

- 1 600 bar pressure chamber and deep sea battery for AUV or ROV purposes.
- 2 Submerging TIETEK-AUV during sea mission with research vessel ALKOR.
- 3 Obstacle avoidance system for AUV's.

DEEP SEA TECHNOLOGY

Exploration, Inspection and Monitoring

Systems and methods for exploring the seafloor, monitoring the marine environment, employment of offshore production, process and quality control technology as well as the increase of navigation accuracy and performance are only a few of the key-words that can be found in the analysis of the requirements for successful sustainable industrialization of the deep sea. Autonomous control, inspection and intervention are necessary in depths where the use of manned platforms and vehicles are too risky, too expensive or even impossible. Improvement and miniaturization of sensors, increase of energy efficiency, simple and robust programming and low request of maintenance are some of the requirements to facilitate the implementation of cost-effective systems for the maritime industry in the deep sea. IBMT uses its background in development of complex mechanical and electrical systems for harsh environments to develop solutions that can be applied in deep sea.

Technology

IBMT focuses its competence in the application of pressure neutral technology for the development of complete acoustic systems including sensors, electronics and data processing and carrier systems including mechanical and electrical components for drive, control and communication. Combining advanced simulation methods, material research and manufacturing technologies, complex systems which can be operated under extreme environment conditions, can be realized.

Application-specific setups for sonar, imaging, monitoring or communication systems in a frequency range from a few kHz up to several MHz can be implemented by combining single- or multi-element probes with appropriate electronic systems including single-channel modules or multi-channel array-systems. By the use of a special casting technology, the systems can operate under pressures up to 600 bar which corresponds to a depth of 6000 m in the open sea.

Fraunhofer Institute for Biomedical Engineering IBMT

Prof. Dr. Heiko Zimmermann
 Prof. Dr. Günter R. Fuhr
 Joseph-von-Fraunhofer-Weg 1
 66280 Sulzbach
 Germany

Contact

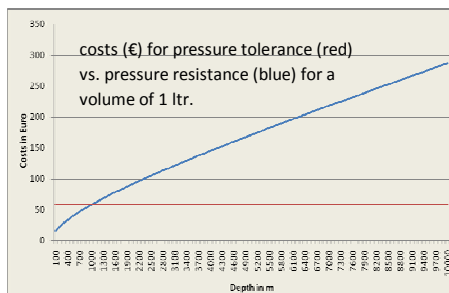
Christian Degel
 Technical Ultrasound
 Telephone +49 6894 980 - 221
 christian.degel@ibmt.fraunhofer.de

www.ibmt.fraunhofer.de



Pressure Tolerance vs. Resistance

Beyond a depth of 1000 m the use of pressure-tolerant components is superior to other technologies concerning weight, energy efficiency and costs (see diagram). A special casting technology in combination with the use of customized components (electronics) and special materials (foams for void-filling or backing) ensures a save and robust use of the pressure-tolerant systems down to a depth of 6000 m.



Resources

In the Ultrasound Division at IBMT, a team of more than 40 engineers and scientists is working on research and development in the field of ultrasonic applications, material research, sensor technology, electronics, mechanical design and data processing and visualization.

Computer-aided design procedures throughout the whole development cycle from simulation to precision part machining allow the minimization of development steps and the minimization of development risks. In-house testing and calibration facilities give confidence in performance and an ISO 9001 certified manufacturing ensures reliability and quality. For testing underwater and high-pressure-resistant components and systems several in- and

outdoor test beds are available:

- 600 bar pressure chamber (diameter 0,43 m, length 2,2 m)
- measurement tanks (e. g. 6 × 8 × 6 m with movable bridges).

Ultrasonic Probes

Dependent on distance and resolution requirements single- and multi-element ultrasonic probes in a broad frequency range are available. For the operation under high-pressure special material and design concepts are used.

For example a multichannel imaging system for real-time cross-sectional (2D) or volumetric (3D) imaging with a miniaturized digital beam-former frontend for direct integration into an array-probe (128 channels, scalable) is one of IBMT's latest developments. The FPGA-based design allows for direct high-level raw data processing and data transmission to a computer by Gigabit-Ethernet. The system is normally prepared to be used in shallow waters or, in a casted implementation, for deep water application.

Electronic Platforms TRM and USS

Different platforms for the development of stand-alone or embedded systems are available. Next to *pressure tolerance* two of the most important aspects for a system operating for a long time in a deep sea environment are *energy efficiency* and *size*. The Ultra Sound System "USS" and the Transmit Receive Module "TRM" are prepared to work in low-power mode and can be switched to sleep-mode. Both systems are prepared to be used for single-channel application with up to 16 sensors

(multiplexed) serving different applications (depth echo sounding, distance metering, obstacle detection/avoidance, flow profile, velocity, doppler measurement, correlation, etc.). Both have successfully been tested to operate under pressure up to 600 bar.

Vehicle Technology (AUVs)

IBMT has mainly developed Fraunhofer's TIETEK AUV-platform. This AUV is a modular system for inspection and exploration purposes operating in shallow water or in depths down to 6000 m. The pressure-tolerant realization of the vehicle makes it very lightweight and easy to handle on board. The modularity allows to assemble a vehicle exactly equipped with the tools customers need for their missions. Also a ROV-mode is possible – directly connected to the control center with camera-view and manipulators.

Our Service Overview

Beyond acoustic technology, IBMT provides competences in the fields of:

- design of sensors and electronics
- signal processing and communication
- vehicle bus systems & control modules
- hydrodynamic simulation
- hull design and manufacturing
- design of mechanical components (manipulators, propulsion, rudder components and control),
- system assembly and testing.

- 1 Payload module of TIETEK-AUV with 6000 m 3-frequency side-scanner.
- 2 TIETEK-AUV boarding RV ALKOR.
- 3 Pressure tolerant electronic.