This allows 2D or 3D measurements even in real-time.

The electronic system works at frequencies of up to 20 MHz with 128 transmit and 128 receive channels.

Using additional 1:8 multiplexing, antennas with up to 1024 single elements can be operated.

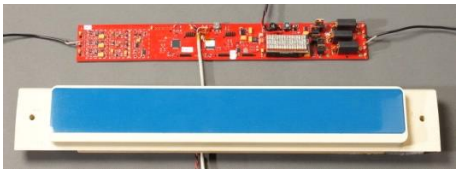
One implementation for harbor and ship hull inspection is a shoe box sized multibeam echo sounder-version of the above mentioned electronics with a compact 128-element, high-bandwidth antenna for high-resolution scanning (figure 1). Antenna and electronic system form a unit that can easily be integrated in AUVs or ROVs.

Other versions especially for volumetric imaging are shown in figure 3 (2D matrix array) and figure 2 (Mills Cross antenna).

Side Scanner

In its basic configuration, IBMT's side-scanner technology uses three sensors at frequencies of 250 kHz, 500 kHz and 1 MHz intended for depths of 180 m, 100 m and 35 m. Depending on the transmit signal, a spatial resolution of up to 4 cm can be achieved.

For higher resolutions (e. g. crack inspections of concrete components) higher frequencies and better spatial resolution are available using the TRM technology. For the use in depths up to 6000 m, a pressure-tolerant setup can be provided.



IBMT 3-frequency side scanner alone and integrated in AUV (pressure balanced electronic is integrated in the transducer housing).

Echo Sounder

From shallow waters to deep oceans, echo-sounders are used for navigational or scientific applications (depth, profile, obstacle, physical or biological structures, etc.). IBMT develops single or multibeam echo sounders in form of single-element or complex antenna configurations (e. g. sparse array approach).

Combined with the DiPhAS, TRM or USS electronic system, stand-alone or embedded devices can be implemented with customer specific properties.

Application specific user interfaces and signal processing methods (envelope detection, correlation, etc.) can be programmed for an optimal solution according to depth and accuracy requirements.

Logger

For speed measurements and profiling, IBMT develops Doppler and correlation based loggers.

The current implementation uses a five head Janus configuration with four side-looking and one bottom-looking transducer working at 500 kHz.

Together with the Transmit Receive Module (TRM) both Doppler and correlation mode can be used for speed logging.

An implementation for current profiling (ADCP) is planned for the near future.

4 Sonar Test Tank (6 x 8 x 6 m³)
Front: Calibration phantoms

5 3D Mills Cross antenna for volumetric sonar measurements

6 Measurement object "bicycle" – result with MBES is shown in figure 2