



# Fraunhofer IBMT

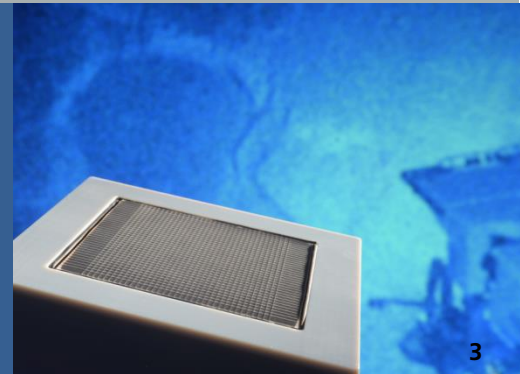
FRAUNHOFER-INSTITUT FÜR BIOMEDIZINISCHE TECHNIK IBMT



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- 1 *IBMT's DiPhAS-system with integrated multiplexer*
- 2 *Medical 2D-matrix probe, 2,5 MHz, 1024 elements*
- 3 *Sonar 2D-matrix probe, 1 MHz, 1024 elements*

Fraunhofer Institute for  
Biomedical Engineering IBMT  
Prof. Dr. Heiko Zimmermann  
Joseph-von-Fraunhofer-Weg 1  
66280 Sulzbach, Germany

## Contact

Christian Degel  
Transducer Engineering

Telephone +49 6897 9071 - 370  
christian.degel@ibmt.fraunhofer.de

[www.ibmt.fraunhofer.de](http://www.ibmt.fraunhofer.de)

## MATRIX ARRAY TECHNOLOGY

### Ultrasound Technology

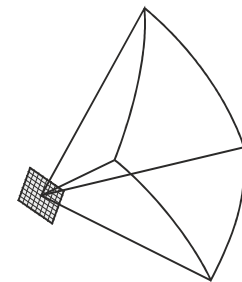
Fraunhofer IBMT's Division Ultrasound is working on a wide range of medical and industrial ultrasound solutions. We offer the simulation of ultrasound components or sound fields, the development of ultrasound system including hard- and software as well as the development of customized probes for most fields of technical and medical ultrasound.

Especially the development of specialized ultrasound probes for medical applications in diagnostic and therapy has a long history at IBMT. We have developed a plurality of linear, phased, curved, circular or annular arrays in the past.

### Matrix Array Technology

A very ambitious kind of probe is the 2D-matrix probe to measure whole volumes of interest. Conventional probes base on the linear arrangement of acoustic transducer elements to scan a plane in front of the array probe. The matrix array has a

2-dimensional arrangement of transducer elements like squares on a chessboard. This allows having control over the sound beam in two perpendicular angles. With that one can steer and focus the sound beam in a whole volume.

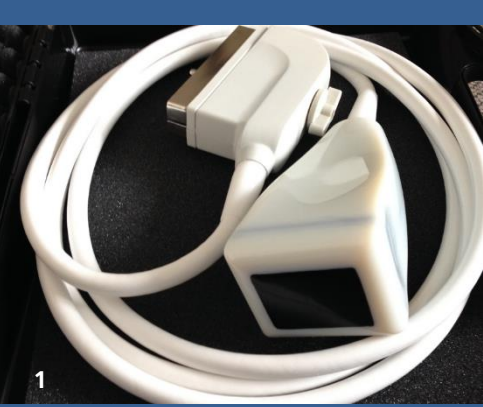


Matrix array to scan a volume of interest

IBMT's know how in that field allows realizing probes with the following features:

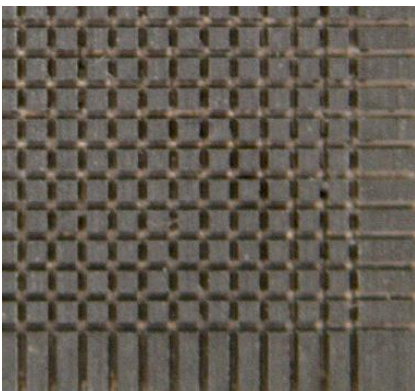
- free number of elements
- wide range of frequency
- adjustable pitch
- single crystal, composite or PZT
- medicine, industry, NDT and sonar
- integrated multiplexer possible

The connection of and to the beamformer electronics is customized. The cable and plug will be developed according your system and requirements.



### Medical 32x32 element matrix array

One example is a probe designed to work at a frequency of 2.5 MHz. The array consists of 32 x 32 (=1024) active elements made of PZT. Each element is connected and addressable by the beamformer electronics.



Matrix-structure of active elements, passive area on the right and lower edge



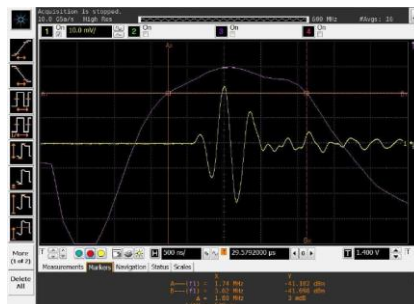
2.5 MHz matrix array with 1024 transducer elements, pitch 308  $\mu\text{m}$

The probe is covered with layer of soft material for best acoustic contact and to protect array and patient.



Adding of soft cover layer

Each element of the array has very good acoustic properties with high signal to noise ratio. The cross-talk between the elements was measured to be less than -32 dB.



Pulse-Echo measurement of a single element of 2D-matrix-array ( $f_c = 2.5 \text{ MHz}$ )

### Full 2D-Matrix Sonar Array

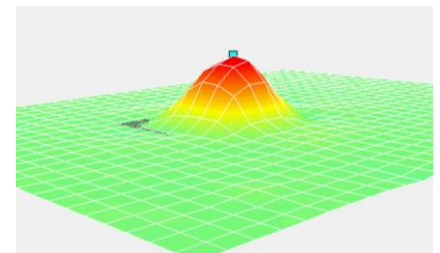
Another realization of the 2D-matrix technology is an array that can be used in the volumetric measurement of subsea environments. The array has a center frequency of 1 MHz and 32 x 32 (=1024) active elements like the medical version. With the array it is possible to scan a range of 15 m.

In that implementation a pitch of 2 Lambda (= 3 mm) was realized, so the active aperture has a size of 96 x 96 mm<sup>2</sup>. The array illuminates a sector of 40° x 40°

with a defocused sound beam.

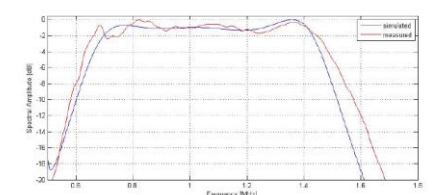
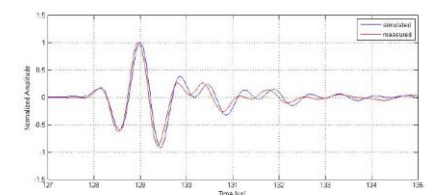
A multiplexer is used to switch the active channels of the beamformer to the transducer elements.

Each element is a transducer for electrical to mechanical energy. Measured with a laser interferometer a single element shows a proper distribution of displacement on the surface, while the neighbors are not affected (low cross-talk).



Displacement on the surface of an element

Each element is mechanically matched to water by a set of matching layers. This allows a bandwidth of approximately 80% and to work with very short pulses for high lateral resolution.



Simulated and measured pulse-echo signal and spectrum of a single transducer element

- 1 121 element, therapeutic probe
- 2 1024 element, 4 MHz probe
- 3 1024 element, 2.5 MHz probe