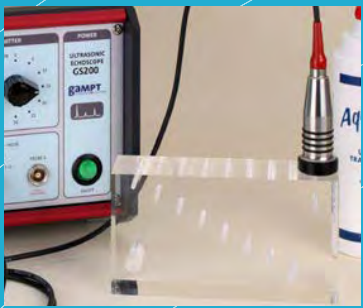
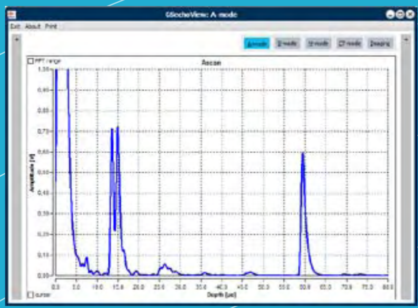
VENTUS
Ciencia Experimental

Catalogue **Education**


Products
Experiments
Experimental setups

Ultrasound in Physics, Medicine and Technique

gaMPT
ULTRASONIC SOLUTIONS

Dear Sir or Madam,

We are pleased to present you our ultrasound catalogue for training and teaching.

Our equipment, such as e.g. the ultrasonic echoscope "GAMPT-Scan", have been successfully in use all over the world for many years in universities and other educational institutions. Our products are constantly being further developed, in order to be able to open up and to offer you new teaching possibilities.

With our experiments and products we would like to familiarise the students with the fundamental principles of ultrasound technology and to demonstrate their implementation in different areas of application such as medicine and industry.

For your convenience, we have put together various experimental sets. With each set, different ultrasound experiments can be carried out on the theme of the set. Like all our products, the sets can be individually combined and supplemented.

Your feedback, comments and suggestions are always welcome. Only this way are we able to fulfil your requests and wishes even better.

We hope you enjoy browsing through and reading our new catalogue!

Yours sincerely,

Dr. Michael Schultz
Managing Director

Dr. Grit Oblonczek
Marketing and Sales Director

Overview

Experimental sets

For some subject areas which represent focuses of training at many technical colleges, advanced technical colleges and universities, we have put together experimental sets.

Each set can be used to carry out different experiments relating to the respective area of training. Set 2 “Ultrasound in medicine”, for example, is aimed more at medical faculties whereas Set 4 “Shear and surface acoustic waves” has been designed more for science departments.

The sets can of course be combined and expanded with other products from our catalogue. This makes it possible to individually adapt the experiments to the respective subject areas, from simple basic experiments up to sophisticated and complex topics.

The set descriptions are divided into:

Related topics: The related topics describe the topics and terms for which experiments can be carried out and the theoretical basic knowledge that is necessary for them.

Equipment: Here the components and materials belonging to the set and shown in the photo above are listed with order number.

Experiments: The experiment list names the experiments that concentrate on a thematic focus and be carried out with this set.

Further possibilities: The suggestions assist combination with other products for the conducting of other experiments.

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Set 1 Basics of ultrasound

Related topics

With this set, experiments can be carried out on the fundamental physical-technical principles of ultrasound technology and its application in medicine, natural and engineering science. Here, reference is made to both the introduction of the basic technical terms of echoscope measuring technology as well as to the essential physical characteristics of ultrasound.

For example the creation and processing of the signal from the transmission pulse to the reflection echo to the A-scan and B-scan image are clearly demonstrated with the ultrasonic echoscope GS200 and the accompanying software. Essential technical terms such as transmission power, receive gain and time gain control (TGC), probe frequency and coupling are elements of the experiments.

Among the physical characteristics, variables such as, in particular, amplitude, frequency dependence, sound velocity, attenuation and reflection coefficient are the objects of investigations.

The transition to the ultrasound applications is achieved with the demonstration of the creation of an ultrasound B-scan image, the basics of non-destructive testing and simple industrial applications such as the level measurement.

With additional accessories, the physical fundamental experiments can be extended to interesting subjects such as spectral investigations, resonance effects and dispersion of ultrasound waves.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 1 MHz	10151
2 Ultrasonic probes 2 MHz	10152
Ultrasonic probe 4 MHz	10154
Test block (transparent)	10201
Test cylinder set	10207
Ultrasonic gel	70200

Experiments

PHY01	Basics of pulse echo method (A-scan)
PHY02	Sound velocity in solids
PHY06	Frequency dependence of resolution power
PHY08	Ultrasonic B-scan
IND01	Non-Destructive Testing (NDT)
IND03	Level measurement

Further possibilities

Shear wave set – 10218:
PHY04 Acoustic attenuation in liquids

Set of reflecting plates – 10202:
PHY05 Spectral investigations

Hydrophone set – 10451:
PHY20 Determination of focus zone

Acoustic impedance samples – 10208:
PHY21 Reflection and transmission at boundaries

Acoustic impedance samples – 10208,
Lambda plates – 10209, Ultrasonic probe 1 MHz – 10131:
PHY22 Phase shift and resonance effects

Tripod set – 10310, Erlenmeyer flask – 10330:
IND03 Level measurement

Transit time pipe – 10180,
Centrifugal pump – 50130, Double reservoir – 50170:
IND09 Transit time flow meter

Breast phantom – 10221:
MED02 Ultrasonic imaging at breast phantom (mammasonography)

Eye phantom – 10222:
MED04 Biometry at the eye phantom

Order no. 19001

Set 2 Ultrasound in medicine

Related topics

This set has been developed for medical vocational training at technical colleges and colleges and medical-technical subjects. The main subject focus is upon the application of ultrasound technology in medical diagnostics.

In assembling the experiments, great importance has been attached to, above all, comprehensive conveying of fundamental knowledge, before the different diagnostic ultrasound techniques such as A-scan, B-scan and M-mode are explained in further experiments.

For example, first of all physical parameters and phenomena relating to the propagation of mechanical waves such as sound velocity, reflection and absorption, frequency dependences of spacial resolution and the fundamental technical parameters of ultrasound devices are dealt with. Then, using selected examples from biometry, echocardiography, and mammasonography, the individual imaging processes of medical diagnostics are explained and different measurement tasks are solved.

This promotes the understanding of the connections between the physical characteristics of an ultrasound wave and the possibilities and limitations in medical use.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 1 MHz	10151
Ultrasonic probe 2 MHz	10152
Ultrasonic probe 4 MHz	10154
Test block (transparent)	10201
Heart model	10220
Breast phantom	10221
Eye phantom	10222
Ultrasonic gel	70200

Experiments

PHY01	Basics of pulse echo method (A-scan)
PHY06	Frequency dependence of resolution power
PHY08	Ultrasonic B-scan
MED01	Ultrasonic TM-mode (echocardiography)
MED02	Ultrasonic imaging at breast phantom (mammasonography)
MED04	Biometry at the eye phantom

Further possibilities

Test cylinder set – 10207:
PHY02 Sound velocity in solids

Acoustic impedance samples – 10208:
PHY21 Reflection and transmission at boundaries

Ultrasonic probes 1/2/4 MHz – 10151, 10152, 10154,
Test cylinder set – 10207:
PHY03 Acoustic attenuation in solids

Order no. 19002

Set 3 Ultrasound in material science and engineering

Related topics

One main field of application of ultrasound is the non-destructive testing (NDT). Ultrasound testing has here become established as a standard procedure for the analysis of material faults, such as cracks, cavities, gas bubbles and inhomogeneities, in an extremely wide variety of materials, such as metals, plastics or composites. A large number of methods have been developed for performing the individual testing tasks.

With this experimental set, some of the most common ultrasound testing methods, such as e.g. the pulse echo method and the through-transmission method, angle beam testing and the TOFD procedure, are explained and applied to different material samples.

Based on the knowledge of physical characteristics of ultrasound waves (e.g. sound velocity, acoustic attenuation, reflection, diffraction, scattering), experiments are performed on special test blocks, for the adjustment of ultrasound testing devices such as the production of a DGS diagram (distance gain size diagram) or the calibration of an angle beam probe. Furthermore, the performance of different test methods is tested for different types of faults and quantitative measurements are carried out, such as e.g. determining crack depths in aluminium samples.

By expanding the set with other material samples and accessories from our range, the experiments can be extended to more special testing methods using shear and surface acoustic waves or guided waves (Lamb waves).

The experiments and measurements with this set make it possible to offer the students a clear introduction into the problems of ultrasound testing and are therefore interesting for training in almost all engineering fields.

Equipment

Ultrasonic echoscope GS200	10400
2 ultrasonic probes 2 MHz	10152
Ultrasonic probe 4 MHz	10154
Angle beam wedge 17°	10233
Angle beam wedge 38°	10234
Transceiver delay line (TOFD)	10237
Test block (transparent)	10201
Test block for angle beam probe	10240
Crack depth test block	10241
Ultrasonic gel	70200

Experiments

PHY01	Basics of pulse echo method (A-scan)
PHY06	Frequency dependence of resolution power
IND01	Non-Destructive Testing (NDT)
IND03	Level measurement
IND06	Angle beam testing
IND07	Crack depth determination (TOFD)

Further possibilities

Shear wave set – 10218:
PHY04 Acoustic attenuation in liquids

Discontinuity test block – 10242:
IND08 Detection of discontinuities

Acoustic impedance samples – 10208:
PHY21 Reflection and transmission at boundaries

Order no. 19003

Set 4 Shear and surface acoustic waves

Related topics

In the classic applications of ultrasound, such as e.g. the time of flight measurements in liquids (level measurement, flow measurement), only the longitudinal propagation of the ultrasonic waves plays a role. Ultrasonic waves can, however, also propagate in the form of shear and surface acoustic waves (SAWs), especially in solid bodies. These wave modes, their propagation characteristics and their dependence on elastic material properties make possible a large number of new methods in material testing (aircraft construction), signal processing (SAW filter) and modern medicine (elastography).

With this set it is possible to carry out experiments to demonstrate the mode transformation of ultrasonic waves at boundaries between liquids and solids or at boundaries of different solids. They can also be used to determine the sound velocity of shear and surface acoustic waves (Rayleigh and Lamb waves) in different material samples. These measurements make it possible to determine the elastic coefficients of the materials such as the elasticity modulus and shear modulus.

This set can also be used to demonstrate the dispersion of ultrasonic waves (frequency dependence of sound velocity) by means of the propagation of Lamb waves on thin glass sheets.

A crack depth test can be carried out on an aluminium sample by means of Rayleigh waves as an application of surface waves in non-destructive testing (NDT).

Equipment

Ultrasonic echoscope GS200	10400
2 ultrasonic probes 1 MHz	10151
2 ultrasonic probes 2 MHz	10152
2 ultrasonic probes 4 MHz	10154
Shear wave set	10218
Rayleigh wave attachments (pair)	10230
Rayleigh wave test block	10232
Lamb wave set	10300
Ultrasonic gel	70200

Experiments

PHY04	Acoustic attenuation in liquids
PHY07	Shear waves in solids
PHY23	Dispersion of ultrasonic waves (Lamb waves)
IND02	Detection of cracks with Rayleigh waves

Further possibilities

Test block (transparent) – 10201:
PHY01 Basics of pulse echo method (A-scan)
PHY08 Ultrasonic B-scan

Test cylinder set – 10207:
PHY02 Sound velocity in solids

Set of reflecting plates – 10202:
PHY05 Spectral investigations

Hydrophone - 10450
Hydrophone support plate and support – 10252, 60123:
PHY20 Determination of focus zone

Acoustic impedance samples – 10208:
PHY21 Reflection and transmission at boundaries

Order no. 19004

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Set 5 Debye-Sears effect

Related topics

With the devices and materials in this set one can conduct experiments as an introduction into acousto-optics and the use of continuously emitted ultrasonic waves (continuous waves - cw). The focus here is upon the Debye-Sears effect and the imaging of a standing ultrasonic wave field using laser light.

With the cw generator SC600 ultrasonic waves of different frequencies can be generated in a water bath. The ultrasonic waves act like the elements of a diffraction grating, the grating constant of which depends on the wavelength of the ultrasound. When parallel laser light passes through, it is diffracted. A classic diffraction pattern, the Debye-Sears effect, results. By using different ultrasound frequencies and red, green and blue laser light, the dependence of the interval of the orders of diffraction on the acoustic and optical wavelengths can be shown. If divergent laser light is used, a direct optical projection of the acoustic wave field can take place. By means of an acoustic absorber, the differences between travelling and standing ultrasonic waves can be demonstrated.

By supplementing the set with a photodiode receiver, it can be expanded into an ultrasound resonance cell. This is primarily used in measuring concentrations.

Equipment

cw generator SC600	20100
Debye-Sears set	20200
Laser module (green)	20211
AOM sample reservoir	20225
Cover for AOM sample reservoir	20223
Projection lens	20230
Acoustic absorber	20227

Experiments

PHY11	Debye-Sears effect
PHY12	Projection of standing waves

Further possibilities

Adjustable reflector – 20302,
Photodiode receiver – 20303:
IND04 Concentration measurement with resonance cell

2 adjustable reflectors – 20302,
2 photodiode receivers – 20303,
Beam splitter – 20301:
PHY17 Acousto-optical modulation at standing waves

Hydrophone set – 10251:
PHY19 Phase and group velocity

Laser module (blue) - 20212:
PHY11 Debye-Sears effect
PHY12 Projection of standing waves

Order no. 19005

Set 6 Ultrasonic Doppler effect

Related topics

The ultrasonic Doppler effect is used in a multitude of measuring devices in industry as well as in medicine. These include devices for measuring flow, characterising blood flow and the foetal Doppler for measuring heart sounds of foetuses.

The set includes the necessary components for building a flow circuit with adjustable flow rates, an ultrasound pulse Doppler with probes of different frequency as a measuring device and software for signal recording and signal processing.

With this one can investigate the essential dependences of the shift in Doppler frequency upon transmission frequency, incidence angle and flow velocity.

The flow pipes of different diameters and the standpipes contained in the circuit allow experiments on fluid mechanics. These include the continuity equation and the Hagen-Poiseuille equation. The flow speed velocity is here measured by means of the Doppler device and the pressure drops with the standpipes.

By supplementing the set with the Doppler probe and the arm phantom, experiments can be carried out on Doppler sonography (application of the ultrasonic Doppler effect in medicine).

Equipment

Ultrasonic Doppler device FlowDop200 **NEW!**	50400
Ultrasonic probe 1 MHz	10151
Ultrasonic probe 2 MHz	10152
Ultrasonic probe 4 MHz	10154
Centrifugal pump MultiFlow	50130
Doppler fluid	50140
Standpipes	50150
Flow measuring set	50201
Ultrasonic gel	70200

Experiments

PHY13	Ultrasonic Doppler effect
PHY15	Fluid mechanics

Further possibilities

Ultrasonic Doppler probe – 50435,
Arm phantom – 50160:
MED03 Basics of Doppler sonography
MED05 Vascular ultrasound (angiology)

Double reservoir – 50170:
IND05 Doppler flow measurement

Order no. 19006

Set 7 Doppler sonography

Related topics

Doppler sonography refers to the use of the ultrasonic Doppler effect in human and veterinary medicine. It is primarily used to determine blood flow velocities, characterise flow curves and localise and classify stenoses and valvular heart defects.

This set helps to demonstrate the fundamental physical dependences of ultrasonic Doppler effect on frequency, incidence angle and blood flow velocity. With the ultrasonic pulse Doppler and the accompanying software, the signal recording and signal processing can be shown, up to the colour-coded Doppler frequency spectrum used for medical diagnostic purposes.

With the realistic arm phantom and the microcontroller-driven centrifugal pump, different blood flows (venous = continuous, arterial = pulsatile) can be set and measured. The stenosis incorporated into the arm phantom is to be detected and characterised by means of the Doppler. Using the pulse curves as a basis, statements can be made regarding the flow velocity and air chamber function.

If the set is supplemented with a blood pressure cuff, Doppler measurements of the occlusion pressure for the characterising of peripheral arterial occlusive diseases can be demonstrated.

Equipment

Ultrasonic Doppler device FlowDop200 **NEW!**	50400
Ultrasonic probe 2 MHz	10152
Doppler prism ⅜"	50112
Centrifugal pump MultiFlow	50130
Ultrasonic Doppler probe	50435
Arm phantom	50160
Ultrasonic gel	70200

Experiments

PHY13	Ultrasonic Doppler effect
MED03	Basics of Doppler sonography
MED05	Vascular ultrasound (angiology)

Further possibilities

Flow measuring set – 50201:
PHY13 Ultrasonic Doppler effect

Standpipes – 50150,
Flow measuring set – 50201:
PHY15 Fluid mechanics

Double reservoir – 50170,
Flow measuring set – 50201:
IND05 Doppler flow measurement

Blood pressure cuff – 50300:
MED06 Peripheral Doppler blood pressure measurement

Order no. 19007

Set 8 Acousto-optical effects

Related topics

This set has been designed for some sophisticated experiments, which deal with the interactions between a mechanical wave and light - the acousto-optical effects (AOM, acousto-optical modulation). The experiments promote a knowledge and understanding of the propagation characteristics of mechanical as well as electromagnetic waves.

It is shown that the changes in density that occur due to the compression and dilatation of an ultrasound wave cause a change in the diffraction index of the medium. The grating created causes the diffraction of laser light. In addition, the intensity modulation and wavelength alteration of laser light are demonstrated.

In different experiments, the diffraction characteristics of light at standing and travelling ultrasonic waves are investigated and measured. The sound velocity of different liquids is determined by means of the variation of the interference maxima of the laser light at different ultrasound frequencies (resonance cell).

The amplitude modulation and phase shifting of laser light at a standing wave can be represented with a photodiode and recorded with an oscilloscope. The frequency change of the sound wave influences the amplitude modulation and makes it possible to calculate the sound velocity of the medium.

The difference of the diffraction at standing and travelling waves is demonstrated by means of an acoustic absorber, which prevents the formation of standing ultrasound waves in the sample reservoir.

At the travelling ultrasonic wave, a frequency shift of the laser light, caused by the Doppler effect, can be measured. Buy using a beam splitter and reflectors, differently diffracted portions of light can be turned into interference. The resulting beats are displayed and measured with the oscilloscope.

This experimental set is suitable both for the demonstration of the acousto-optical effects and their application in technology and for carrying out interesting experiments in advanced practical training in all natural scientific and technical fields.

Equipment

cw generator SC600	20100
Debye-Sears set	20200
2 photodiode receivers	20303
3 adjustable reflectors	20302
Beam splitter	20301
Acoustic absorber	20227

Experiments

PHY11	Debye-Sears effect
PHY17	Acousto-optical modulation at standing waves
IND04	Concentration measurement with resonance cell

Further possibilities

Laser module (green) - 20211,
Laser module (blue) - 20212:
PHY11 Debye-Sears effect

Laser module (green) - 20211,
Laser module (blue) - 2012,
Projection lens - 20230:
PHY12 Projection of standing waves

Order no. 19008

Set 9 Ultrasonic CT and scanning methods

Related topics

With this set, comprehensive and clear experiments can be carried out on special measuring procedures by means of ultrasound. The focus is upon conveying knowledge of the structure and function of computer tomography measuring systems. The tomography that is familiar from use in medical X-ray diagnostics is based on attenuation effects and analysis with convolution algorithms, regardless of the type of measurement signal used (X-ray, nuclear spin, ultrasound etc.). The creation of a CT image is explained and demonstrated in the experiment (PHY09) step by step using the example of ultrasonic tomography. By using ultrasound as a measurement signal, two different images can be recorded and analysed, the attenuation and sound velocity tomogram of the test object. Your own test objects can also be scanned. This enables you to make practical work interesting.

The set is also excellently suitable for scanning any samples you choose. This way, cross-sectional images (B-scans) of medical objects, such as e.g. of the breast phantom, can be represented with high image quality as well as line scans of different test blocks from the field of non-destructive testing. The scan images have high lateral resolution. By using different probes, the measurement parameters can be adjusted to the appropriate test objects.

To deepen knowledge of ultrasonic measuring technology, e.g. in the training of medical technicians, the scanner can also be used for the measurement of sound field characteristics such as beam width, focus zone, intensity distribution and near-field length of an ultrasonic probe. An understanding of the characteristics of complex interference patterns within the sound field of an ultrasonic probe is a decisive requirement for improving image quality in medical diagnostics.

The set includes a large number of subject areas, so that it can be used to carry out sophisticated experiments in almost all medical, scientific and technical fields of training.

Equipment

Ultrasonic echoscope GS200	10400
CT scanner	60200
CT control unit UCT200	60210
CT reservoir	60120
CT sample	60121
Ultrasonic probe 1 MHz	10151
2 ultrasonic probes 2 MHz	10152
Test block (transparent)	10201
Hydrophone	10250
Hydrophone support	60123
Ultrasonic gel	70200

Experiments

PHY08	Ultrasonic B-scan
PHY09	Ultrasonic computer tomography (CT)
PHY10	Characteristics of sound field
PHY16	Mechanical scan methods
PHY20	Determination of focus zone

Further possibilities

Breast phantom – 10221:
MED02 Ultrasonic imaging at breast phantom (mammasonography)

Order no. 19009

Set 10 Ultrasonic imaging

Related topics

B-mode imaging is an ultrasound method frequently applied in medicine or in non-destructive material testing. Similar to X-ray or MRI procedures, the B-mode method delivers sectional images of the internal structure of a technical body or an organism, however without exposing it to radiation.

This experimetal set was composed to be able to track the individual steps from the ultrasound signal to the complete B-scan image and to examine the possibilities and limits of the B-scan method as well as training its practical application. The set enables basic and application experiments for training and lab courses in medical and medical engineering specialities.

The 2 MHz ultrasonic probe and the test block enable experiments in view of the fundamental physical principles of ultrasound propagation (time of flight, acoustic attenuation, reflection at boundaries, acoustic shadow, ...). By using a single-element-transducer, it is possible to track the way from the ultrasound signal via the amplitude signal (A-scan), its conversion into a grey scale or coulor coded line scan and the composition of such line scans in a complete sectional image (B-scan).

For practical experiments, the set comprises two ultrasound phantoms with acoustic characteristics similar to those of human tissue.

In order to image the internal structures of the phantoms, an array probe (2-5 MHz) is used, as for example applied in medicine for examining the abdomen. This ultrasound probe possesses an array of 64 convexly arranged individual transducer elements. For the controlling of the array probe and the recording and analysis of the signal, a separate extension module is integrated in the GS200i ultrasonic echoscope.

The internal structures can be imaged and their dimensions can be measured by means of the measurement software.

Furthermore, the influence of various parameters (focus, dynamic range, graphic filters, brightness, contrast, ...) on the processing of signal and image can be examined.

Equipment

Ultrasonic echoscope GS200i (incl. array probe)	10410
Ultrasonic probe 2 MHz	10152
Test block (transparent)	10201
Ultrasound test phantom	10420
Ultrasound fetal phantom	10430
Ultrasonic gel	70200

Experiments

PHY01	Basics of pulse echo method (A-scan)
PHY08	Ultrasonic B-scan
MED07	Ultrasound test phantom
MED08	Ultrasound fetal phantom

Further possibilities

Ultrasonic probes 1 MHz - 10151 and 4 MHz - 10154:
PHY06 Frequency dependence of resolution power

Acoustic impedance samples – 10208:
PHY21 Reflection and transmission at boundaries

Heart model - 10220,
Ultrasonic probe 4 MHz - 10154:
MED01 Ultrasonic TM-mode (echocardiography)

Breast phantom - 10221,
Ultrasonic probe 1 MHz - 10151:
MED02 Ultrasonic imaging at breast phantom

Eye phantom - 10222:
MED04 Biometry at the eye phantom

Order no. 19010

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Set 11 B-scan ultrasonography New!

Related topics

Ultrasound imaging based on the B-scan method is an important tool in medical diagnostics. Similar to the X-ray or MRI methods, the B-scan ultrasonography provides sectional images of the internal structure of a technical body or an organism, however without exposing it to radiation exposure.

This simple set enables application-oriented experiments for the training and practical courses of the medical and medical-technical disciplines. With the experimental set, the possibilities and limitations of the B-scan technique can be investigated and the fundamental handling of an B-scan ultrasound device can be trained.

For practical experiments, the Set 11 includes an ultrasound fetal phantom and a second selectable ultrasound model (see Equipment). The set can be extended by further ultrasound models.

In order to image the internal structures of the phantoms, an array probe is used, as it is used in medicine for examinations of the abdominal cavity. This ultrasound probe has an array of 64 convexly arranged individual transducer elements.

The internal structures can be imaged and their dimensions can be measured by means of the measuring and control software. In addition, the influence of various parameters (focusing, dynamic range, graphic filters, brightness, contrast, ...) on the signal and image processing can be examined.

Equipment

B-scan ultrasound device Gi210 **NEW** (incl. array probe)	10412
Ultrasound fetal phantom	10430
ONE *of the following three ultrasound models (your choice):*	
• Ultrasound breast model with cysts *or*	10224
• Ultrasound breast model with tumours *or*	10225
• Ultrasound gallbladder model	10440

Experiments

MED08	Ultrasound fetal phantom

Depending on the choice of the second ultrasound model:

MED09	Mamma sonography (in progress)
MED10	Gallbladder ultrasound (in progress)

Further possibilities

Ultrasound test phantom - 10420:
MED07 Ultrasound test phantom

Ultrasound breast model with cysts - 10224,
Ultrasound breast model with tumours - 10225:
MED09 Mamma sonography (in progress)

Ultrasound gallbladder model - 10440:
MED10 Gallbladder ultrasound (in progress)

Order no. 19011

Equipment and materials

In the following you will find an overview of the individual equipment and materials. For a first orientation, the products are divided into four groups according to their relevance and application in view of the different fields of **pulse echo method** (echoscopy), **continuous wave**, **Doppler** or **scanning**.

For each item, a list has been produced with the experiments in which the corresponding item is used. Of course, our products can also be entirely individually combined and put together for new experiments.

In addition to this, for many products you will find a list of individual components (including order number), which can be separately ordered as spare parts.

Our range of products is constantly being improved and expanded in order to be able to carry out new experiments. You can find information on this on our website at **www.gampt.de**.

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cw (continuous wave) 36-43

Doppler 44-49

Scanning 50-52

Ultrasonic Echoscope GS200

The GS200 is a high-resolution ultrasonic measurement system for connection to a PC or an oscilloscope. Ultrasonic probes equipped with robust snap-in connectors can be operated at two connections as a transmitter/receiver (reflection) and/or as a transmitter or receiver (transmission) as preferred. The operation mode of the probes is selected directly on the device. With the adjustable transmission and receiver power, the ultrasonic signals can be adjusted to almost any examination object. Losses in intensity of the ultrasonic signals from lower examination areas can be balanced out by time gain control (TGC). Threshold, starting point, end point and slope of the TGC can be freely selected.

When used with an oscilloscope the most important signals (trigger, TGC, US signal and A-scan signal) can be tapped at BNC sockets.

For PC operation, the GS200 is connected to the PC via USB. A comprehensive signal analysis (US and A-scan signal, B image, M mode, spectral analysis) is performed with the supplied measurement software. The measurement range, i.e. the interesting range of time-of-flight or depth can be freely selected and sampling rates between 10 and 100 MHz can be chosen.

There is a large range of ultrasonic probes (1, 2 and 4 MHz) and accessories for practical experiments. The range of subjects reaches from the physical basics of ultrasound to applications in industry and medicine. Together with the scanner system (order no. 60200 and 60210) experimental arrangements can be set up for ultrasonic computer tomography and mechanical scanning procedures.

Technical data

- Dimensions: 226 mm × 169 mm × 325 mm (W × H × D)
- Frequency: 1-5 MHz
- PC connection: USB
- Measuring modes: reflection and transmission
- Transmission signal: 0-300 Volt
- Transmission level: 0-30 dB
- Gain: 0-35 dB
- TGC: 0-32 dB, threshold, slope, wide (width), start
- Outputs: trigger, TGC, US signal, A-scan signal
- Mains voltage: 100-240 V, 50/60 Hz

Order no. 10400

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Software

The GS200 echoscopes are delivered with the new measurement software GS-EchoView (Windows 7/8). The programme interface is clearly divided into three areas: measurement parameters, measurement diagrams and device and status information.

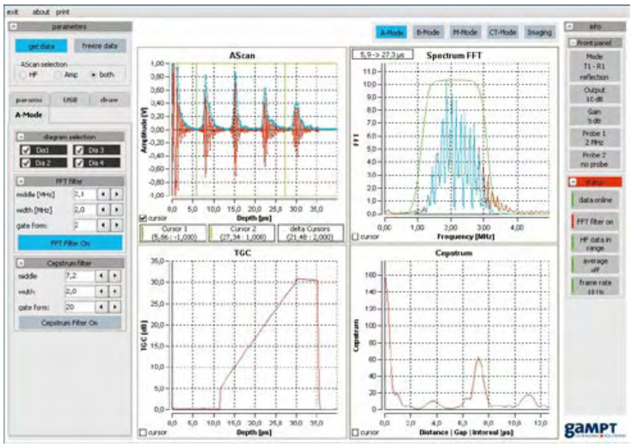
The general and special (dependent on the measurement mode) framework conditions for a measurement and its analysis and imaging are specified via the measuring parameters (sampling rate, measurement range). After the start of measuring, the programme controls and/or triggers the echoscope. The measurement data obtained are automatically called and processed by the programme.

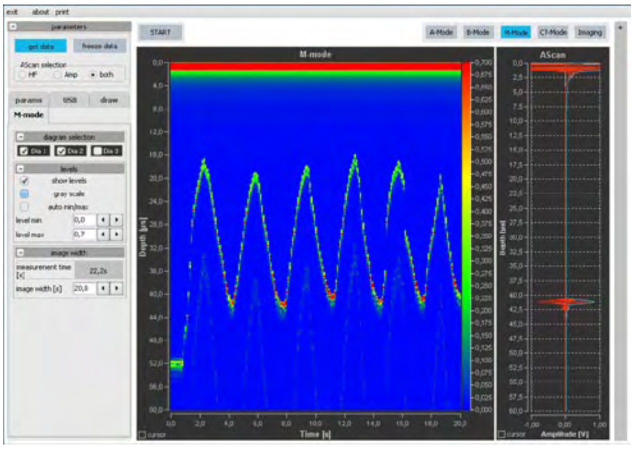
The measurement results are centrally presented in the form of diagrams. Depending on the measurement mode, different diagrams can be shown, or hidden, next to each other for the analysis and presentation of the measurement data.

In the **A-mode**, for example, the measurement signal of an amplitude scan is shown as a time-of-flight signal (or depth-of-field signal) in the A-scan diagram. In parallel with this, the TGC setting can be displayed in a second diagram. In addition, two more diagrams can be shown that allow a frequency analysis of the US signal by means of Fast Fourier Transformation (FFT) and a Cepstrum analysis of the FFT spectrum.
The diagrams have measurement cursors for reading off individual values and toolbars for further zoom, saving and adjustment functions.

In addition to the A-mode, measurements can also be carried out in the following measuring modes:
B-mode: generating of 2-dimensional US sectional images (B images) hand-operated with a single-element transducer,
M-mode: recording of the chronological sequence of moving reflective layers using the time-motion method,
CT-mode: computer tomography ultrasonic examinations, mechanically operated B-image scans or sound field scans.

On the right-hand side of the programme window, device information such as operation mode, transmission level, gain, configuration of the probe connections and status information of the software are shown in a clear fashion.





Experiments

PHY01 Basics of pulse echo method (A-scan)
PHY02 Sound velocity in solids
PHY03 Acoustic attenuation in solids
PHY04 Acoustic attenuation in liquids
PHY05 Spectral investigations
PHY06 Frequency dependence of resolution power
PHY07 Shear waves in solids
PHY08 Ultrasonic B-scan
PHY09 Ultrasonic computer tomography (CT)
PHY10 Characteristics of sound field
PHY16 Mechanical scan methods
PHY20 Determination of focus zone
PHY21 Reflection and transmission at boundaries
PHY22 Phase shift and resonance effects
IND01 Non-Destructive Testing (NDT)
IND02 Detection of cracks with Rayleigh waves
IND03 Level measurement
IND06 Angle beam testing
IND07 Crack depth determination (TOFD)
IND08 Detection of discontinuities
IND09 Transit time flow meter
MED01 Ultrasonic TM-mode (echocardiography)
MED02 Ultrasonic imaging at breast phantom (mammasonography)
MED04 Biometry at the eye phantom

Expansion

A factory upgrade to GS200i (order no. 10410) is available for the GS200. This expansion for B-imaging measurements includes an additional module with accompanying array transducer.

B-imaging expansion	10411

Ultrasonic probe 1 MHz

The ultrasonic probes are characterised by high sound intensity and short sound impulses. These are especially suitable for the pulse-echo method. The probes have a robust metal housing and are moulded so that they are watertight at the sound surface. The probes are delivered with special plugs for connection to the GAMPT echoscopes or with a BNC connector for universal use. Due to their high sound intensity they are especially suitable for investigations with large penetration depths, of highly attenuating materials and for the generation of Rayleigh and/or shear waves. They can here be used as transmitters or receivers.

Order no. 10131 (GAMPT-Scan/FlowDop)

Order no. 10141 (BNC)

Order no. 10151 (GS200/GS200i)

Technical data:

- Frequency: 1 MHz
- Dimensions: length = 70 mm, diameter = 27 mm
- Cable length: approx. 1 m
- Sound adaptation to water/acrylic
- Different plugs with probe identification for connection to GAMPT echoscopes or universal plug connector (BNC)

Experiments

PHY01 Basics of pulse echo method (A-scan)
PHY02 Sound velocity in solids
PHY03 Acoustic attenuation in solids
PHY06 Frequency dependence of resolution power
PHY07 Shear waves in solids
PHY08 Ultrasonic B-scan
PHY16 Mechanical scan methods
PHY20 Determination of focus zone
PHY22 Phase shift and resonance effects
PHY23 Dispersion of ultrasonic waves (Lamb waves)
IND02 Detection of cracks with Rayleigh waves
MED02 Ultrasonic imaging at breast phantom (mammasonography)

Ultrasonic probe 2 MHz

With a frequency of 2 MHz, these probes are suitable for a wide range of applications. Due to the higher frequency, the axial and lateral resolution power is clearly higher than with the 1 MHz probes. On the other hand, the attenuation for 2 MHz in most materials is still not too large, so investigation areas at medium depth can still be reached without any problem. In particular, these probes are also suitable for studies on medical objects and as ultrasonic Doppler probes.

Order no. 10132 (GAMPT-Scan/FlowDop)

Order no. 10142 (BNC)

Order no. 10152 (GS200/GS200i)

Technical data:

- Frequency: 2 MHz
- Dimensions: length = 70 mm, diameter = 27 mm
- Cable length: approx. 1 m
- Sound adaptation to water/acrylic
- Different plugs with probe identification for connection to GAMPT echoscopes or universal plug connector (BNC)

Experiments

PHY02 Sound velocity in solids
PHY03 Acoustic attenuation in solids
PHY04 Acoustic attenuation in liquids
PHY05 Spectral investigations
PHY08 Ultrasonic B-scan
PHY09 Ultrasonic computer tomography (CT)
PHY10 Characteristics of sound field
PHY13 Ultrasonic Doppler effect
PHY15 Fluid mechanics
PHY16 Mechanical scan methods
PHY20 Determination of focus zone
PHY21 Reflection and transmission at boundaries
PHY22 Phase shift and resonance effects
PHY23 Dispersion of ultrasonic waves (Lamb waves)
IND01 Non-Destructive Testing (NDT)
IND03 Level measurement
IND05 Doppler flow measurement
IND06 Angle beam testing
IND07 Crack depth determination (TOFD)
IND08 Detection of discontinuities
IND09 Transit time flow meter
MED04 Biometry at the eye phantom

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Ultrasonic probe 4 MHz

The 4 MHz probes are characterised by extremely short dying out behaviour and thus the highest axial resolution power. They are particularly used where very small structures must be detected.

Technical data

- Frequency: 4 MHz
- Dimensions: length = 70 mm, diameter = 27 mm
- Cable length: approx. 1 m
- Sound adaptation to water/acrylic
- Different plugs with probe identification for connection to GAMPT echoscopes or universal plug connector (BNC)

Experiments

PHY03 Acoustic attenuation in solids
PHY06 Frequency dependence of resolution power
MED01 Ultrasonic TM-mode (echocardiography)

Order no. 10134 (GAMPT-Scan/FlowDop)

Order no. 10144 (BNC)

Order no. 10154 (GS200/GS200i)

Hydrophone

The hydrophone can be used to measure the characteristics of sound field of an ultrasonic probe. The near-field length (focus zone) can be determined from the amplitude modulation along the central axis of a sound probe. Similarly, the lateral extension of the sound field can be measured at different distances from the probe surface. The hydrophone is suitable for a frequency range of 1-5 MHz and can be connected directly to the receiver inputs of a GAMPT echoscope. In the simplest case, the measurements are carried out by shifting the hydrophone by hand or by using the CT scanner. For both variants, there is an appropriate support for the hydrophone.

Technical data

- Frequency range: 1-5 MHz
- Dimensions: length = 125 mm, width = 24 mm
- Active sensor area: diameter = 3 mm
- Cable length: approx. 1 m

Experiments

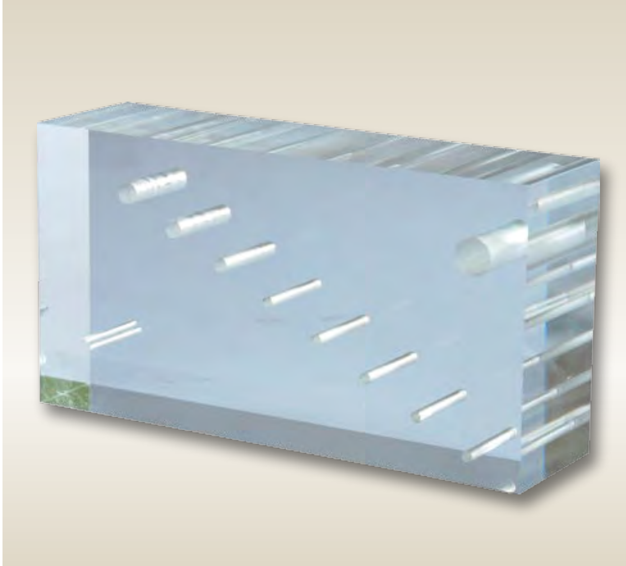
PHY10 Characteristics of sound field
PHY19 Phase and group velocity
PHY20 Determination of focus zone
PHY23 Dispersion of ultrasonic waves (Lamb waves)

Order no. 10250 (GAMPT-Scan)

Order no. 10450 (GS200/GS200i)

Test block (transparent)

The transparent test block made of homogeneous acrylic is especially suitable for echoscopy investigations. Acrylic is a material with medium acoustic attenuation, so that a sufficient penetration depth is achieved with all probes. The block has a group of differently sized defects at different depths, a large defect (acoustic shadow) and a double defect (resolution power). In this way fundamental knowledge can be gained of the determining of sound velocity, the echo method, acoustic shadows, multiple reflections, focus zones and the resolution power of ultrasound of different frequency.



Order no. 10201

Technical data

- Dimensions: 150 mm × 80 mm × 40 mm
- Material: acrylic, transparent
- Sound velocity: ~ 2700 m/s (longitudinal)
- Density: 1.2 g/cm³
- Defects: 11

Experiments

PHY01 Basics of pulse echo method (A-scan)
PHY06 Frequency dependence of resolution power
PHY08 Ultrasonic B-scan
PHY16 Mechanical scan methods
IND01 Non-Destructive Testing (NDT)

Test block (black)

This test block made of black opaque acrylic is intended for a version of the basic experiment PHY01, in which the focus is upon searching for defects in unfamiliar test objects. In this, the test block can be scanned from all sides and the number and location of the defects can be determined. In further experiments, probes of different frequencies are used to determine the shape and size of the individual inhomogeneities. In these investigations, the main aim is to develop suitable strategies for the complete localisation of all defects. In addition to this, all experiments in which the use of the transparent test block is envisaged can, of course, also be carried out with the black test block. The acoustic characteristics and the arrangement of the defects correspond to those of the transparent test block.

Order no. 10204

Technical data

- Dimensions: 150 mm × 80 mm × 40 mm
- Material: acrylic, black
- Sound velocity: ~ 2700 m/s (longitudinal)
- Density: 1.2 g/cm³
- Defects: 11

Experiments

PHY01 Basics of pulse echo method (A-scan)
PHY06 Frequency dependence of resolution power
PHY08 Ultrasonic B-scan
PHY16 Mechanical scan methods
IND01 Non-Destructive Testing (NDT)

Test cylinder set

Sound velocity, acoustic impedance and attenuation are typical material-specific parameters, which can be determined in reflection and transmission using these three acrylic cylinders. The determining of sound velocity at three objects made of the same material but of different lengths allows a detailed error analysis. Determining attenuation in transmission at various ultrasonic frequencies conveys knowledge of fundamental relationships of ultrasound absorption in solids.

Technical data

- Dimensions: diameter = 40 mm, length = 40 mm, 80 mm and 120 mm
- Material: acrylic, transparent
- Sound velocity: ~ 2700 m/s (longitudinal)
- Density: 1.2 g/cm³

Experiments

PHY02 Sound velocity in solids
PHY03 Acoustic attenuation in solids
PHY22 Phase shift and resonance effects

Order no. 10207 (Set)

Spare parts

3 cylinders	10203
Probe support	10215
Cylinder holder	10205

Shear wave set

If an ultrasonic wave hits a solid body at an oblique angle, shear waves are generated with an increasing angle. Shear waves have a sound velocity that differs from the longitudinal wave. With this experiment equipment, the angle-dependent transition from longitudinal to shear waves can be measured. The measurement is carried out in transmission with two fixed probes (1 MHz). The sample holder can be longitudinally shifted on the sample reservoir and has an angle scale. The elastic constants of the material can be determined from the measurement of the longitudinal and transversal velocity of sound. Acrylic and aluminium are available as sample materials. With the aluminium sample, this experiment arrangement is also suitable for determining the attenuation of ultrasound in liquids (water, glycerine, oil,...) due to the adjustable and movable sample plate.

Technical data

- Sample holder with angle scale 0-360° in 5° steps
- Sample material 1: acrylic (transparent)
- Sound velocity: longitudinal ~ 2700 m/s; transversal ~ 1450 m/s
- Sample material 2: aluminium
- Sound velocity: longitudinal ~ 6400 m/s; transversal ~ 3100 m/s
- 2 probe supports of acrylic (black)
- 1 sample reservoir for taking a liquid and the material sample component

Experiments

PHY04 Acoustic attenuation in liquids
PHY07 Shear waves in solids

Order no. 10218 (Set)

Spare parts

Sample reservoir	10214
Probe support	10215
Acrylic sample	10211
Aluminium sample	10213

Acrylic sample for shear wave set

For the determination of elastic material constants from the longitudinal and transversal sound wave velocity there is a material sample made of acrylic. The longitudinal sound velocity is higher in acrylic than in water, whereas the transversal sound velocity is in the order of magnitude of the sound velocity in water.

Technical data

- Sample material: acrylic
- Sound velocity: longitudinal ~ 2700 m/s
  transversal ~ 1450 m/s

Experiments

PHY07 Shear waves in solids

Order no. 10211

Aluminium sample for shear wave set

For the determination of elastic material constants from the longitudinal and transversal sound wave velocity there is a further material sample made of aluminium. In aluminium, both the longitudinal and the transversal sound velocity are higher than in water. The aluminium sample is furthermore suitable as a movable reflecting plate for measurements using the pulse-echo method, e.g. to determine the acoustic attenuation in liquids.

Technical data

- Sample material: aluminium
- Sound velocity: longitudinal ~ 6400 m/s
  transversal ~ 3100 m/s

Experiments

PHY04 Acoustic attenuation in liquids
PHY07 Shear waves in solids

Order no. 10213

POM sample for shear wave set

For the determination of elastic material constants from the longitudinal and transversal sound wave velocity, a third material sample made of polyoxymethylene (POM) is available. In POM, the transversal sound velocity is lower than the sound velocity in water.

Technical data

- Material: POM
- Sound velocity: longitudinal ~2470 m/s
  transversal ~1200 m/s

Experiments

PHY07 Shear waves in solids

Order no. 10212

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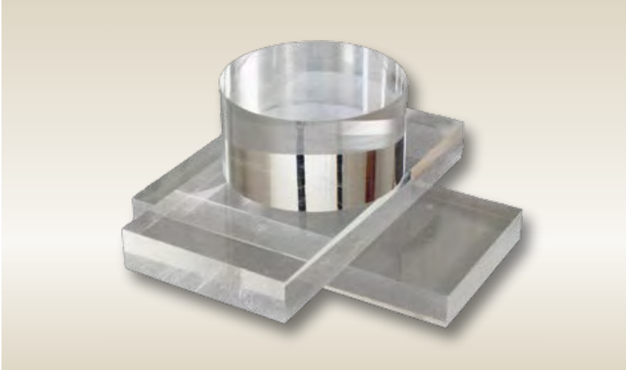
Set of reflecting plates

The pair of acrylic plates makes possible a number of interesting spectral investigations with ultrasound. Due to the low plate thicknesses, the echogram shows multiple reflections. The spectral analysis of individual reflections shows an increasing shifting of the spectrum towards lower frequencies as a result of the frequency-dependent attenuation. The plate thickness is included as a periodic modulation in the spectrum of all reflections. When the plates lie on top of each other, a diffuse echogram is obtained, the spectrum of which also includes diffuse modulations. The individual plate thicknesses can only be determined by a cepstrum analysis. The set includes an acrylic delay line.



Order no. 10202

Technical data

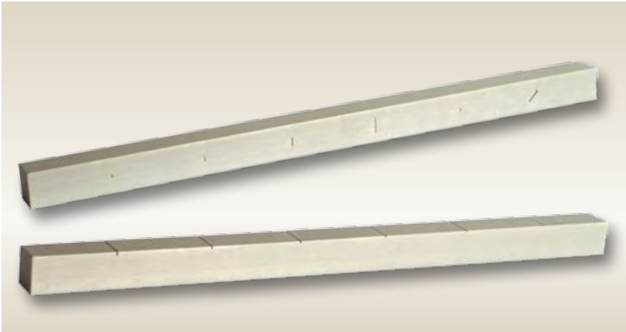
- Material: acrylic, transparent
- Dimensions: width = 40 mm, length = 80 mm, plate thicknesses ~7.5 mm and ~10 mm
- Sound velocity: ~ 2700 m/s (longitudinal)
- Density: 1.2 g/cm³

Experiments

PHY05 Spectral investigations

Rayleigh wave test block

The material sample for investigation with Rayleigh waves has an intact surface side, at which the velocity of Rayleigh waves can be determined in transmission mode. Another side has different material defects that can be detected and localised by means of the Rayleigh waves. A special process in material testing is crack depth measuring using Rayleigh waves. For this purpose, on one side there are several cracks of varying depths, from which the signal amplitude of the Rayleigh wave can be measured.



Order no. 10232

Technical data

- Material: aluminium
- Dimensions: 35 mm × 35 mm × 600 mm
- Weight: 2.5 kg
- Sound velocity of Rayleigh waves: ~ 2950 m/s
- Different discontinuities for non-destructive testing

Experiments

IND02 Detection of cracks with Rayleigh waves

Test block for angle beam probe

The aluminium test block is for the adjustment of angle beam probes, regarding the refraction angle, sound velocity, sound emergence point and the length of the delay line. The angle is here determined by the measurement of the wall echo at different projection intervals. The adjustment is checked at a cylindrical discontinuity (drilled hole).

Order no. 10240

Technical data

- Material: aluminium
- Sound velocity: longitudinal ~ 6400 m/s;
  transversal ~ 3100 m/s
- Dimensions: 35 mm × 35 mm × 120 mm
- Drilled hole: diameter = 8 mm

Experiments

IND06 Angle beam testing

Angle beam wedge

Angle beam testing is one of the most important processes in non-destructive testing with ultrasound. The refraction angle for the longitudinal wave and the shear wave results from the sound velocity of the delay line and of the test material in accordance with the refraction law. The delay line is suitable for tests in transmission, reflection and in case of the use of 2 delay lines as a transmitter-receiver (TR) probe, also known as dual-element probe. The angle beam wedges can be used with all GAMPT probes (1, 2 and 4 MHz).

Technical data

- Material: acrylic
- Sound velocity in acrylic: ~ 2700 m/s (longitudinal)
- Angle of incidence (delay line): 17° 38° 56°
- Refraction angle in aluminium
  shear wave (~ 3100 m/s): ~ 20° ~ 45° ~ 72°
  longitudinal wave (~ 6400 m/s): ~ 44°

Order no. 10233 (17°)

Order no. 10234 (38°)

Order no. 10235 (56°)

Experiments

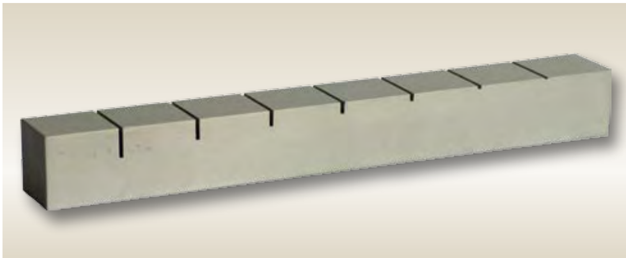
IND06 Angle beam testing
IND07 Crack depth determination (TOFD)
IND08 Detection of discontinuities

Crack depth test block

The test block contains cracks with different depths. Using two different measuring techniques the cracks can be localised and their depths determined. With an angle beam probe, the angle echo amplitude is determined in dependence on crack depth. This method fails, however, in the case of greater crack depths. With the TOFD technique, cracks of greater depth can also be localised and measured. The capabilities and the limitations of the two processes are determined on this test block.

Technical data

- Material: aluminium
- Sound velocity: longitudinal ~ 6400 m/s;
  transversal ~ 3100 m/s
- Dimensions: 35 mm × 35 mm × 300 mm
- Crack depths: 2, 4, 6, 8, 10 and 15 mm



Order no. 10241

Experiments

IND07 Crack depth determination (TOFD)

Discontinuity test block

The aluminium test block contains different reflector types that can be used for producing echoes. Five mirror-type reflectors and one crack-type reflector are differentiated. The mirror-type reflectors include three cylinders, a disk, a vertical crack and a oblique crack each with different orientations to the surface. Diffraction effects can be investigated at the crack. Different locating techniques such as the echo, delta, tandem, transfer and angle techniques are applied for the locating of discontinuities (defect search).

Technical data

- Material: aluminium
- Sound velocity: longitudinal ~ 6400 m/s;
  transversal ~ 3100 m/s
- Dimensions: 35 mm × 35 mm × 300 mm
- Number of discontinuities: 6

Order no. 10242

Experiments

IND08 Detection of discontinuities

Transceiver delay line (TOFD)

A special probe is used in the testing for discontinuities with the TOFD method (time of flight diffraction). This consists of a transmitter probe and a receiver probe, which are guided over the surface of the test object at a particular angle and a fixed distance to each other. Such a transmitter-receiver or dual-element probe can be put together with this delay line and two GAMPT probes of the same frequency.

Technical data

- Material: acrylic
- Sound velocity (acrylic): ~ 2700 m/s
- Angle of incidence: 38°
- Refraction angle of the shear wave in aluminium (c ≈ 3100 m/s): ~ 45°

Order no. 10237

Experiments

IND07 Crack depth determination (TOFD)
IND08 Detection of discontinuities

Acoustic impedance samples

This sample set can be used to examine the reflection and transmission behaviour of ultrasonic waves at the boundary of materials of different acoustic impedance. PVC, acrylic and brass are available as sample materials. Comparative measurements of the reflection coefficients at the material/air boundaries can be used to determine the reflection coefficients of different combinations of these materials.

Technical data

3 cylindric test samples
- Materials: acrylic, PVC and brass
- Dimensions: height = 20 mm, diameter = 38 mm

Clamping plates
- Material: aluminium
- Dimensions: height = 10 mm, diameter = 100 mm

Order no. 10208

Experiments

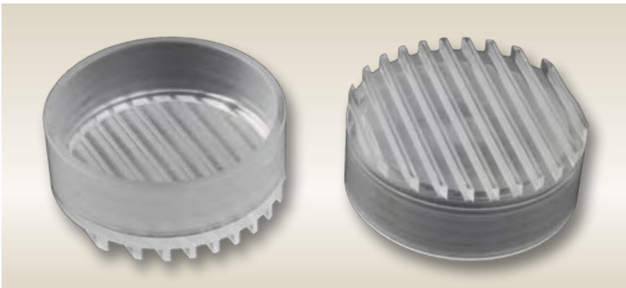
PHY21 Reflection and transmission at boundaries
PHY22 Phase shift and resonance effects

Rayleigh wave attachments (pair)

With this attachments adjusted to aluminium, surface waves (Rayleigh waves) can be stimulated and received in a sample. In this way, the sound velocity of the Rayleigh waves can be determined and statements can also be made about material faults close to the surface. The attachments have been directionally worked for optimisation of the signal amplitude and specially adapted to a 1 MHz probe.

Technical data

- Material: acrylic
- Required excitation frequency (probe): 1 MHz
- Diameter: 32 mm
- Height: 10 mm



Order no. 10230 (for US probe 10151)

Order no. 10231 (for US probe 10131)

Experiments

IND02 Detection of cracks with Rayleigh waves

Hydrophone set

With this set, different experiments can be carried out for investigating ultrasound propagation phenomena and sound fields. It contains a hydrophone, with which the sound pressure amplitudes in the frequency range of 1-5 MHz can be measured with a lateral resolution of approx. 3 mm. To determine the focus zone of an ultrasonic probe the set contains a small sample reservoir and an appropriate hydrophone support. With this, the sound field along the sound axis can be measured by simple pushing of the hydrophone by hand and the focus zone of the probe can be determined. At the same time, this arrangement is suitable for the determining of the phase and group velocity with the cw generator SC600 (order no. 20100). One part of the hydrophone holding appliance can be directly adapted to the sample holder of the CT scanner (order no. 60100/60200). Because of this, the lateral distribution of the sound pressure amplitude can also be recorded at high resolution with the hydrophone.

Technical data (hydrophone)

- Frequency range: 1-5 MHz
- Dimensions: length = 125 mm, width = 24 mm
- Active sensor area: diameter = 3 mm
- Cable length: approx. 1 m

Experiments

PHY10 Characteristics of sound field
PHY19 Phase and group velocity
PHY20 Determination of focus zone

Order no. 10251 (Set for GAMPT-Scan)

Order no. 10451 (Set for GS200/GS200i)

Spare parts

Sample reservoir	10214
Probe support	10215
Hydrophone (GAMPT-Scan)	10250
Hydrophone (GS200/GS200i)	10450
Hydrophone support plate	10252
Hydrophone support	60123

Lamb wave set

With the set the frequency-dependent propagation velocity (dispersion) of ultrasonic waves in a thin glass plate (Lamb waves) can be measured. The set contains several Lamb wave combinations (LW1-KW7), each consisting of a glass plate and two angle beam delay lines. One of the delay lines is adhered to the glass plate and the other is free. Together with an ultrasonic probe (order no. 10151, 10152, 10154) the delay lines form angle beam probes which allow an oblique ultrasound coupling into the glass plate. The delay line angles and the plate thicknesses are selected in such a way, that in combination with one of the ultrasonic probes Lamb wave modes can be selectively excited and amplified. The group velocity of the excited Lamb wave can be determined by varying the distance between the probes and measuring the associated change of time of flight in the glass plate (transmission measurement).

Technical data

Angle beam delay lines

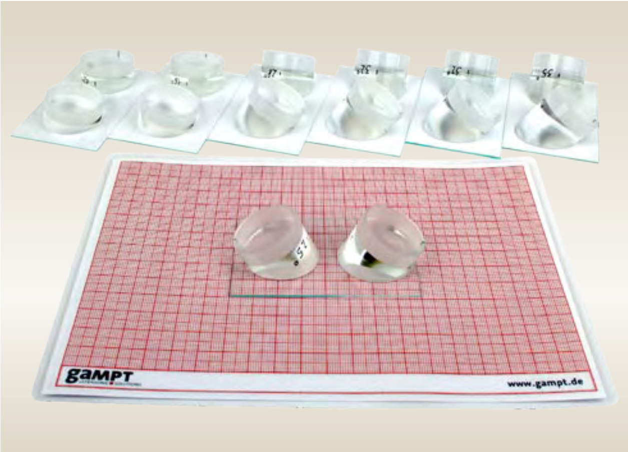
- Material: acrylic (c_L ~ 2700 m/s)
- Incidence angle: 12°, 15°, 25°, 28°, 32° or 35°

Plate structure

- Material: glass (E = 73 kN/mm², ρ = 2.52 g/cm³, μ = 0.22)
- Thickness: approx. 1 or 1.3 mm

Experiments

PHY23 Dispersion of ultrasonic waves (Lamb waves)



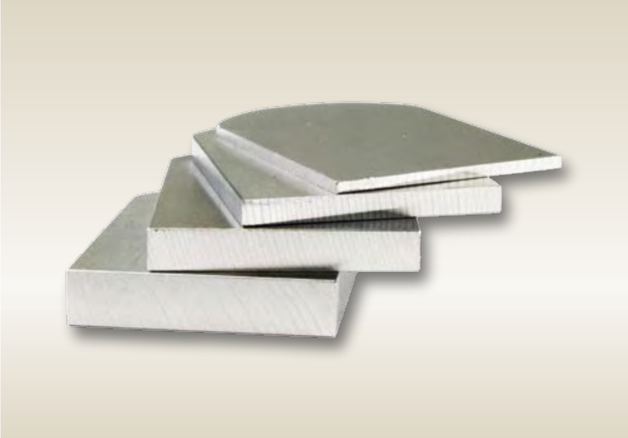
Order no. 10300

Spare parts

Lamb wave combination LW1 (12°, 1 mm)	10311
Lamb wave combination LW2 (15°, 1 mm)	10312
Lamb wave combination LW3 (28°, 1 mm)	10313
Lamb wave combination LW4 (32°, 1 mm)	10314
Lamb wave combination LW5 (35°, 1 mm)	10315
Lamb wave combination LW6 (25°, 1.3 mm)	10316
Lamb wave combination LW7 (32°, 1.3 mm)	10317

Lambda plates

Sound waves are partially or entirely reflected at the boundary of two materials with different characteristic acoustic impedances. Here, the amplitude and phase of the reflected sound waves and the sound waves passing through can change. The reflected and/or transmitted part of the sound energy can be described by the reflection and/or transmission coefficient. Particularly interesting effects occur during passing through thin layers the thickness of which lies in the range of the wavelength of the ultrasonic waves (λ/4, λ/2 and their multiples). These effects can be investigated with this plate set.



Order no. 10209

Technical data

- Material: aluminium
- Sound velocity: longitudinal ~6400 m/s
- Thickness of the plates: ~ λ/4, ~ λ/2, ~ ¾λ, ~ λ (1 MHz)

Experiments

PHY22 Phase shift and resonance effects

Transit time pipe

This pipe is specially intended for flow measurements using the transit time method. It consists of a central flow pipe and two connection blocks with the connections for the measuring circuit and supports for the ultrasonic probes.

Order no. 10180

Technical data

- Material: acrylic
- Dimensions: 50 mm × 55 mm × 310 mm
- Inside diameter of the flow pipe: ~ 7 mm
- Connectors: 3/8''

Experiments

IND09 Transit time flow meter

Spare parts

Tubes	10181

Breast phantom

The breast phantom made of silicone rubber possesses two occlusions. These are intended to simulate benign tumours. The location of the tumours can first be palpated so that a targeted ultrasonic investigation can then be carried out. The tumours can be well shown with a hand-guided B-scan (compound scan) and/or with imaging in the linear scanner (better resolution due to better coupling and local assignment). The position and size of the tumours can be determined from the B-scan image. This breast phantom is thus very suitable as a practical example in the ultrasound training of medics.

Technical data

- Material: silicone
- Inclusions: 2 movable tumours at a depth of approx. 10 mm, diameter approx. 20 mm

Order no. 10221

Experiments

MED02 Ultrasonic imaging at breast phantom

Eye phantom

Biometric measurements with ultrasound are an important diagnostic method in ophthalmology. The typical biometric measurements of the length of the eye axes are excellently suitable for demonstration of the fundamentals of ultrasonic pulse-echo applications. With this phantom and the ultrasonic device GS200/GS200i (order no. 10400/10410) with a 2 MHz probe one receives echoes that are typical of the eye. The eye consists of a lens and the vitreous body with different sound velocities. The geometric dimensions of these objects can be determined by the distance of the echoes. In addition, an injury with a diffuse echo structure close to the fundus of the eye can be detected.

Technical data

- Eye phantom with lens and vitreous body at scale 3:1
- Diameter: 80 mm

Order no. 10222

Experiments

MED04 Biometry at the eye phantom

Heart model

The TM mode (time motion) is used for the examination of movement sequences in the ultrasonic image. The echoes are here continuously recorded along the sound axis. This way one can record e.g. movements of the cardiac wall and/or heart valves. The heart model includes a movable membrane, the echo of which produces a TM-mode image similar to a movement of the heart valve and/or cardiac wall. The membrane is periodically arched upward with the rubber ball. Due to a slow return flow of air one receives a characteristic curve progression. The wall speed and the stroke volume can be calculated from the recorded curve.

Technical data

- Double container with rubber membrane
- Rubber pressure ball

Order no. 10220

Experiments

MED01 Ultrasonic TM-mode (echocardiography)

Tripod set

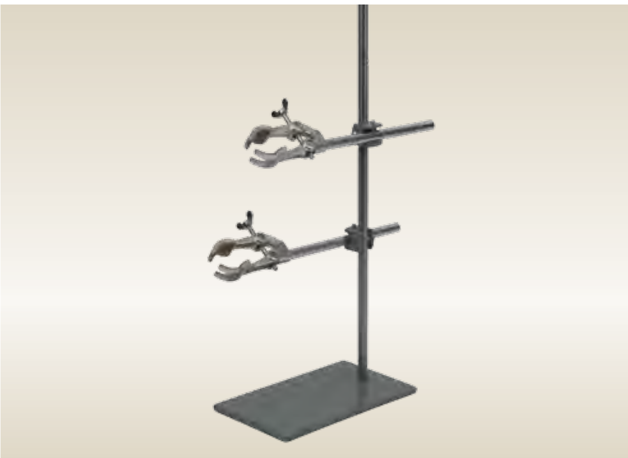
The tripod set has been specially selected and assembled for experiments in the present catalogue. It consists of a tripod with a very robust and stably standing base plate, a 750 mm long stainless steel tripod rod, two solid bossheads, which ensure simple handling and very secure holding and two universal clamps made of hard aluminium with a span of up to 80 mm. These are suitable for all holdings necessary for the experiments.

Technical data

- 1 base plate of steel, powder-coated, 25 cm × 16 cm
- 1 tripod bar of stainless steel, length ~ 75 cm
- 2 bossheads of steel, powder-coated, Allen head screws
- 2 clamps of hard aluminium, 0-80 mm, length ~ 300 mm

Experiments

IND03 Level measurement
PHY23 Dispersion of ultrasonic waves (Lamb waves)
PHY24 Thermoacoustic sensor



Order no. 10310

Spare parts

Tripod	10304
Clamp	10305
Bosshead	10303

Erlenmeyer flask

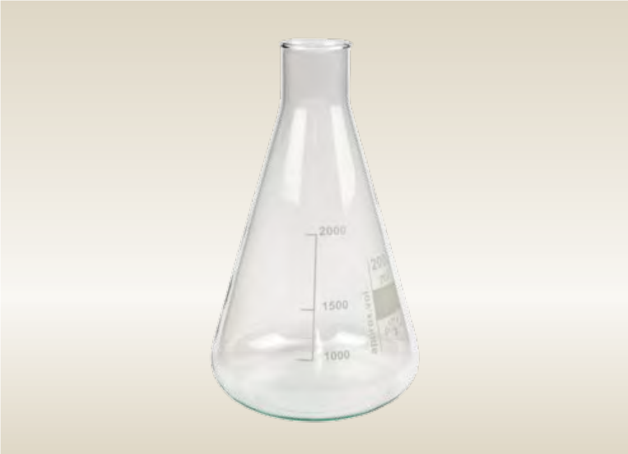
The Erlenmeyer flask made of borosilicate glass is well suited to level measurement experiments. The even bottom permits a good coupling of the ultrasonic sensor to the reservoir. Due to the narrow neck the flask can be fixed in place with a simple laboratory clamp. With a total height of 280 mm, a sufficient range of different filling levels can be realised. Glass flasks can be easily cleaned and can be used for many different liquids.

Technical data

- Material: borosilicate glass
- Capacity: 2000 ml (with 500 ml divisions)
- Height: 280 mm
- Diameter: 166 mm

Experiments

IND03 Level measurement



Order no. 10330

Adapter BNC/LEMO for GAMPT-Scan

The adapter allows the connection of ultrasonic probes with a BNC plug connection to the LEMO connectors of the GAMPT-Scan echoscope.

NB: *GAMPT-Scan and GAMPT probes are adapted to each other. Before you use probes from other manufacturers, please check whether the technical parameters are compatible.*

Order no. 10270

Ultrasonic Echoscope GS200i

The GS200i is a high-resolution ultrasonic measurement system based on the GS200 (order no. 10400). With this device ultrasonic measurements can be made with the single-element transducers (order no. 10151-10154) and ultrasonic images can be produced using the B-mode and M-mode methods with an ultrasonic array transducer.

The ultrasonic transducer that is part of the scope of supply possesses an array of 64 convexly arranged individual elements. For the controlling of the array transducer and the recording and analysis of the signal, a separate extension module is integrated into the device.

This module and the array transducer are directly controlled from the PC. The supplied measurement software GS-EchoView possesses an additional programme mode via which the adjustment of the measurement parameters (frequency, transmission and reception power, measurement and focal ranges, TGC) and typical parameters for signal and image processing (dynamic range, rejection, image improvement, speckle reduction, contrast, brightness) and the actual conducting of the measurement takes place.

Two ultrasonic phantoms are available for experiments using the expansion module:
- a test phantom (order no.10420) with structures that allow the examination and visualisation of physical factors and phenomena of the propagation of ultrasound (sonic time of flight, reflection, acoustic attenuation, sound frequency, axial/lateral resolution, sound field) and
- a phantom (order no. 10430) with a fetometrically measurable foetus model.

With this equipment, experiments can be created for medical-technical and medical training that relate to both fundamentals and application.

Technical data

- Dimensions: 226 mm × 169 mm × 325 mm (W × H × D)
- Mains voltage: 100-240 V, 50/60 Hz
- PC connection: USB

Basic device (GS200)
- Frequency: 1-5 MHz
- Measuring modes: reflection and transmission
- Transmission signal/level: 0-300 Volt / 0-30 dB
- Gain: 0-35 dB
- TGC: 0-32 dB, threshold, slope, wide (width), start
- Outputs: trigger, TGC, US signal, A-scan signal

Expansion (GS200i)
- Imaging module
- Imaging methods: B, B+M
- Automatic probe recognition

Array transducer
- Frequency range: 2-5 MHz
- Transducer array: convex, 64 elements

Spare part

Array transducer	10415

Order no. 10410

Software

The GS200 and GS200i echoscopes are delivered with the new measurement software GS-EchoView (Windows 7/8). With this programme, ultrasonic measurements can be carried out with single-element transducers, using the A-mode, B-mode or M-mode methods and also computer tomography ultrasonic examinations (see software description for GS200). An additional programme mode is available for the GS200i with its expansion module for ultrasonic examinations with an array transducer: **Imaging**.

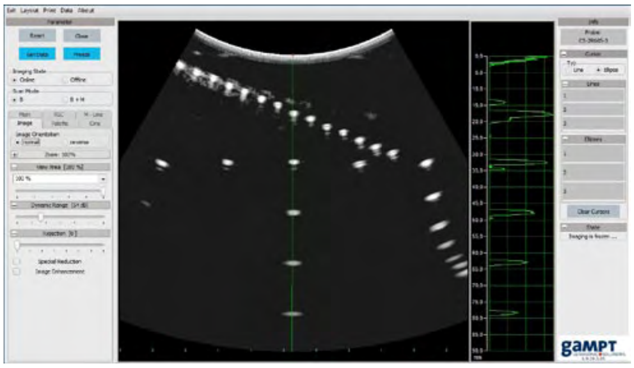
In imaging mode, ultrasonic measurements can be carried out with the **B-mode method** with or without additional **M-mode scan**. The ultrasonic images are shown in the middle of the programme window.

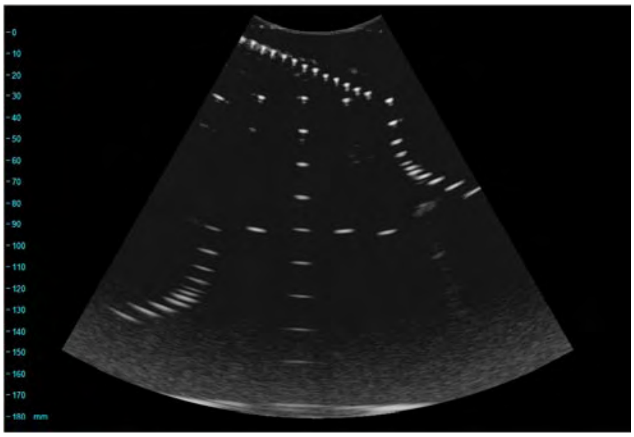
In parallel with the ultrasonic B-image, the amplitude signal can be shown along a single scan line. This way, it is simple to illustrate the step from the actual measurement signal - the ultrasonic signal - to the B-image.

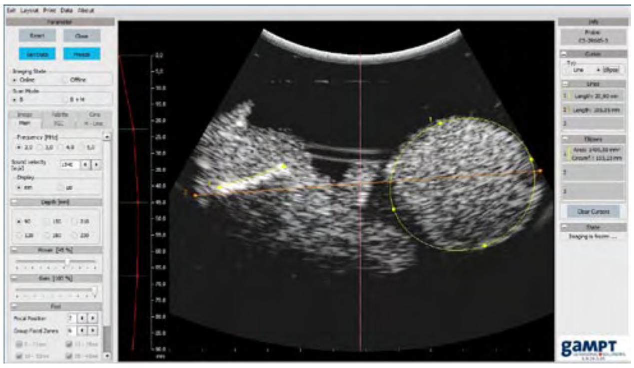
For the carrying-out of a measurement, the transmission power, gain and measurement range can be adjusted, focus areas set and the TGC added over several sampling points through the measurement range.

Typical parameters and methods of signal and image processing such as smoothing and sharpening filters, dynamic range, rejection, speckle reduction, brightness, contrast and gamma correction can be applied and altered in order to investigate their influence upon the measurement results, i.e. the ultrasonic images.

For the analysis of the measurements, lines and ellipses can be generated in the ultrasound B-image in order to measure spacing, lengths or areas and their perimeters.







Experiments

PHY01 Basics of pulse echo method (A-scan)
PHY02 Sound velocity in solids
PHY03 Acoustic attenuation in solids
PHY04 Acoustic attenuation in liquids
PHY05 Spectral investigations
PHY06 Frequency dependence of resolution power
PHY07 Shear waves in solids
PHY08 Ultrasonic B-scan
PHY09 Ultrasonic computer tomography (CT)
PHY10 Characteristics of sound field
PHY16 Mechanical scan methods
PHY20 Determination of focus zone
PHY21 Reflection and transmission at boundaries
PHY22 Phase shift and resonance effects
IND01 Non-Destructive Testing (NDT)
IND02 Detection of cracks with Rayleigh waves
IND03 Level measurement
IND06 Angle beam testing
IND07 Crack depth determination (TOFD)
IND08 Detection of discontinuities
IND09 Transit time flow meter
MED01 Ultrasonic TM-mode (echocardiography)
MED02 Ultrasonic imaging at breast phantom
MED04 Biometry at the eye phantom
MED07 Ultrasound test phantom
MED08 Ultrasound fetal phantom
MED09 Mammasonography
Med10 Gallbladder ultrasound

Ultrasonic B-scan device Gi210

New!

With the Gi210 device and an ultrasonic array transducer, ultrasonic images can be produced using the B-mode and M-mode methods. The ultrasonic probe that is part of the scope of supply possesses an array of 64 convexly arranged individual transducer elements.

The device is directly controlled from the PC. Via the PC software, measurement parameters for the actual measuring operation can be set and typical parameters for signal and image processing can be adjusted.

A number of ultrasonic models are available for practical experiments:

- a ultrasound test phantom (order no. 10420) with various test structures,
- a ultrasound fetal phantom (order no. 10430) with a fetometrically measurable fetus model,
- a ultrasound breast model with cysts (order no. 10224),
- a ultrasound breast model with tumours (order no. 10225) and
- a ultrasound gallbladder model (order no. 10440).

With this equipment, experiments can be created for medical-technical and medical training that relate to both fundamentals and application.

Technical data

- Convex array probe with 64 transducer elements
- Automatic probe recognition
- Frequency range: 2-5 MHz
- Imaging methods: B, B+M
- Interface to the PC: USB
- Dimensions: 255 mm × 170 mm × 265 mm
- Power Supply: 100-240 V, 50 Hz/60 Hz

Software

With the software (Windows 7 and higher), ultrasonic measurements can be carried out using the B-mode methode with or without an additional M-mode scan.

In parallel with the ultrasonic B-image, the amplitude signal can be shown along a single scan line. This way, it is

simple to illustrate the step from the actual measurement signal - the ultrasonic signal - to the B-image.

For the carrying-out of a measurement, the transmission power, gain and measurement range can be adjusted, focus areas set and the TGC added over several sampling points through the measurement range.

Typical parameters and methods of signal and image processing such as smoothing and sharpening filters, dynamic range, rejection, speckle reduction, brightness, contrast and gamma correction can be applied and altered in order to investigate their influence upon the measurement results, i.e. the ultrasonic images.

For the analysis of the measurements, lines and ellipses can be generated in the ultrasound B-image in order to measure spacing, lengths or areas and their perimeters.

Experiments

MED07 Ultrasound test phantom
MED08 Ultrasound fetal phantom
MED09 Mammasonography (in progress)
MED10 Gallbladder ultrasound (in progress)

Order no. 10412

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Ultrasound breast model with cysts

Order no. 10224

The ultrasound model is a realistic breast replication with two fluid-filled and non-palpable cysts.

The material of the model replicates the haptic properties of real soft tissue and enables ultrasound images with tissue-like texture and echogenicity.

Technical data

- Dimensions: approx. 240 mm × 190 mm × 80 mm
- Inclusions: 2 cysts, diameter approx. 20 mm

Experiments

MED09 Mammasonography (in progress)

Ultrasound breast model with tumours

Order no. 10225

The ultrasound model is a realistic breast replication with three malignant tumours.

The material of the model replicates the haptic properties of real soft tissue and enables ultrasound images with tissue-like texture and echogenicity.

Technical data

- Dimensions: approx. 240 mm × 190 mm × 85 mm
- Inclusions: 3 tumours, diameters approx. 18 × 11 mm, 21 × 15 mm und 28 × 15 mm

Experiments

MED09 Mammasonography (in progress)

Ultrasound gallbladder model

Order no. 10440

The ultrasound model consists of a block with three enclosed gallbladders. The model simulates different illness symptoms of the gallbladder:

- gallstones
- thickened gallbladder wall and
- sludge deposits.

The gallstones and the biliary sludge deposit are freely movable.

The material of the block replicates the haptic properties of real soft tissue and enables ultrasound images with tissue-like texture and echogenicity.

Technical data

- Dimensions: approx. 240 mm × 190 mm × 90 mm
- Gallbladder 1: approx. 90 mm × 30 mm; 2 stones in the gallbladder (Ø approx. 10 mm); 1 stone in the canal (Ø approx. 8 mm)
- Gallbladder 2: approx. 90 mm × 30 mm (inner dimensions); wall thickness approx. 5-6 mm; 1 stone in the gallbladder (Ø approx. 10 mm)
- Gallbladder 3 with sludge: approx. 95 mm × 35 mm

Experiments

MED10 Gallbladder ultrasound (in progress)

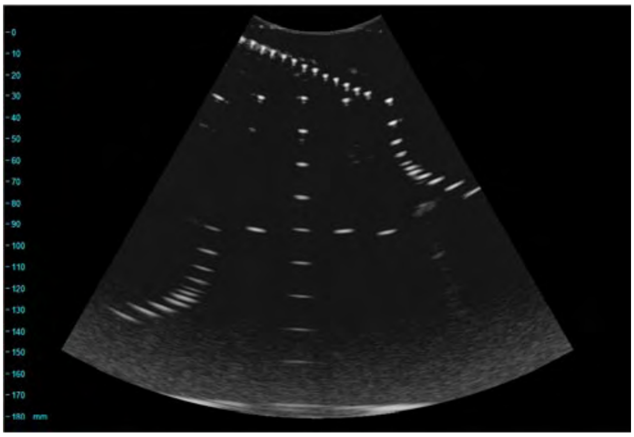
Ultrasound Test Phantom

Tissue-equivalent phantoms are used for quality assurance and evaluation of the accuracy and performance of imaging ultrasonic systems. The phantoms are made of materials possessing physical characteristics similar to the acoustic characteristics of human tissue.

Different kinds of test structures can be embedded in the tissue-equivalent material, allowing objective and comparable evaluation of imaging characteristics of ultrasonic devices.

Routine checks with test phantoms can reveal changes in image quality, which could be due to e.g. a deterioration of system components. The test phantoms are generally adapted to specific groups of equipment.

Together with the GS200i echoscope (order no. 10410) and a convex array transducer, they allow a demonstrative introduction or realistic training in the use of test phantoms resembling tissue. Phenomena and factors of sound propagation (time of flight, sound velocity, reflection, acoustic attenuation, sound field, resolution) can be examined by means of the structures in the phantom. The influence of typical signal and image processing factors (focussing, dynamic range, graphic filters, brightness, contrast) can also be demonstrated.



Technical data

- Dimensions: 270 mm × 200 mm × 60 mm (W × H × D)

Phantom body
- Material: polyurethane
- Velocity of sound: approx. 1460 m/s

Test structures
- Material: CRP rods, Ø = 0.5 mm
- „Dead zone“ group (15 targets, vertical spacing 2 mm)
- vertical group (10 targets, 15 mm spacing)
- two horizontal groups (5 targets each, spacing 20 mm, depths approx. 3.3 and 9.3 cm)
- two axial-lateral resolution groups (11 targets each, spacing 2, 4, 6, 8, 10 mm, depths 6.3 and 12.3 cm)

Experiments

MED07 Experiment for the ultrasound test phantom

Order no. 10420

Ultrasound Fetal Phantom

Sonographic examinations during pregnancy have now become standard. It is generally recommended to have three ultrasonic examinations.

In addition to the assessment of the position of the child and of the placenta, the amount of amniotic fluid or the heart rate, the foetus is also measured (fetometrics). Different fetometric variables are measured depending on the age of the foetus. Based on these measurements, the doctor can e.g. judge whether the foetus has developed in line with its age or if there are possibly malformations or developmental delays.

When used together with the GS200i echoscope (order no. 10410) and a convex multi-element ultrasonic transducer (order no. 10415) for the abdominal area, the fundamentals of sonographic fetometrics can already be taught in pre-clinical training with the ultrasound fetal phantom from GAMPT.

The size of the foetus model corresponds roughly to the size of a foetus in the 15th to 17th week of pregnancy. The following variables can be measured on the model:

- the crown-rump length (CRL)
- the biparietal diameter (BPD)
- the fronto-occipital diameter (FRO)
- the head circumference (HC)
- the femur length (FL).

Technical data

- Dimensions: approx. 170 mm × 155 mm × 60 mm

Phantom body

- Material: polyurethane
- Velocity of sound: approx. 1460 m/s

Foetus model

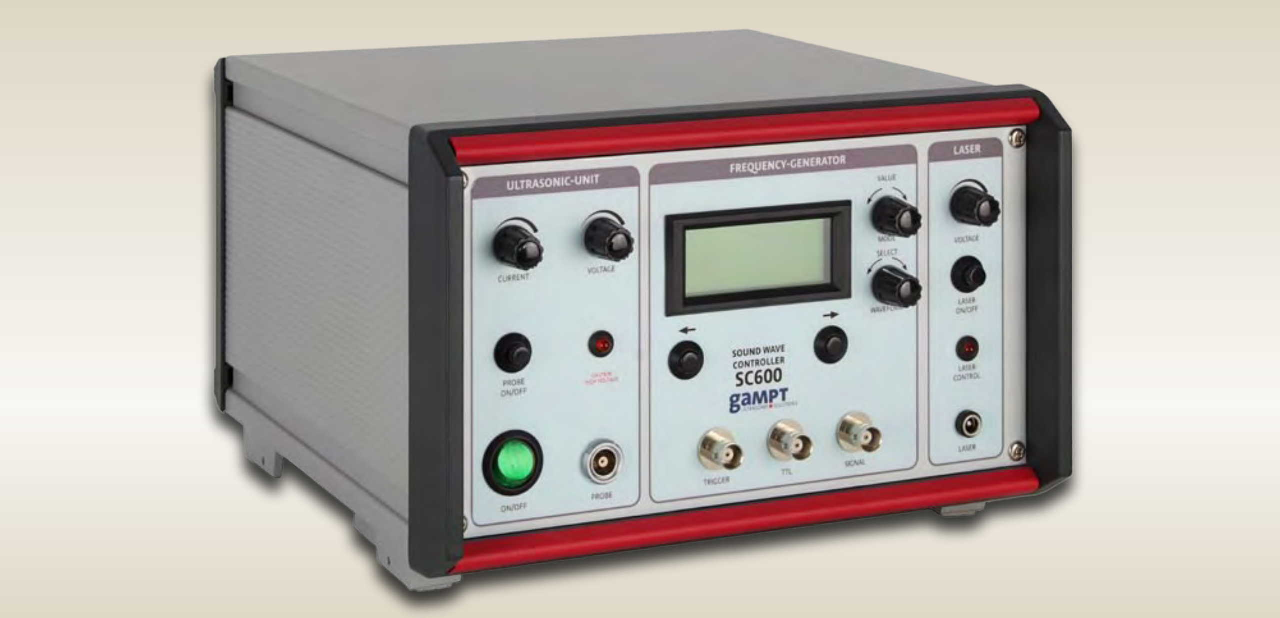
- Material: polyurethane + contrast materials
- Velocity of sound: approx. 1460 m/s

Experiments

MED08 Experiment for the ultrasound fetal phantom

Order no. 10430

cw generator SC600



The cw generator SC600 permits the generation of continuous sound waves (continuous wave - cw) with high power over a wide frequency range up to 20 MHz. Additional the output can be switched to burst or pulse mode. The transmission frequency can be digitally adjusted in 1 Hz steps and is shown on a display. The sound power can also be adjusted. It is controlled via the transmission voltage on the ultrasound transformer and can be switched on and off separately. The transmission mode is displayed by an indicator light. The transmission voltage and current are shown by a LCD display. The limit of transmission current can be adjusted from 0 mA to 1000 mA to protect the ultrasonic probe from overheating. A sinusoidal signal with a maximum amplitude of 46 Vpp is available at the transmission output. The cw generator SC600 is specially adapted for connection of the GAMPT multifrequency probe (order no. 20139). With this, ultrasonic waves can be produced in the range of 1-13 MHz.

Furthermore, the transmission frequency is present as a TTL signal at a BNC connector and as a low power signal (sine, square, triangle) at an other BNC connector. That means the SC600 can also be used as a flexible signal generator.

In addition, an appropriate voltage output is available for controlling the laser diodes (red, green and blue) when they are used for the Debye-Sears experiment or the central projection of standing waves. The output voltage can be adjusted and displayed. This can also be separately switched on and off and is equipped with an indicator light.

Technical data

- Frequency: ≤ 20 MHz
- Frequency graduation: 1 Hz
- Signal amplitude ultrasound generator: 2-50 Vpp
- Transmission signal output: cw/burst/pulse signal, on-off switch, LED indicator light
- TTL output: 0-5 V, square wave signal

- Signal generator output: sine/triangle/square with cw/burst/pulse, max. signal amplitude 2 Vpp
- Connection for laser module: adjustable, on-off switch, LED indicator light
- Display: current, voltage, frequency and mode (cw/burst/pulse) or alternative laser voltage, signal generator amplitude and type (sine/triangle/square), burst length and pulse repetition frequency
- Dimensions: 255 mm × 265 mm × 170 mm (W × D × H)
- Mains voltage: 100-240 V, 50/60 Hz

Experiments

PHY11 Debye-Sears effect
PHY12 Projection of standing waves
PHY17 Acousto-optical modulation at standing waves
PHY19 Phase and group velocity
PHY24 Thermoacoustic sensor
IND04 Concentration measurement with resonance cell

Order no. 20100

Debye-Sears set

The generation of standing waves for the Debye-Sears experiment and the projection of ultrasonic waves in a special sample reservoir, with the probe adjustment of which the ultrasonic probe can be aligned so that incidence is precisely perpendicular. In addition, a laser support - with lens holder - arranged perpendicularly to the sound axis is attached, which allows exact positioning of the laser beam in the sound field and the insertion of a lens for the generation of a divergent laser beam (for central projection).

Order no. 20200 (Set)

Technical data

- Sample reservoir: glass, with laser support and lens holder, 123 mm × 144 mm × 115 mm (W × D × H)
- Probe adjustment: POM, three-point adjustment, 123 mm × 105 mm × 52 mm (W × D × H)
- Ultrasonic probe: 1-13 MHz, metal housing, moulded
- Laser module: red (650 nm), laser class 3R (EN 60825-1)

Experiments

PHY11 Debye-Sears effect
PHY12 Projection of standing waves
PHY17 Acousto-optical modulation at standing waves
IND04 Concentration measurement with resonance cell

Spare parts

Multifrequency probe	20139
Laser module (red)	20210
AOM probe adjustment	20224
AOM sample reservoir	20225

Multifrequency probe

This ultrasonic probe has been specially developed for use with the multifrequency cw generator. It is distinguished by very good sound generation characteristics in a frequency range from 1 MHz to over 10 MHz, so that all experiments with the cw generator can be carried out with one probe over a broad frequency range. Like all GAMPT probes it is equipped with a robust metal housing. The sound emission area is moulded watertight.

Order no. 20139

Technical data

- Frequency: 1-13 MHz
- Dimensions: 65 mm × 27 mm
- Cable length: approx. 1 m

Experiments

PHY11 Debye-Sears effect
PHY12 Projection of standing waves
PHY17 Acousto-optical modulation at standing waves
PHY19 Phase and group velocity
PHY24 Thermoacoustic sensor
IND04 Concentration measurement with resonance cell

Laser module (red)

The red laser module with a wavelength of approx. 650 nm is in a special housing for simple positioning in the laser support of the sample reservoir. The laser module is connected to the cw ultrasonic generator via coaxial power connectors and from there supplied with the appropriate voltage. The laser beam is focussed.

Order no. 20210

Technical data

- Dimensions: length = 107 mm, Ø = 18 mm | cable: ~ 1 m
- Wavelength: 650 nm
- Current consumption: max. 40 mA | Voltage: ≤ 3.3 V DC
- Power: ≤ 5 mW | Laser class: 3R (EN 60825-1)

Experiments

PHY11 Debye-Sears effect
PHY12 Projection of standing waves
PHY17 Acousto-optical modulation at standing waves
IND04 Concentration measurement with resonance cell

Laser module (green)

The green laser module with a wavelength of approx. 532 nm is in a special housing for simple positioning in the laser support of the sample reservoir. The module with a laser diode of the laser class 3R is connected to the cw ultrasonic generator via coaxial power connectors and from there supplied with the appropriate voltage. The laser beam is focussed.

Order no. 20211

Technical data

- Dimensions: length = 107 mm, Ø = 18 mm | cable: ~ 1 m
- Wavelength: 532 nm
- Current consumption: max. 375 mA | Voltage: ≤ 3.3 V DC
- Power: ≤ 5 mW | Laser class: 3R (EN 60825-1)

Experiments

PHY11 Debye-Sears effect
PHY12 Projection of standing waves

Laser module (blue)

The blue laser module with a wavelength of approx. 405 nm is in a special housing for simple positioning in the laser support of the sample reservoir. The module with a laser diode of the laser class 2 is connected to the cw ultrasonic generator via coaxial power connectors and from there supplied with the appropriate voltage. The laser beam is focussed.

Order no. 20212

Technical data

- Dimensions: length = 107 mm, Ø = 18 mm | cable: ~ 1 m
- Wavelength: 405 nm
- Current consumption: max. 90 mA | Voltage: ≤ 3.3 V DC
- Power: ≤ 1 mW | Laser class: 2 (EN 60825-1)

Experiments

PHY11 Debye-Sears effect
PHY12 Projection of standing waves

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AOM sample reservoir

The sample reservoir made of glass is suitable for all liquids, is easy to clean and offers optimal conditions for sound reflection for the production of standing waves and radiography with laser light, thanks to the even bottom and the plane-parallel side areas. Due to the fixed installation of the laser support, the laser beam is always perpendicularly aligned to the outer wall so that only the sound probe has to be adjusted. At the same time, the laser support includes a shaft for insertion of the lens for the projection of the standing waves in the beam path. In order to investigate different liquids or series of concentrations, it is recommended to use several reservoirs so that measurements can be carried out in quick alternation by simple placing on the sample cover with probe and probe adjustment. The costly probe support here only needs to be purchased once.

Order no. 20225

Technical data

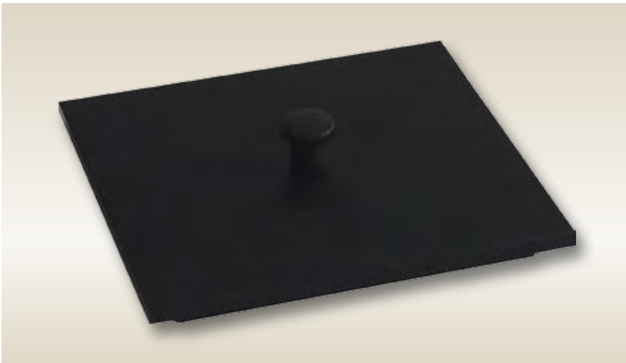
- Material: glass (wall thickness 4 mm)
- Dimensions: 123 mm × 144 mm × 115 mm (W × D × H)

Experiments

PHY11 Debye-Sears effect
PHY12 Projection of standing waves
PHY17 Acousto-optical modulation at standing waves
IND04 Concentration measurement with resonance cell

Cover for AOM sample reservoir

If more than one sample reservoir is used, this cover prevents evaporation and therefore a change in the concentration of the liquid. The cover also helps to prevent contamination.



Order no. 20223

Technical data

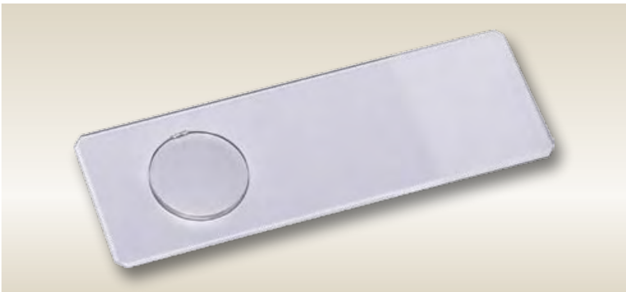
- Material: POM
- Dimensions: 123 mm × 105 mm × 25 mm (W × D × H)

Experiments

PHY11 Debye-Sears effect

Projection lens

The plano-convex optical lens is placed, for the projection of standing ultrasonic waves, in the beam path between laser source and ultrasonic wave, to produce a divergent laser beam. The lens is fixed onto a rectangular glass holder which can be inserted into the corresponding slot in the laser support on the sample reservoir. By simple insertion and removal of the lens holder, it is possible to change quickly between diffraction and projection experiment.



Order no. 20230

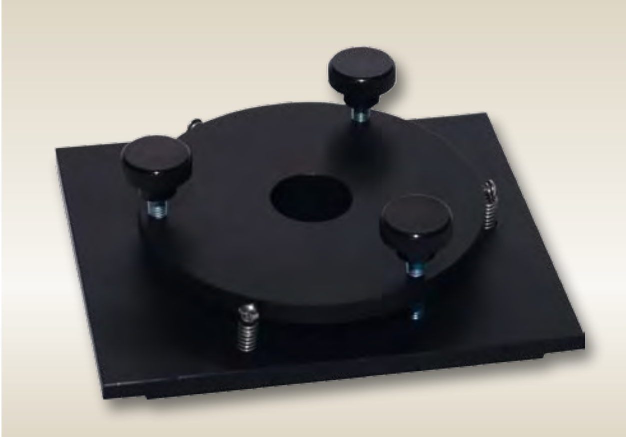
Technical data

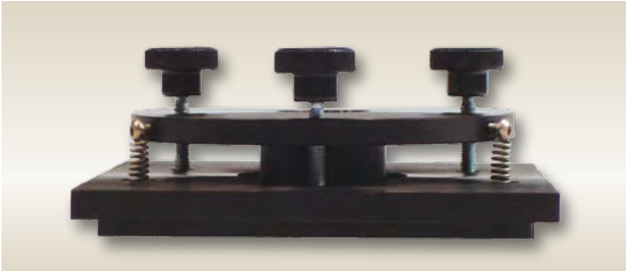
- Dimensions of the glass holder: 25 mm × 75 mm
- Lens diameter: 12.5 mm
- Focal length of lens: 173 mm

Experiments

PHY12 Projection of standing waves

AOM probe adjustment





This cover for the glass sample reservoirs (order no. 20225) possesses a probe support for firm holding of the multifrequency probe (order no. 20139). This can be further secured with a screw. The sprung suspended adjusting washer with the probe support is adjusted with three-point adjustment with adjusting screws, so that the probe and thus the emitted sound wave can be optimally oriented to the laser beam. With a precisely perpendicular orientation of the sound axis and a spacing adapted to the wavelength, a standing wave can be generated. This means a maximum of orders of diffraction and/or resolution as sharp as possible in the imaging of the central projection.

Technical data

- Material: POM
- Dimensions: 123 mm × 105 mm × 52 mm (W × D × H)
- Three-point adjustment with probe support

Experiments

PHY11 Debye-Sears effect
PHY12 Projection of standing waves
PHY17 Acousto-optical modulation at standing waves
IND04 Concentration measurement with resonance cell

Order no. 20224

Acoustic absorber

The acoustic absorber consists of a special silicone material that is able to absorb ultrasonic waves almost completely. The absorber is used for the prevention of undesired sound reflections in the AOM experiments or with the thermoacoustic sensor. The acoustic impedance of the silicone material has been adapted to water. In addition, the circular lamellae reduce reflections on the absorber surface. The sound energy absorbed is entirely transformed into heat by the high absorption capacity of the material. (The colour of the acoustic absorber supplied can differ from that shown in the product photo.)

Technical data

- Material: silicone
- Dimensions: 110 mm × 90 mm × 19 mm (W × D × H)

Experiments

PHY12 Projection of standing waves
PHY24 Thermoacoustic sensor

Order no. 20227

Beam splitter

A semipermeable reflector is used as a beam splitter for laser light. The transmission/reflection ratio is 1:1.

Technical data

- Dimensions of the reflector:
  20 mm × 37 mm (W × H)
- Dimensions of the support:
  60 mm × 80 mm × 90 mm (W × D × H)

Experiments

PHY17 Acousto-optical modulation at standing waves

Order no. 20301

Adjustable reflector

The reflector is fastened to a support with three-point adjustment. It can be horizontally and vertically adjusted to align the laser beam precisely to the target object (photodiode, reflector, beam splitter).

Technical data

- Dimensions of the reflector:
  52 mm × 80 mm (W × H)
- Dimensions of the support:
  60 mm × 80 mm × 120 mm (W × D × H)

Experiments

PHY17 Acousto-optical modulation at standing waves
IND04 Concentration measurement with resonance cell

Order no. 20302

Photodiode receiver

With this photodiode receiver with built-in amplifier, a quantitative recording of the intensity of the laser light is possible. The amplitudes of the orders of diffraction can thus be measured and the occurring modulations (AOM) can be analysed with an oscilloscope. The photodiode receiver is delivered complete with power pack and BNC connection cable.

Technical data

- Photodiode - spectral range of sensitivity (10% of the max.): 400-1100 nm
- Maximum light sensitivity: 850 nm
- Light sensitive area: 7 mm²
- Power supply: 12 V, 500 mW
- Amplifier output (BNC): 0-10 V adjustable
- Dimensions: 60 mm × 80 mm × 120 mm (W × D × H)

Experiments

PHY17 Acousto-optical modulation at standing waves
IND04 Concentration measurement with resonance cell

Order no. 20303

Thermoacoustic sensor

The thermoacoustic sensor is a very simple and cheap measuring method for determining the local average intensity of ultrasonic waves. The sensor works based on the transformation of sound energy into heat within a very small cylindrical absorber. The heating is proportional to the irradiated intensity and is transformed into a voltage signal by means of a thermocouple and a measuring amplifier. The voltage signal can be registered using a simple voltmeter or recorded via a USB interface with the PC. For the compensation of the ambient temperature the measuring amplifier has a zero balancing. The set is supplied including the connection cables for a voltmeter.
The thermoacoustic sensor has a high sensitivity and a high local resolution power, due to the very small active area, so that the intensity distribution of sound fields can also be measured.

Technical data

Sensor:
- Measuring range: 0.1-5 W/m²
- Active sensor area: ~ 0.2 mm²
- Lateral resolution power: ~ 0.5 mm
- Dimensions of probe head: diameter ~8 mm, length ~ 16 mm

Measuring amplifier:
- Signal output: ± 10 V DC
- Zero balancing (temperature compensation)
- Dimensions: 107 mm × 140 mm × 80 mm (W × D × H)
- Power Supply: 100-240 V

Order no. 20400

Spare parts

Thermoacoustic probe	20410
Measuring amplifier	20420
Cables for voltmeter	20421

Experiments

PHY24 Thermoacoustic sensor

Stirrer for SC500/SC600

For the measurements with the thermoacoustic probe or the concentration measurements with the resonance cell it is recommended to use a stirrer. With the thermoacoustic sensor the stirrer prevents the formation of local temperature differences and the manufacturing of the solutions for concentration measurement is made simpler. The stirrer can be plugged directly in the laser probe jack of the SC500/SC600 and the rotational speed can be set with the controller for probe voltage. No additional control device is necessary for the stirrer.

Technical data

- Propeller stirrer made of plastic
- Rotational speed: 0-120 rpm
- Connection: coaxial power connector for connection to the laser jack of the SC500/SC600

Order no. 20450

Experiments

PHY24 Thermoacoustic sensor

Measuring reservoir

The measuring reservoir is made of thin acrylic plates. At one face side of the reservoir, a support is provided into which an ultrasonic probe (e.g. order no. 20139) can be fastened. The opposite reservoir side is prepared to hold an ultrasonic acoustic absorber made of silicone (order no. 20227).

Technical data

- Material: acrylic
- Dimensions: ~ 116 mm × 310 mm × 116 mm (W × L × H)

Experiments

PHY24 Thermoacoustic sensor

Order no. 20430

Adapter BNC/LEMO for SC500/SC600

The adapter makes it possible to connect ultrasonic probes with a BNC connector to the LEMO connector of the cw generator SC500 or SC600.

NB: *SC500 or SC600 and GAMPT probes are adapted to each other. Before you use probes from other manufacturers, please check whether the technical parameters are compatible.*

Order no. 20280

Adapter LEMO/BNC for multi-frequency and GS200 probes

Using this adapter, the 1, 2 and 4 MHz ultrasonic probes (order no. 10151, 10152, 10154) for the GS200/GS200i, the multifrequency probe (order no. 20139) or the hydrophone (order no. 10450) can for example be connected to the BNC inputs of an oscilloscope to read the probe signals.

Order no. 20285

Adapter LEMO/BNC for GAMPT-Scan probes

The adapter makes it possible to connect the hydrophone (order no. 10250) or the 1, 2 and 4 MHz ultrasonic probes (order no. 10131, 10132, 10134) for the GAMPT-Scan with a LEMO connector on the BNC connections of an oscilloscope.

Order no. 20290

Ultrasonic Doppler device FlowDop200 **New!**

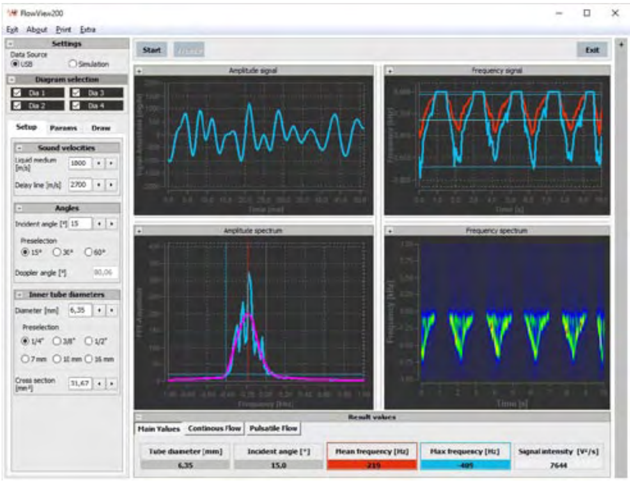
The ultrasonic Doppler device FlowDop200 generates transmission signals with an adjustable frequency of 1, 2, 4 or 8 MHz, which are transmitted with the connected probe as ultrasonic waves.
If these waves are reflected or scattered by moving particles or bubbles, they undergo a frequency shift (Doppler effect). The reflected or scattered ultrasonic waves are recorded and analysed by the device.
The measurement signal is also converted into an acoustic signal. The volume of the acoustic signal is here a measure of the amplitude of the recorded signal and its frequency is a measure of the velocity of the scatterers.
The measurement signal can be adapted to the respective measuring task by means of the adjustable gain, transmission power and measuring depth. The measurement data can be read out and recorded via a USB interface for detailed analysis on the computer.

Technical data

- Frequency: 1, 2, 4 and 8 MHz
- Low pass filter: 2.5, 5, 7.5 and 10 kHz
- Gain: 15-85 dB
- Operating modes: PW (CW prepared)
- PW-Timing:
  - Pulse repetition time: 50 µs
  - Burst lenght: 1, 2, 4 or 8 µs
  - Sample width: 1, 5, 10 or 30 µs
  - Penetration depth: 0-39 µs (step size 1 µs)
- Acoustic signal with volume control
- Interface to the PC: USB
- Dimensions: 255 mm × 170 mm × 265 mm
- Power Supply: 100-240 V, 50 Hz/60 Hz

Software

By means of the FlowView200 software provided, the data measured by the device can be analysed on a computer. The device is connected via a USB interface. During the measurement, the software displays the current Doppler signal. The analysis is carried out by transformation into the frequency domain by means of the Fourier transformation. From the spectrum, the average and maximum frequency shift are determined. The corresponding frequencies and/or the velocities and flow values calculated from them are presented on the screen as values and/or a time curve. In addition, the energy content of the signal is represented. Further analysis functions are the representation of the spectrum with colour-coded intensities over the time range or the investigation of the pulsatility of the flow.



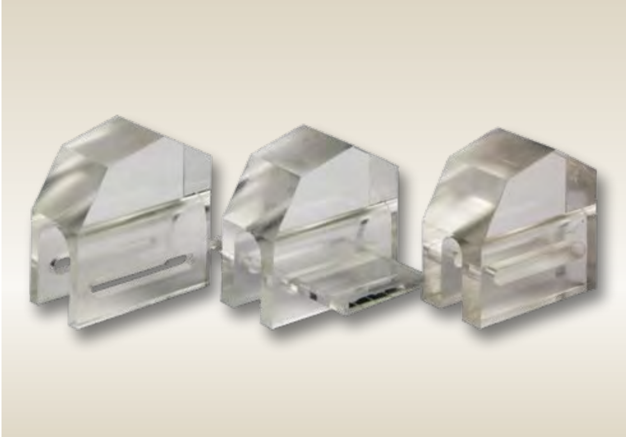
Experiments

PHY13 Ultrasonic Doppler effect
PHY15 Fluid mechanics
IND05 Doppler flow measurement
MED03 Basics of Doppler sonography
MED05 Vascular ultrasound (angiology)
MED06 Peripheral Doppler blood pressure measurement

Order no. 50400

Doppler prism

The Doppler prism serves as a connection between ultrasonic probe and flow pipe and/or tube. Due to its design it can be simply and securely coupled to the flow pipe or the tube. The planar surfaces allow simple coupling of the ultrasonic probe. The strength of the frequency shift depends largely on the angle between the irradiated ultrasonic wave and the direction of flow. The Doppler prism makes it possible to irradiate with three different angles and thus to investigate the influence of the Doppler angle on the frequency shift.



Order no. 50111 (1/2")

Order no. 50112 (3/8")

Order no. 50113 (1/4")

Technical data

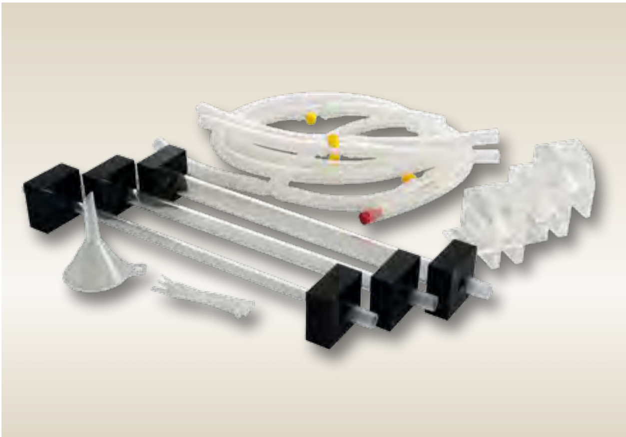
- Material: acrylic
- Adapter for tubes/pipes: 1/2", 3/8" or 1/4"
- Incidence angle: 15°, 30°, 60°
- Delay line: 30 mm

Experiments

PHY13 Ultrasonic Doppler effect
PHY15 Fluid mechanics
IND05 Doppler flow measurement

Flow measuring set

There are flow pipes with three different inside diameters for the investigation of flow phenomena. The connections are designed for 3/8" tubes. The flow velocities and flow profiles in the pipes can be measured using the Doppler prisms to couple the probes on the pipe. The flow pipes can be combined with the standpipes for pressure measurement (order no. 50150) and the centrifugal pump (order no. 50130). In this way, a large number of interesting practical experiments can be carried out on the subject of flow phenomena. As well as the flow pipes and the Doppler prisms, the set also includes the tubes and connecting pieces necessary to construct a flow circuit (including Luer lock connections).



Order no. 50201 (Set)

Technical data

- Material: acrylic
- Pipe length: 300 mm
- Pipe inside diameter: ~ 16 mm, ~ 10 mm and ~ 7 mm
- Connections: 3/8"

Experiments

PHY13 Ultrasonic Doppler effect
PHY15 Fluid mechanics
IND05 Doppler flow measurement

Spare parts

Doppler prisms (1/2", 3/8", 1/4")	50111, 50112, 50113
Tubes	50121
Tube connectors	50122
Flow pipes (16, 10 or 7 mm)	50151, 50152, 50153

Standpipes

For the investigation of the flow laws according to Hagen-Poiseuille and the Bernoulli's equation, the pressure ratios along a flow line must be measured. A simple, but very clear method here is pressure measurement with standpipes. The pressure drop along a pipe can already be seen purely visually from the falling head of the liquid columns. The pressure scale has four standpipes, which can be connected through the provided tubes and Luer lock tube connectors with 3/8" tubes. The tube connectors provided are connected to the measuring points in the flow circuit (order no. 50201). The scale is divided into centimetres and millimetres. It is up to the student to carry out the conversion into corresponding pressures.

Order no. 50150

Technical data

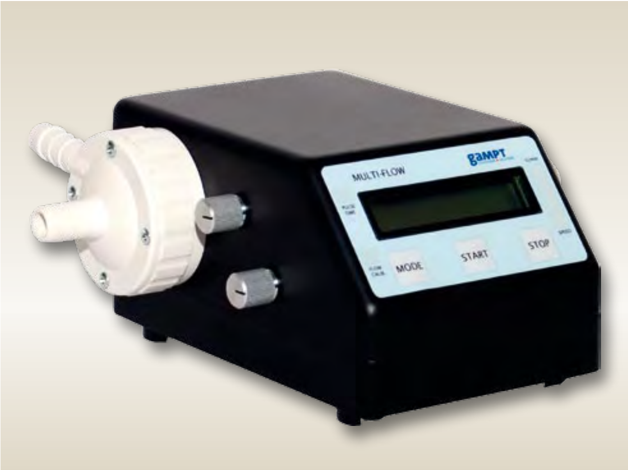
- Material: glass
- Length of the standpipes: 1000 mm
- Length of the tubes: 800 mm
- Connections: Luer lock, male
- Tripod

Experiments

PHY15 Fluid mechanics

Centrifugal pump MultiFlow

The centrifugal pump makes possible a laminar and constant flow with different flow rates as a precondition for the investigation of flow phenomena. The flow rate is adjusted via the speed control of the pump in the range from 0-10 l/min. Here the display either shows the motor rotation speed directly or a flow that can be calibrated by means of a potentiometer.
To simulate heart function for the experiments on Doppler sonography, the pump can be operated in three different pulse modes. The pump here produces pulsatile flow curves with different rising and falling edges. The pulse duration (equivalent to heart rate) is variably adjustable.



Order no. 50130

Technical data

- Connections: 3/8"
- Pump power: max. 10 l/min, adjustable
- Display: LCD
- Supply voltage: 100-240 V, 50/60 Hz

Experiments

PHY13 Ultrasonic Doppler effect
PHY15 Fluid mechanics
IND05 Doppler flow measurement
IND09 Transit time flow meter
MED03 Basics of Doppler sonography
MED05 Vascular ultrasound (angiology)
MED06 Peripheral Doppler blood pressure measurement

Double reservoir

The double reservoir makes it possible to calibrate a flow measurement by volumetric calibration. This can be used to build up measurement circuits, e.g. for flow measurement experiments using the Doppler method (IND05) or the transit time method (IND09). The double reservoir consists of two upright columns, which are connected via a pipe with blocking valve. With the tubes provided, the double reservoir can be connected to the centrifugal pump (order no. 50130) and the respective flow or transit time pipes (order no. 50152 and 10180), via the connections located on the sides.

Order no. 50170

Technical data

- Material: acrylic
- Dimensions: 470 mm × 500 mm × 200 mm
- Volume per column: approx. 3.4 l

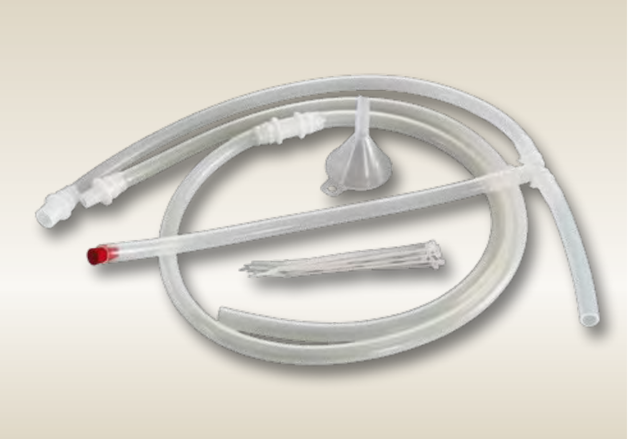
Spare parts

Tubes	50171

Experiments

IND05 Doppler flow measurement
IND09 Transit time flow meter

Flexible tubes set



The acoustic characteristics of the tubes used are decisively important in their selection. For example, if the material is too soft not enough sound can be coupled into the tube to receive measurement data that can be analysed. The tubes offered here have been tested and are used in medicine among other areas of application. The tubes can be easily replaced and there is no danger of breakage or injury.

Order no. 50120

Technical data

- Tube thickness: 3/8''
- Total tube length: approx. 2.5 m
- Different tube connectors

Experiments

PHY13 Ultrasonic Doppler effect

Doppler fluid

For the measurement of ultrasonic Doppler signals, scattering particles must be contained in the liquid. Their acoustic impedance and their size must be suitable for the ultrasonic frequency being used. The Doppler fluid offered here contains particles with outstanding scatter characteristics. The viscosity of the Doppler fluid has been adjusted so that laminar flows are produced in the flow pipes at medium flow velocities.

Order no. 50140

Technical data

- Capacity: 1 l
- Ultrasonic scattering: 1-6 MHz

Experiments

PHY13 Ultrasonic Doppler effect
PHY15 Fluid mechanics
MED03 Basics of Doppler sonography
MED05 Vascular ultrasound (angiology)

Arm phantom

This realistic model of a human arm allows an introduction into the methods of ultrasonic Doppler diagnostics. These methods demand a high degree of knowledge of Doppler sonography and its results. With the arm phantom it is possible to demonstrate the fundamental principles and functioning of the methods. Different vessels and a stenosis have been integrated in the arm phantom. When this is combined with the centrifugal pump MultiFlow (order no. 50130) a number of experiments can be carried out on the arm. In these experiments, the students can measure typical spectra of continual or pulsating blood flow. By means of the curves measured, the flow, pulse and resistance index can be calculated. Additional measurements include the determining of the average and maximum flow velocity within a flow profile. In the area of the stenosis, the increased flow components can be detected in positive and negative direction before and after the narrowing of the vessel. The arm phantom is supplied including connecting tubes, filling funnel and Doppler fluid (250 ml).

Technical data

• Skin and tubes made of silicone

Experiments

MED03 Basics of Doppler sonography
MED05 Vascular ultrasound (angiology)
MED06 Peripheral Doppler blood pressure measurement

Spare parts

Doppler fluid (250 ml)	50161

Order no. 50160 (Set)

Blood pressure cuff

For experiments with the arm phantom (order no. 50160) on blood pressure measurement with the ultrasonic Doppler method (MED06) it is necessary to use a modified blood pressure cuff adapted to the arm phantom. The product shown in the photo on the right is only intended as an example and can differ in shape and colour.

Technical data

• Pressure range: 0-300 mmHg

Experiments

MED06 Peripheral Doppler blood pressure measurement

Order no. 50300

Ultrasonic Doppler probe

The ultrasonic Doppler probe with a frequency of 2 MHz has been specially developed for measurements on the arm phantom (order no. 50160). The pen shape and the small sound area permit simple handling and lead to sufficient local resolution. The delay line with an angle of 30° creates a constant Doppler angle and a sufficient frequency shift. In this way, quantitative measurements can be carried out for determining the flow velocity.

Technical data

- Frequency: 2 MHz
- Dimensions: length = 200 mm, diameter = 15 mm
- Cable length: approx. 1 m
- Special connection for ultrasonic pulse Doppler FlowDop

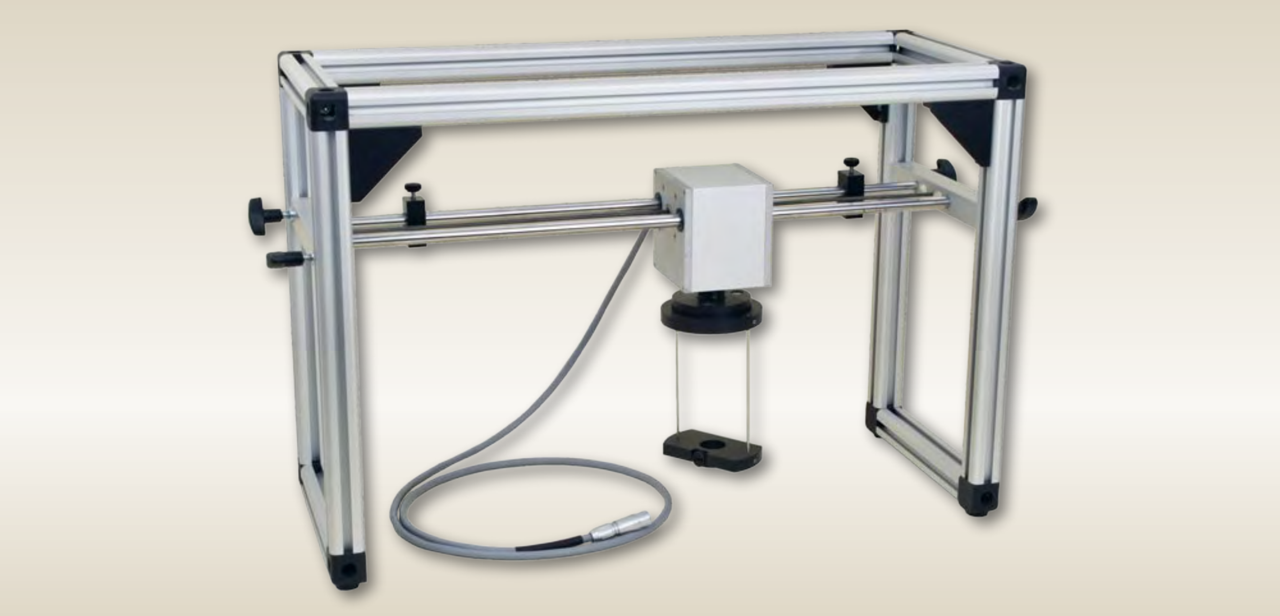
Experiments

MED03 Basics of Doppler sonography
MED05 Vascular ultrasound (angiology)
MED06 Peripheral Doppler blood pressure measurement

Order no. 50435 (FlowDop200 - 50400)

Order no. 50135 (FlowDop - 50100)

CT scanner



It is not only in diagnostic medicine that computer tomography (CT) is an important method for investigating inner structures but also in material testing. The principle of tomographic imaging is here independent of the measuring method used. In addition to the well-known methods of nuclear spin tomography NMR (nuclear magnetic resonance) and X-ray tomography, other measurement values are also recorded by means of tomography, e.g. positron emission tomography (PET) and ultrasonic tomography. The CT scanner achieves the rotation and linear shifting of the sample necessary for tomography. When this is combined with the CT control unit and the ultrasonic echoscope (GS200/GS200i or GAMPT-Scan), a versatile computer tomography device can be built up. The scanner possesses a sample table for holding suitable test objects. The sample table is turned via a step motor, with exact angle positioning. A second step motor carries out the longitudinal movement with a spatial resolution of < 10 µm. The sample table is dipped in a sample reservoir. The complete slide is adjustable in height, so that the area of investigation of the sample can be adapted. During the measurement, the scanner moves the sample back and forth between the ultrasonic probes coupled to the sample reservoir from the outside, in accordance with the CT algorithm.

In addition to this the scanner opens up a large number of possibilities for practical work in application for cross-sectional imaging. The sample table here acts as a probe holder for a GAMPT ultrasonic probe (1, 2 or 4 MHz). The test object , e.g. the transparent/black test block or the breast phantom is placed in the sample basin and scanned with the scanner control unit. For this, the scanner can be controlled manually or with the provided software (GS-EchoView or AScan). The recorded B-scan images are free of movement artefacts and exact local assignment is possible. The images are of high quality, because scans can be carried out with high line density (see also: CT control unit).

Spare parts

CT sample holder	60124

Technical data

- Linear movement: approx. 400 mm, resolution < 10 µm, max. motion speed 18 cm/min
- Rotary movement: 360°, resolution 0.225°, max. rotating speed 1 rps
- Dimensions: 210 mm × 353 mm × 520 mm
- Maintenance-free sliding bearing

Experiments

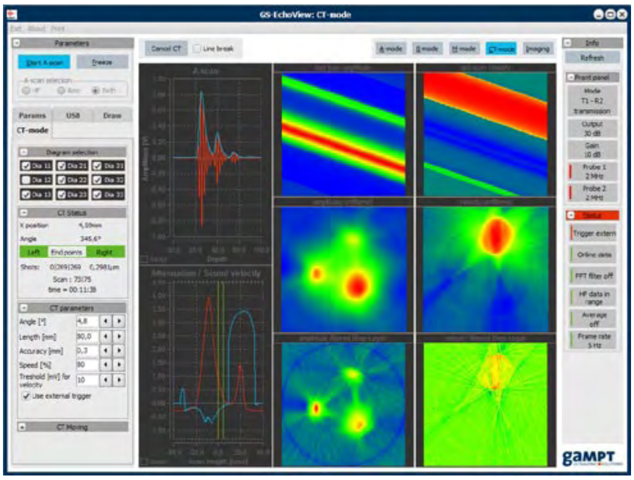
PHY09 Ultrasonic computer tomography (CT)
PHY10 Characteristics of sound field
PHY16 Mechanical scan methods

Order no. 60100 (for GAMPT-Scan)

Order no. 60200 (for GS200/GS200i)

CT control unit

The CT control unit UTC200 for the CT scanner is connected to the PC via a USB interface. When this is combined with the ultrasonic device (GS200/GS200i or GAMPT-Scan) and the software (GSEchoView or AScan) the result is a high-performance computer tomography device and a B-scan scanner. Two step motors (linear axis, rotational axis) can be controlled via a microcontroller. Using the PC and the control unit, the travel speed is adjusted and the positioning of the slide is controlled. The motors can also be controlled directly by hand on the control unit via rotary switches for direction of travel and/or rotation (LINEAR, ROTATION) and speed of travel and/or rotation (SPEED).



Technical data

- Output: 2 × step motor control, bipolar 5 V, max. 2 A
- Interface: USB
- Dimensions: 155 mm × 170 mm × 315 mm
- Supply voltage: 100-240 V, 50/60 Hz
- Power consumption: max. 50 VA

Software

With the measurement and control software GS-EchoView or AScan, the CT control unit can also be controlled from the computer, as well as the reading out and processing of measuring data of the ultrasonic device GS200/GS200i (order no. 10400/10410) or GAMPT-Scan (no longer available). In this way, mechanically scanned B-scan images can be produced as well as ultrasonic tomograms. The CT algorithm has been incorporated into the software as a module. The unfiltered and filtered attenuation and time of flight images, the current A-scan image, the settings for TGC (time gain control) and the amplitude and time of flight of the currently running line scan are graphically represented. In addition to this, the respective scanner position in millimetres and the current angle of rotation in degrees are displayed. The presentation of the CT scan (attenuation and time of flight images) is updated and gradually built up after each line scan so that the creation of the tomogram can be understood in detail. The CT and B-scan images can be exported and printed. Depending on the time and the object, the number of rotation positions, the step size and the length of the scan can be set.

Experiments

PHY09 Ultrasonic computer tomography (CT)
PHY10 Characteristics of sound field
PHY16 Mechanical scan methods

Order no. 60110 (for GAMPT-Scan)

Order no. 60210 (for GS200/GS200i)

CT reservoir

The sample reservoir for the CT scanner is made of thin plates of acrylic glass. This ensures good coupling of the probes to the wall of the reservoir. In the case of acrylic the jump in acoustic impedance when moving to water is relatively slight compared with glass, so reflections can be largely avoided. The reservoir has several probe supports with which the ultrasonic probes can be fixed directly to the reservoir.

Order no. 60120

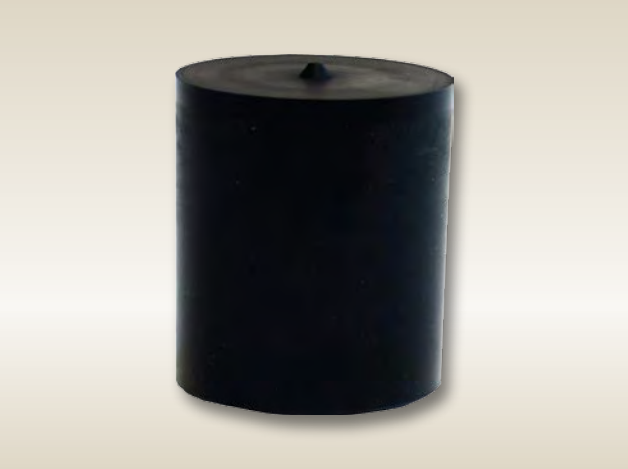
Technical data

- Dimensions: 430 mm × 150 mm × 150 mm
- Material: acrylic | wall thickness: 4 mm

Experiments

PHY09 Ultrasonic computer tomography (CT)
PHY10 Characteristics of sound field
PHY16 Mechanical scan methods

CT sample



In ultrasonic tomography, two different measurement values can be recorded, absorption and sound velocity. The sample for the tomogram consists of a black plastic cylinder that contains inhomogeneities of absorption and sound velocity. The sample is fastened to the rotary disc of the scan apparatus using a magnetic holder.

Order no. 60121

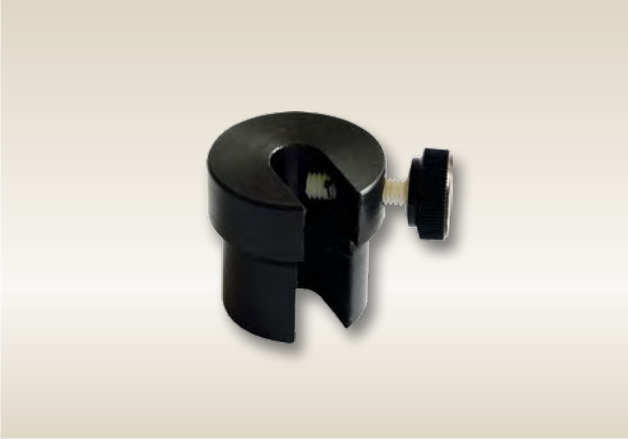
Technical data

- Diameter: 60 mm
- Height: 70 mm

Experiments

PHY09 Ultrasonic computer tomography (CT)

Hydrophone support



The hydrophone support helps one to adapt the hydrophone to the CT sample holder (order no. 60124). The hydrophone can thus be easily used with the CT scanner for sound field measurements. (The support is also part of the hydrophone set, for adapting the hydrophone to the hydrophone plate.)

Order no. 60123

Technical data

- Diameter: 25 mm
- Height: 25 mm

Experiments

PHY10 Characteristics of sound field
PHY19 Phase and group velocity
PHY20 Determination of focus zone

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Ultrasonic gel

A coupling medium must be used for the coupling of the ultrasonic probes to the test object. Different oils and predominantly water are used for this. For use in practical training it is recommended that an ultrasonic gel from medical diagnostics should be used, because these gels have a high viscosity but do not contain any oily constituents (there is no danger of contamination). The ultrasonic gel is non-toxic, water-soluble and skin-compatible.

Technical data

- Sound transfer in a wide frequency range
- Water-soluble
- Hypoallergenic
- Content of the dispensing bottle: 250 ml

Order no. 70200

Ultrasound in laboratory course

Ultrasound is used in a wide variety of ways in today's society. The use of ultrasound has spread throughout all fields, from households to medicine to special industrial applications. Examples of this include, among others, humidifiers, ultrasonic cleaning devices, distance meters, the sonography of internal organs or foetuses, blood-flow analyses, therapeutic ultrasound, liquid level meters, ultrasonic welding, echo sounding and non-destructive testing.

Knowledge of the basics of the generation, propagation and interaction of ultrasound, the fundamental structure of ultrasonic devices and special measuring methods is thus useful or even necessary for all natural scientific, technical and medical subjects.

The following examples of practical training experiments are divided into three categories.

PHY: In the category of physics, the basics of the creation, propagation and interaction of ultrasound and the methodology of ultrasonic methods are dealt with.

IND: The category of industry includes experiment suggestions for some selected industrial applications of ultrasound and the subject of non-destructive testing.

MED: The category of medicine contains examples for experiments on medical subjects.

The experiment descriptions give an overview of the tasks and related topics of the individual experiments. There is a short theoretical introduction to the basics and/or the groups of themes being dealt with and the presentation of an exemplary experiment result. The material list contains all the necessary devices, accessories and consumable materials with order numbers.

In addition, supplementary and more advanced experiments are suggested. All presented experiments are examples which can be combined and/or extended as you wish. In this way, both short basic experiments and complex subject areas can be dealt with (by combination). As a simple aid to orientation, the experiment descriptions are provided with pictograms which describe:

I II III an easy, medium or higher degree of difficulty and/or

a short, medium or long experiment duration.

The experiments are constantly revised and expanded by us. We are of course happy to help you with further information, or you can visit our website at **www.gampt.de**.

Experiments

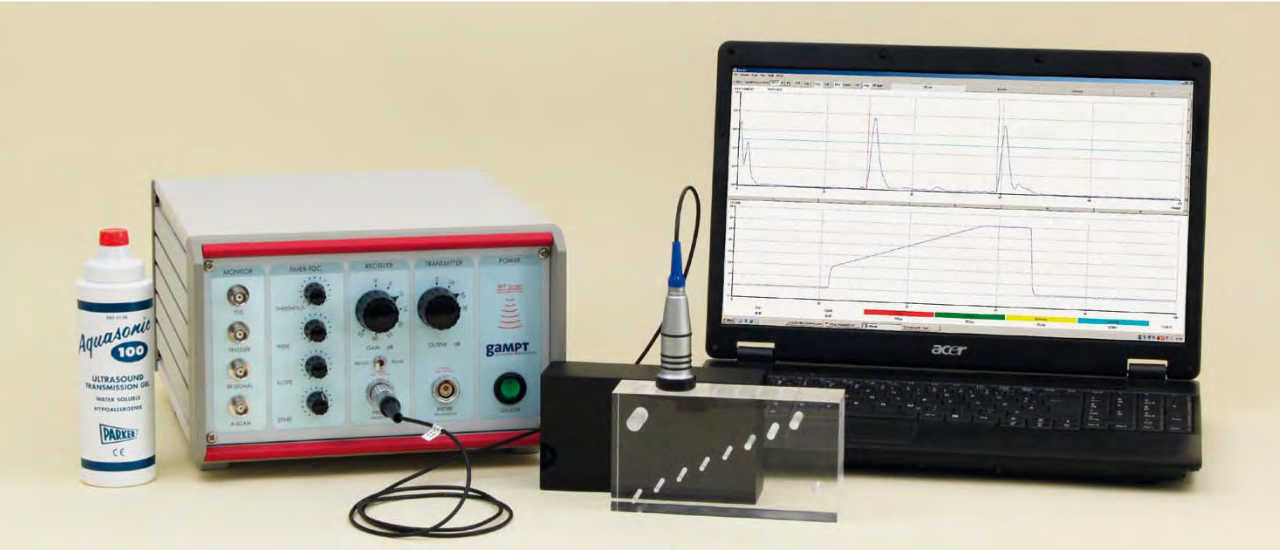
Physics 56–78

Industry 79–87

Medicine 88–95

PHY01 Basics of pulse echo method (A-scan)

A sample with built-in discontinuities is examined by means of the pulse echo method. Amplitude scans are carried out from different sides of the sample. The echo signals imaged in the recorded A-scan images are examined and analysed.



Related topics

Propagation of ultrasonic waves, time of flight of sound, sound velocity, characteristic acoustic impedance, reflection and transmission, pulse echo method, ultrasonic A-scan

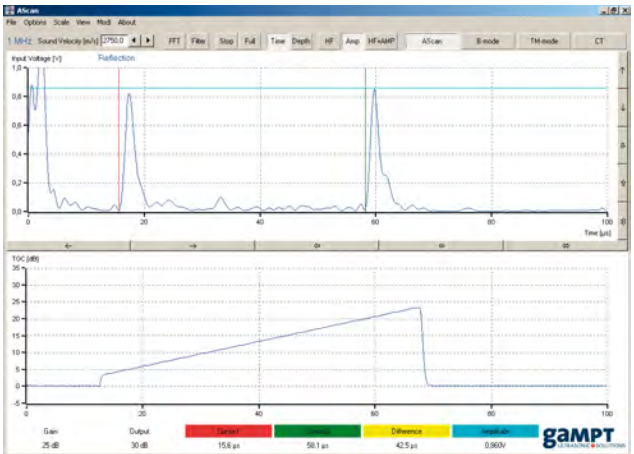
The pulse echo method forms the basis of many imaging methods in non-invasive medical diagnostics and non-destructive testing. In this method, electrical pulses are transformed into mechanical vibrations by an ultrasonic probe. These are coupled into the sample being examined and pass through it as sound waves. Waves that are reflected on discontinuities return to the probe and are converted back into an electrical signal. The chronological recording of the amplitude of this signal (amplitude scan) is graphically imaged as a so-called ultrasonic A-scan image. Based on the reflection echoes in the A-scan image, times of flight can be determined, the sound velocity in the material calculated and discontinuities in the sample detected.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 1 MHz	10151
Test block (transparent)	10201
- optional: test block (black)	10204
Ultrasonic gel	70200

Results

The screen shot of the measurement software shows a typical ultrasonic A-scan image of the test block. One can observe: the initial echo, the echo of a discontinuity and the bottom echo at the material-air boundary at the opposite end of the sample. The value to be determined for the sound velocity in the test block (acrylic) is around 2700 m/s. From the ascertained sound velocity and the measured times of flight of the reflection echoes of the discontinuities, their depth in the sample can be established.



Related experiments

PHY02 Sound velocity in solids
PHY03 Acoustic attenuation in solids
PHY21 Reflection and transmission at boundaries
IND01 Non-Destructive Testing (NDT)
IND06 Angle beam testing
MED02 Ultrasonic imaging at breast phantom (mammasonography)
MED04 Biometry at the eye phantom

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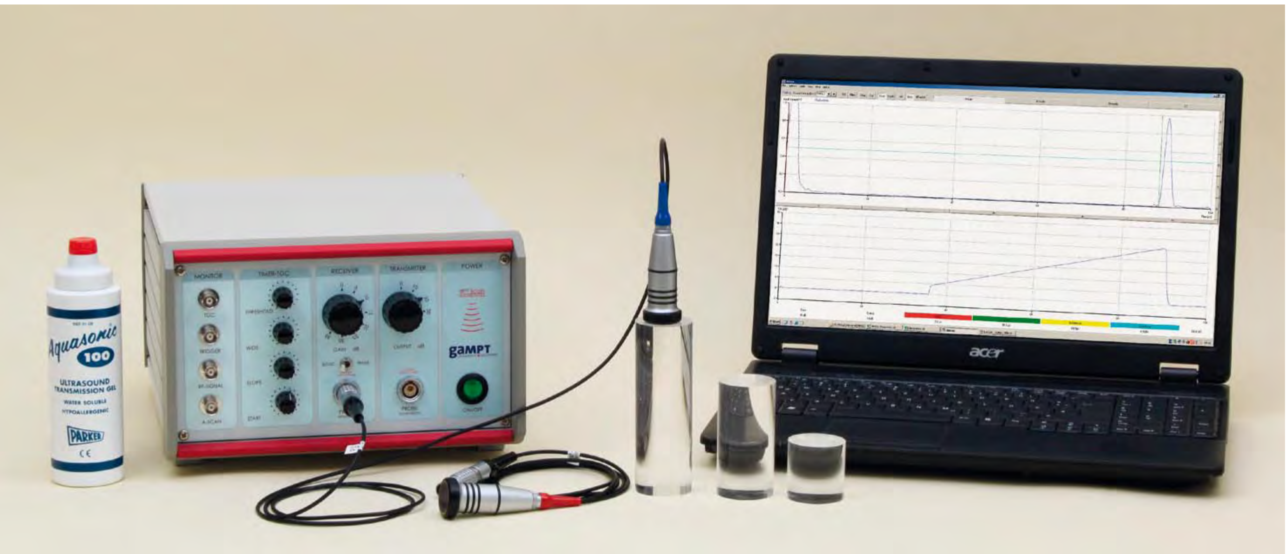
PHY02 Sound velocity in solids

In the experiment, the longitudinal sound velocity in acrylic is to be examined and determined at two different sound frequencies. For this purpose, time of flight measurements are carried out according to the pulse echo method (ultrasonic A-scan) at three acrylic cylinders of different lengths.



Related topics

Propagation of ultrasonic waves, characteristic acoustic impedance, reflection, time of flight, sound velocity, pulse echo method, ultrasonic A-scan

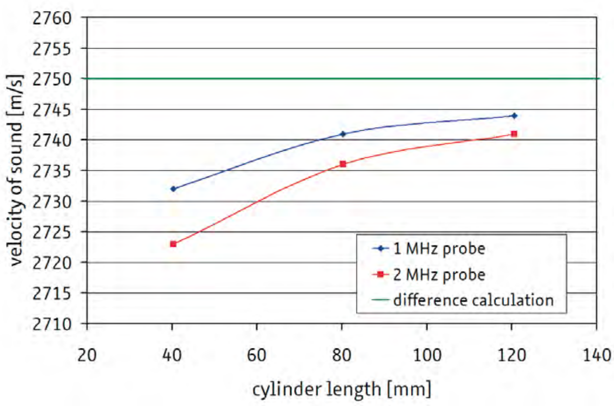
Ultrasonic waves propagate in a medium with a material-dependent velocity, which can be frequency-dependent. In gases and liquids sound propagation only takes place in the form of longitudinal waves. In solids, on the other hand, due to their elastic properties, shear waves can also occur. Shear and longitudinal waves generally propagate at different velocity. The sound velocity of the longitudinal waves generated in a solid with perpendicular sound coupling can be simply determined by means of time of flight measurements using the pulse echo method. By using samples of different lengths and sound probes with different frequencies, the intention in the experiment is to make statements on the frequency dependence of the sound propagation and on sources of errors caused by the structure of the ultrasonic probes that are used.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 1 MHz	10151
Ultrasonic probe 2 MHz	10152
Test cylinder set	10207
Ultrasonic gel	70200

Results

The sound velocities calculated from the times of flight measured show a systematic error, the influence of which becomes smaller as the measuring length is increased, and which is caused by the time of flight also measured in the protection/adaption layer of the probes. In this case, the 2 MHz probe possesses a thicker protection/adaption layer so that the sound velocities determined with it show a greater error. Using a difference calculation from two measurements with different sample lengths, this error can be eliminated (green line in the graphic, c_L = 2750 m/s, same values for both frequencies, no dispersion).

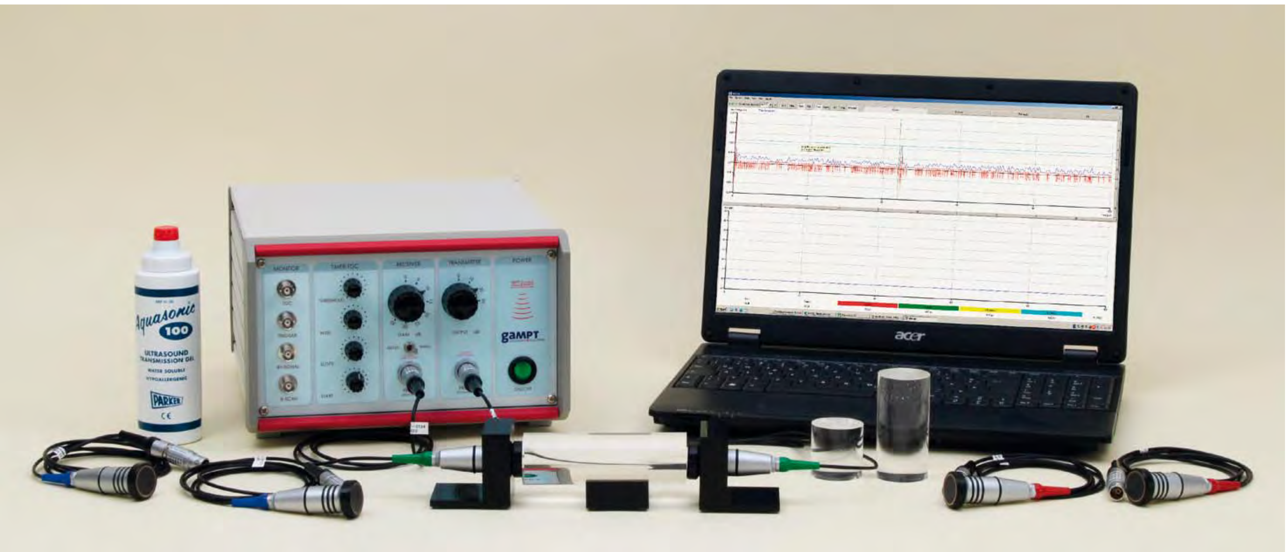


Related experiments

PHY07 Shear waves in solids
IND01 Non-Destructive Testing (NDT)
IND06 Angle beam testing
MED04 Biometry at the eye phantom

PHY03 Acoustic attenuation in solids

By means of amplitude measurements according to the ultrasonic transmission method in samples of different lengths, the attenuation of an ultrasonic wave on its way through a medium is determined. Ascertaining the acoustic attenuation coefficient at different ultrasonic frequencies sheds light upon the frequency dependence of acoustic attenuation.



Related topics

Acoustic attenuation in solids, scattering, absorption, reflection, attenuation coefficient, frequency dependence of acoustic attenuation, transmission measurement

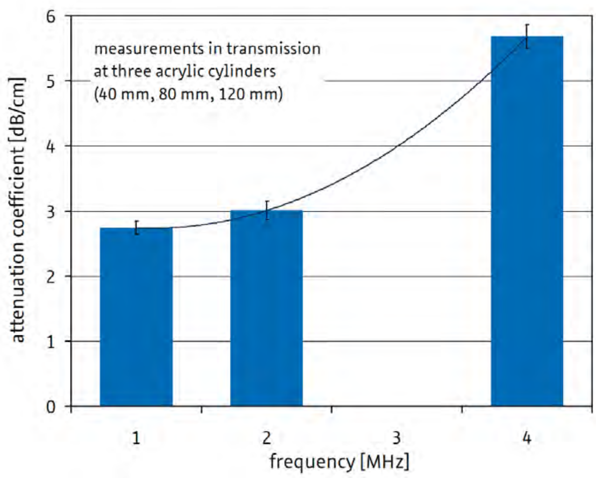
Sound waves lose energy on their way through a medium due to different processes such as absorption, scattering or reflection. This loss of energy causes a change in the sound intensity, which decreases as the distance increases. The strength of this attenuation is dependent on the material. It can be determined by the measurement of the amplitudes of transmission pulses or reflection pulses in an amplitude scan for different path lengths and can be described by the material-specific attenuation coefficient. In the experiment, these measurements are carried out at acrylic cylinders of different lengths. In order to be able to make statements about the frequency dependence of sound attenuation in acrylic, these measurements are carried out for different sound frequencies.

Equipment

Ultrasonic echoscope GS200	10400
2 ultrasonic probes 1 MHz	10151
2 ultrasonic probes 2 MHz	10152
2 ultrasonic probes 4 MHz	10154
Test cylinder set	10207
Ultrasonic gel	70200

Results

The graphic presents the measurement values of an example measurement in through-transmission at 3 acrylic test cylinders of different lengths. In the examined frequency range from 1 MHz to 4 MHz the attenuation coefficients ascertained lay between 2.7 dB/cm and 5.7 dB/cm. It can be seen that the acoustic attenuation in acrylic sharply increases as the frequency rises. In order to extend the database with other path lengths the cylinders can also be investigated with the reflection method.

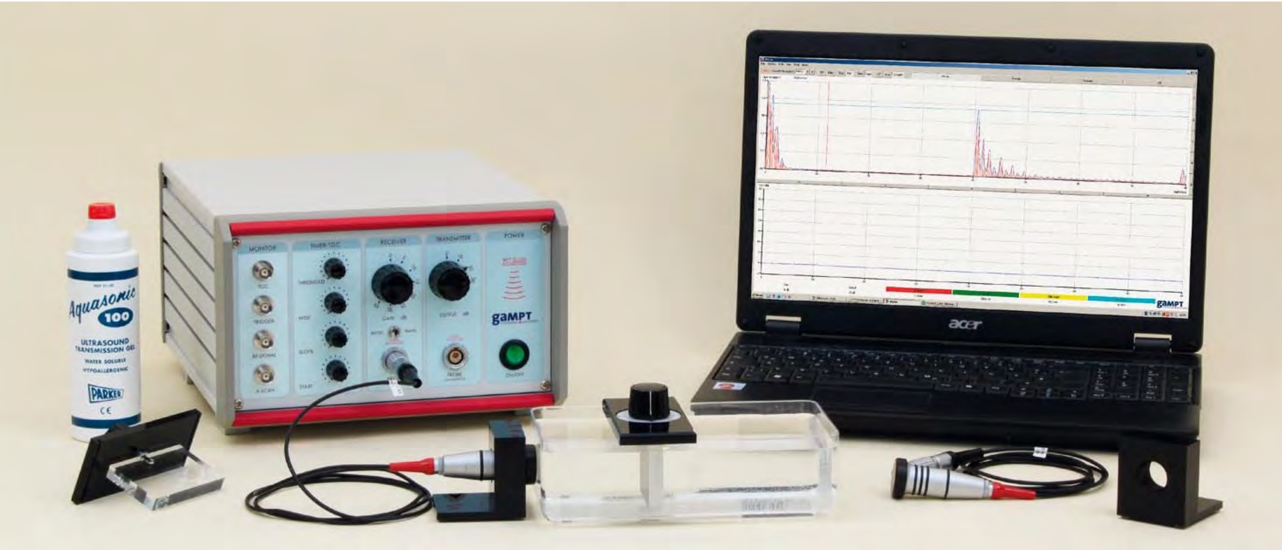


Related experiments

PHY04 Acoustic attenuation in liquids
IND01 Non-Destructive Testing (NDT)
IND03 Level measurement
MED02 Ultrasonic imaging at breast phantom (mammasonography)

PHY04 Acoustic attenuation in liquids

In the experiment, the attenuation of sound waves in different liquids in dependence on the sound path is investigated. For each of the liquids the acoustic attenuation coefficient is determined by linear regression.



Related topics

Sound propagation in liquids, longitudinal waves, reflection, absorption, scattering, acoustic attenuation in liquids, attenuation coefficient

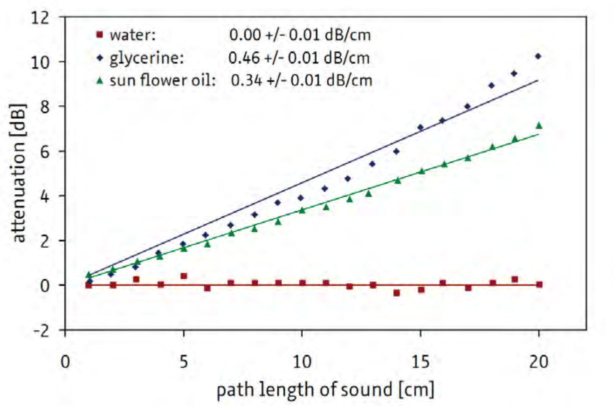
In gases and liquids sound propagation takes place in the form of longitudinal waves. Here, the sound waves can lose energy on their way through the liquid through absorption, reflection or scattering. In addition to these, sound field geometry can also influence acoustic attenuation. In the experiment, the amplitudes of the reflection echoes from a simply movable sound reflector made of aluminium are measured. Due to its shift in the liquid to be investigated, the amplitude values for a large number of different sound paths can be quickly ascertained using the pulse echo method. The attenuation of the signal amplitude A can here be described by the general law of attenuation $A = A_0 \cdot e^{-\alpha x}$. For two different sound paths x_1 and x_2 the following linearised form results: $2 \cdot \mathrm{Ln}(A_2/A_1) = \alpha \cdot (x_1 - x_2)$. The attenuation coefficient α of the respective liquid can thus be determined by a linear regression via the measurement points in the attenuation sound path diagram.

Equipment

Ultrasonic echoscope GS200	10400
2 ultrasonic probes 2 MHz	10152
Shear wave set	10218
Ultrasonic gel	70200

Results

In the experiment acoustic attenuation is investigated in the examples of water, a commercially available sunflower oil and glycerine (86.5 %). The diagram shows the measurement values with the regression lines for determining the acoustic attenuation coefficients α. At the used frequency of 2 MHz, the measurement with water shows no measurable attenuation, so the influence of sound field geometry can be regarded as negligible for the measurements in the experiment.

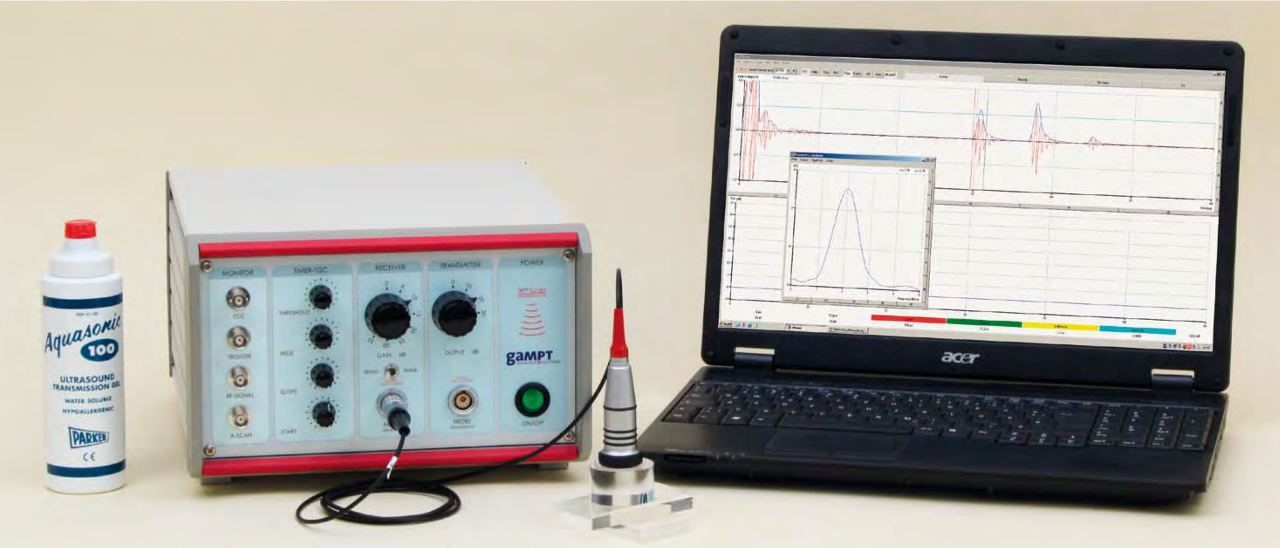


Related experiments

PHY01 Basics of pulse echo method (A-scan)
PHY02 Sound velocity in solids
PHY03 Acoustic attenuation in solids
PHY19 Phase and group velocity

PHY05 Spectral investigations

Using the simple model of multiple reflection at a plate, the experiment shows the difference between the spectrum of a pulse and the spectra of periodic signals. The cepstrum is derived from the periodic spectrum and in both cases the periodic time is determined in order to calculate the plate thickness.



Related topics

Reflection, transmission, multiple reflection at one or several plates, single pulse, periodic signals, Fourier transformation, frequency spectrum, cepstrum

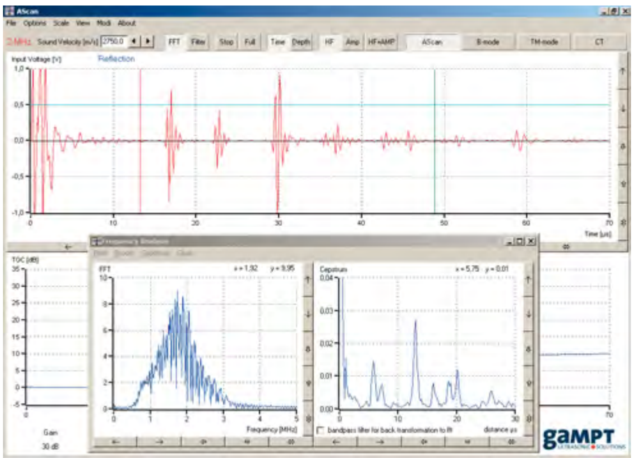
A time-variable signal such as the signal of an amplitude scan (A-scan) can be broken down into its frequency components by means of a Fourier transformation (FFT - Fast Fourier Transformation). With this spectrum, small periodic structures can be made visible and characteristics such as layer thicknesses and scattering intervals can be derived. Whereas the Fourier transformation of a pulse only provides that pulse's basic maximum, the frequency spectrum of a periodic excitation (e.g. via the echo signals of a multiple reflection) shows maximums with equidistant intervals, from which the periodic time of the excitation (time of flight between the reflexes) results. By smoothing the frequency spectrum using the cepstrum method, the equidistant frequency interval can be isolated as a maximum on the time axis of the cepstrum.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 2 MHz	10152
Set of reflecting plates	10202
Ultrasonic gel	70200

Results

The screen shot of the measurement software shows the A-scan image of overlapping multiple reflections at two acrylic plates approx. 7.5 mm and 10 mm thick. Whereas the first echoes at the boundaries delay line/plate 1, plate 1/plate 2 and plate 2/air are still clearly recognisable, clear separation of individual echoes is no longer possible in the further progression of the amplitude signal. This state is reflected in the FFT spectrum via the signal. In the cepstrum, on the other hand, two times of flight (first maxima) can be determined: 5.75 µs and 7.2 µs. With a sound velocity of around 2700 m/s, this yields plate thicknesses of 7.8 mm and 9.8 mm.

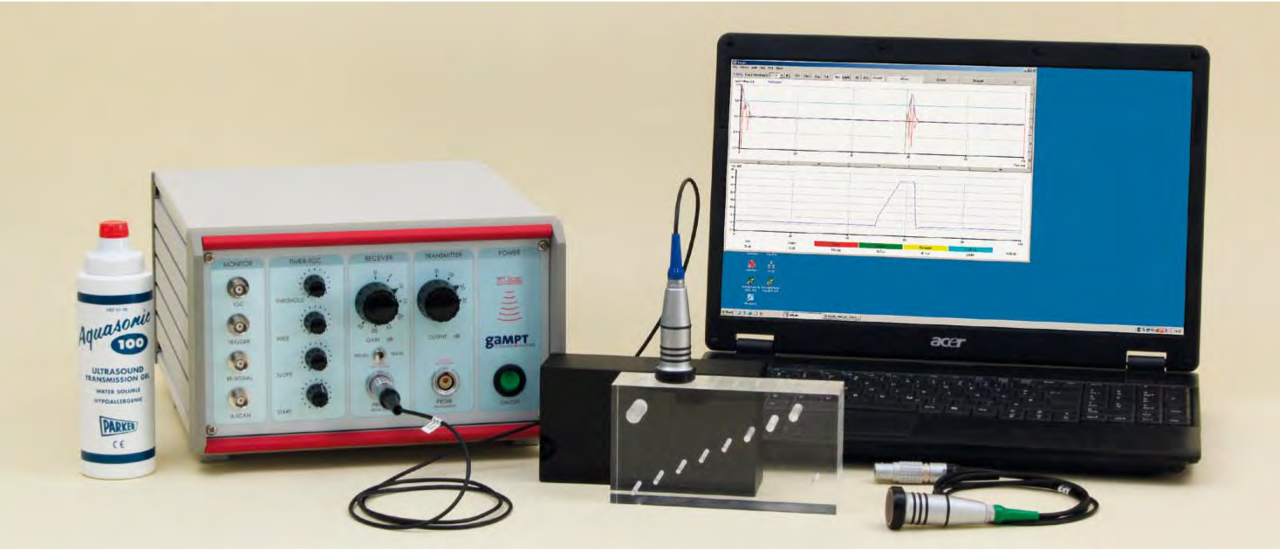


Related experiments

PHY02 Sound velocity in solids
PHY03 Acoustic attenuation in solids
PHY06 Frequency dependence of resolution power

PHY06 Frequency dependence of resolution power

Based on two small and closely spaced discontinuities, the axial resolution power of two ultrasonic probes of different frequency is investigated. By analysing the recorded A-scan images, the connections between wavelength, frequency, pulse length and resolution power are demonstrated.



Related topics

Pulse echo method, amplitude scan, A-scan presentation, sound frequency, periodic time, wavelength, sound velocity, pulse length, axial and lateral resolution

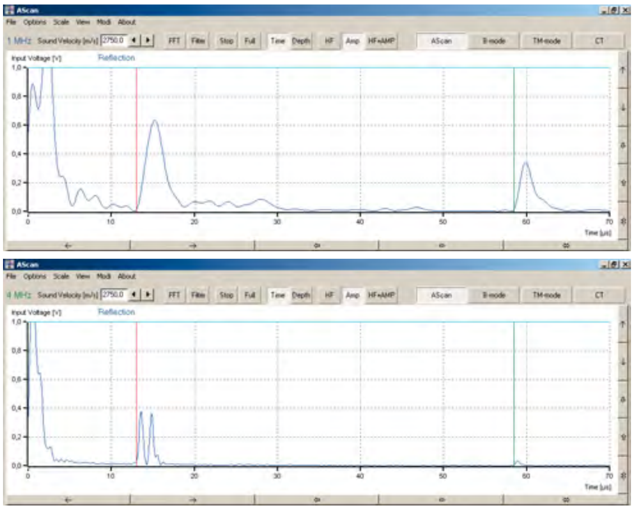
Investigation methods with ultrasonic systems are based on the exact assigning of the information on a point in the test area to a recorded ultrasonic echo. Because of this, the resolution power of the ultrasonic probes is enormously important. The resolution power can be described as the smallest possible distance between two points the echoes of which can still be separately detected. In the experiment, two neighbouring discontinuities in a test block are to be investigated with a 1 MHz probe and with a 4 MHz probe. The discontinuities are chosen, with regard to size, location and spacing, so that differentiation is only possible with one of the two test probes. In this way, the influence of frequency on the axial resolution power of an ultrasonic probe can be clearly shown.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 1 MHz	10151
Ultrasonic probe 4 MHz	10154
Test block (transparent)	10201
- optional: test block (black)	10204
Ultrasonic gel	70200

Results

In the experiment, first of all, a slightly attenuated echo is searched for with each of the two ultrasonic probes and the frequency, wavelength and pulse length determined. After this, the double discontinuity of the test block is investigated. The screen shots of the measurement software show recorded A-scan images of the double discontinuity (top 1 MHz, bottom 4 MHz). As well as the higher resolution power of the 4 MHz probe, however, the stronger attenuation of the 4 MHz signal is also made clear. In comparison to the 1 MHz probe, the bottom echo with the 4 MHz probe is almost no longer visible.

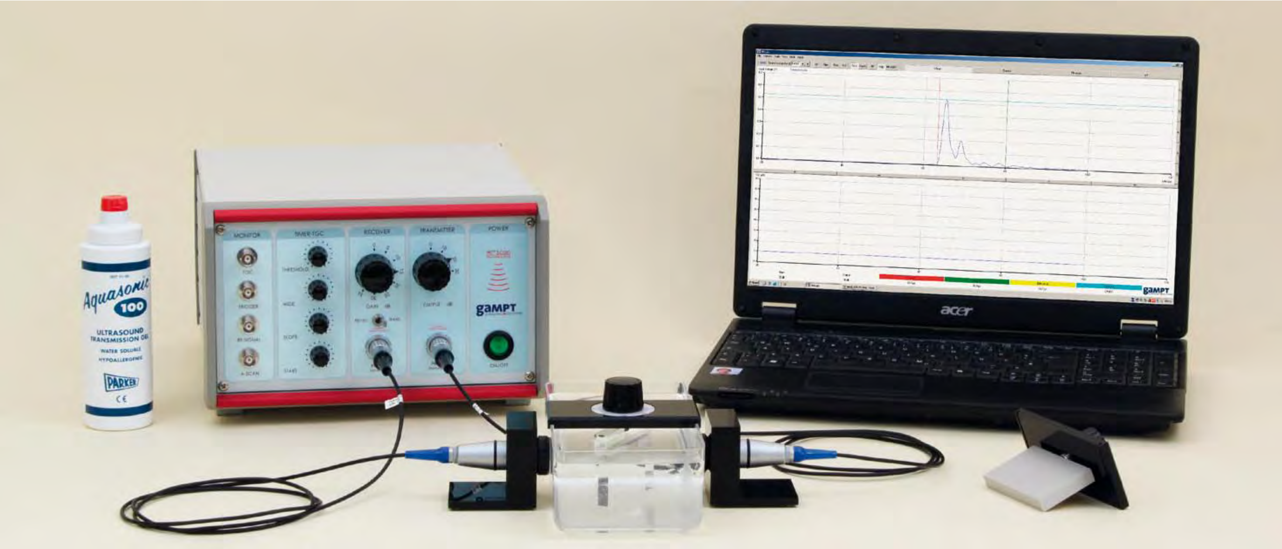


Related experiments

PHY08 Ultrasonic B-scan
IND01 Non-Destructive Testing (NDT)
MED02 Ultrasonic imaging at breast phantom (mammasonography)

PHY07 Shear waves in solids

Based upon the ultrasonic transmission through a plane parallel plate at different angles of incidence, the formation and propagation of longitudinal and shear acoustic waves in solids is investigated. From the determined longitudinal and transversal sound velocities, the elastic material factors such as the modulus of elasticity and shear and Poisson's ratio are derived for the plate materials used.



Related topics

Ultrasonic propagation in solids, transmission, reflection, longitudinal and shear waves and sound velocities, modulus of elasticity, modulus of shear, Poisson's ratio

Unlike in gases and liquids, in solids both shear and longitudinal waves can be excited due to their elastic material properties. During passage through a plane parallel plate longitudinal and/or shear waves are excited depending on the incidence angle. The angles of total reflection for the longitudinal and shear wave and the angle at which the shear wave shows its maximum here correspond with the respective sound velocity. By recording the amplitudes of the longitudinal and transversal transmission signals over a corresponding range of the angle of incidence, these angles can be ascertained and the respective sound velocities determined. From the sound velocities, the elastic material factors of the plate materials used can be calculated, such as the modulus of elasticity and shear and the Poisson's ratio.

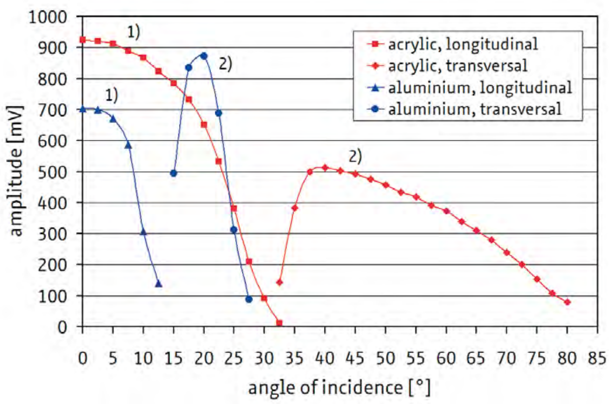
Equipment

Ultrasonic echoscope GS200	10400
2 ultrasonic probes 1 MHz	10151
Shear wave set	10218
Ultrasonic gel	70200

Results

The graphic shows the amplitude-angle curves for the determining of the angles for total reflection (longitudinal and transversal) and the maximum amplitude (transversal).

Independent of the material, but for different angles, the amplitude-angle dependence of the transmission can always be described by three categories: longitudinal signal only (1), a mixed mode of longitudinal and transversal signal and transversal signal only (2).



Related experiments

PHY20 Determination of focus zone
IND06 Angle beam testing
IND08 Detection of discontinuities
MED02 Ultrasonic imaging at breast phantom (mammasonography)

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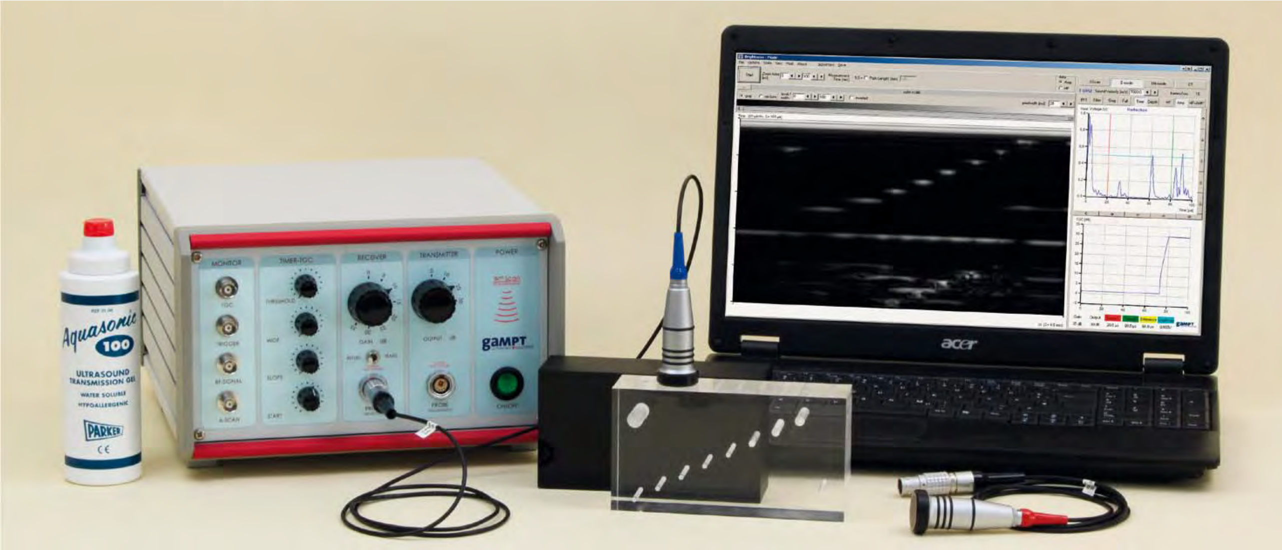
PHY08 Ultrasonic B-scan

By recording the ultrasonic cross-sectional image of a simple test object "by hand" using an ultrasonic echoscope, the basics of the B-scan method are clearly demonstrated. Special features regarding scan quality such as sound focus, spatial resolution or imaging errors are investigated and analysed.



Related topics

Sound velocity, reflection, transmission, reflection coefficient, ultrasonic echography, A-scan image, grey scale representation, B-scan image, lateral resolution, focus zone, image artefacts

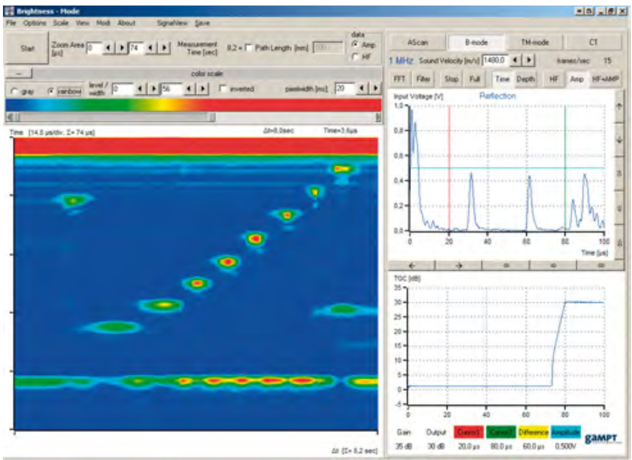
The conversion of the amplitude values of an amplitude scan into grey scale or colour values and the presentation of the time of flight as penetration depth yield a line of points with different brightness and/or colour values. The stringing together of such adjoining depth scans of an ultrasonic probe, which is guided along a line over the test area produces a sectional image, the so-called B-scan image. Localisation along this line is based on the position of the probe and its movement speed. A simple way to obtain a B-scan image is to guide the ultrasonic probe slowly by hand (compound scan). Scan quality is here dependent upon the coordinate-accurate transferral of scan points, the axial and lateral resolution of the ultrasonic probe, the grey scale and/or colour value resolution, the number of lines and imaging errors. In order to achieve e.g. exact lateral resolution, an additional coordinate-recording system is necessary such as a linear scanner.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 1 MHz	10151
Ultrasonic probe 2 MHz	10152
Test block (transparent)	10201
- optional: test block (black)	10204
Ultrasonic gel	70200

Results

The screen shot of the measurement software shows the B-scan presentation of the investigation of a sample with defined, built-in defects. The manual scanning of the block makes the functioning of the B-scan method "easy to grasp". The problems of movement artefacts with regard to lateral resolution caused "by hand" can be reduced by a mechanical scanning (PHY 16).

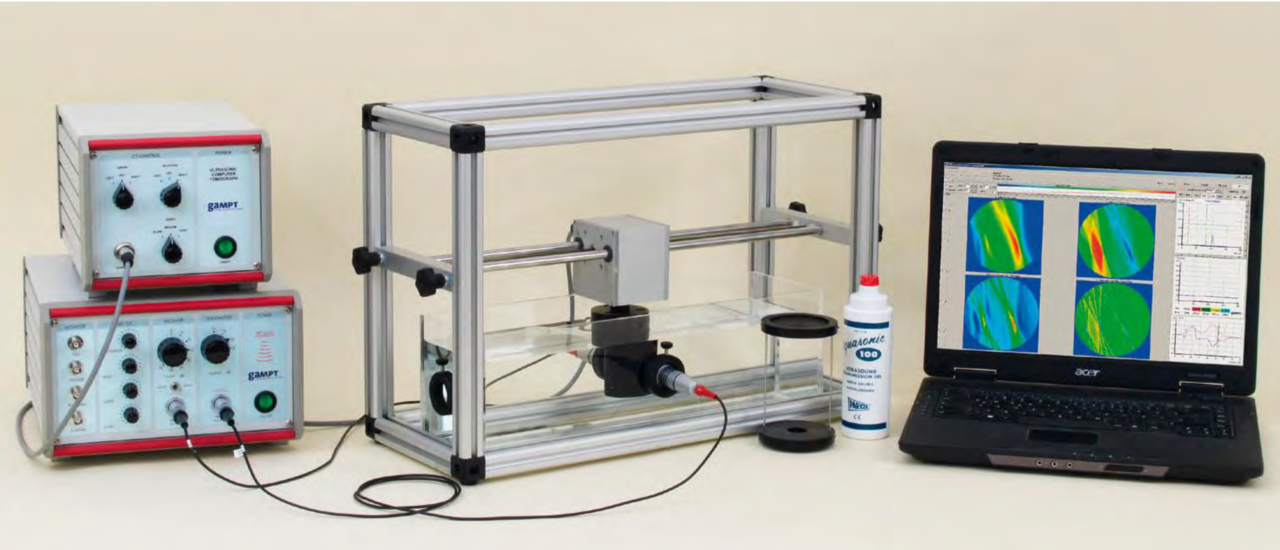


Related experiments

PHY16 Mechanical scan methods
PHY20 Determination of focus zone
MED02 Ultrasonic imaging at breast phantom (mammasonography)

PHY09 Ultrasonic computer tomography (CT)

In this experiment the formation of an ultrasonic CT scan image is clearly shown. The relevance and differences of individual measurement parameters such as attenuation and sound velocity are analysed and the influence of filters and image processing is investigated.



Related topics

Reflection, scattering, transmission, absorption, acoustic attenuation, sound velocity, resolution, ultrasonic echography (A-scan, B-scan), tomography, CT scan image, image processing, filters

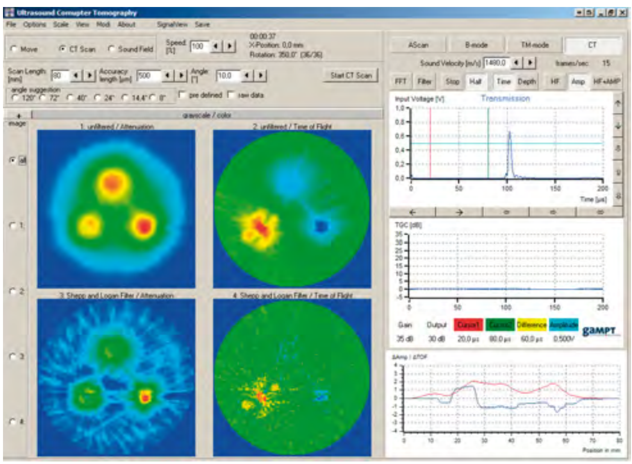
X-ray CT, MRT and PET are computer-aided imaging methods used in medical diagnostics, industry and research. Processes such as radiation absorption, nuclear magnetic resonance or particle emission are used to produce cross-sectional images by means of appropriately measurable physical quantities. Ultrasonic computer tomography is another CT method. It differs from X-ray CT in that instead of the attenuation of X-rays, the attenuation and times of flight of ultrasonic signals in the test object are measured. With our ultrasonic CT, line scans are recorded at different angles and put together to form a cross-sectional image. In this process, the sample arranged between transmission and receiving probe is moved and turned under computer control. The overlaying of the projections of individual scans can be followed step by step on the PC.

Equipment

Ultrasonic echoscope GS200	10400
CT scanner	60200
CT control unit UCT200	60210
2 ultrasonic probes 2 MHz	10152
CT sample	60121
CT reservoir	60120
Ultrasonic gel	70200

Results

In the experiment, CT scans for different settings of the transmission power and gain are recorded and comparatively analysed. The attenuation and time of flight tomograms are shown on the left in the measuring and controlling software, unfiltered at the top and mathematically filtered (contours reinforced) at the bottom. A simple form of image processing can be carried out by changing the brightness, contrast and colour.



Related experiments

PHY02 Sound velocity in solids
PHY03 Acoustic attenuation in solids
PHY04 Acoustic attenuation in liquids
PHY10 Characteristics of sound field

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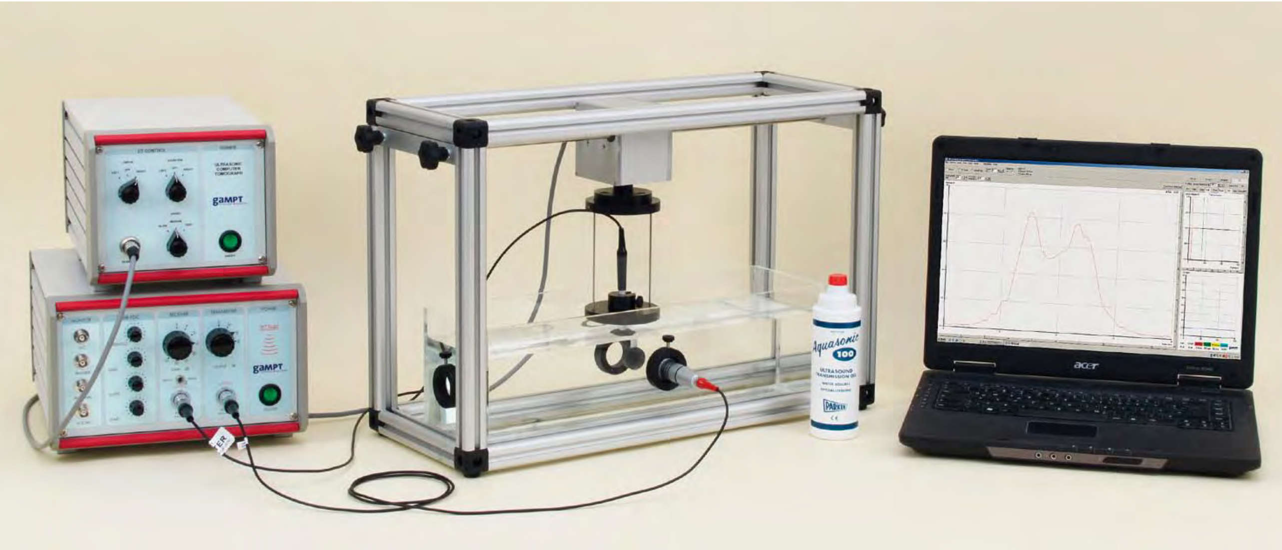
PHY10 Characteristics of sound field

In this experiment the sound field of an ultrasonic probe in water is investigated by determining the sound pressure distribution in the axial and lateral direction by means of a hydrophone and characteristic sound field quantities are discussed.



Related topics

Sound field, near field, far field, focus zone, sound pressure, sound pressure distribution, sound velocity, sound intensity

The area in a medium in which sound waves are propagating is called the sound field. It possesses a certain geometry dependent on the material and the sound generation and/or sound coupling, decisively limits the lateral resolution power of an ultrasonic probe and can influence sound attenuation. The sound field can be described by sound field quantities such as sound pressure and sound particle velocity or sound energy quantities such as sound energy and sound intensity. By means of a hydrophone, the sound field in a liquid can be investigated by determining the sound pressure amplitude along and perpendicular to the sound field axis. Characteristic features such as near field length and sound field width can be derived from the amplitude distribution.

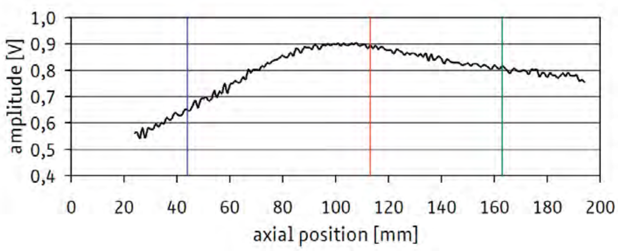
Equipment

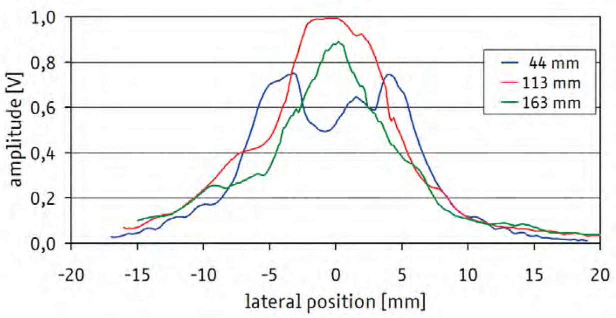
Ultrasonic echoscope GS200	10400
CT scanner	60200
CT control unit UCT200	60210
CT reservoir	60120
Ultrasonic probe 2 MHz	10152
Hydrophone	10450
Hydrophone support	60123
Ultrasonic gel	70200

Results

A theoretical near field length of 85 mm results for a 2 MHz probe (16 mm diameter) in water (c = 1497 m/s, T = 25 °C).

The hydrophone measurement along the sound field axis (top diagram) shows a maximum set back slightly at approx. 100 mm. The measurements of the lateral sound field distribution in different probe intervals (bottom diagram) show a local modulation of the signal amplitude in the area of the near field.



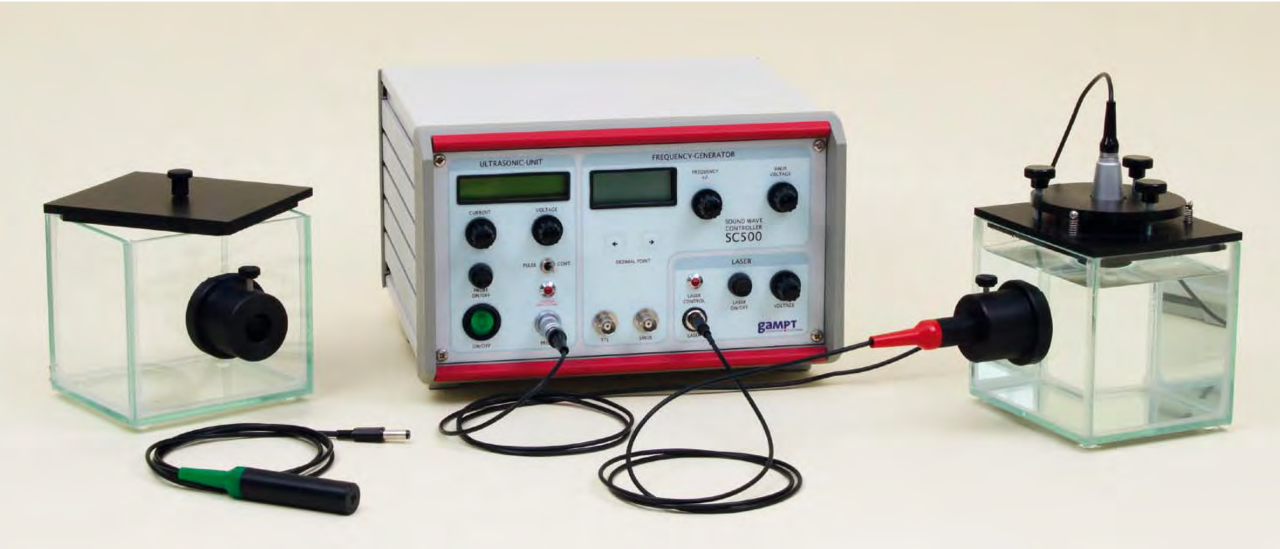


Related experiments

PHY04 Acoustic attenuation in liquids
PHY06 Frequency dependence of resolution power
PHY09 Ultrasonic computer tomography (CT)

PHY11 Debye-Sears effect

The experiment shows the diffraction of light at a standing ultrasonic wave (Debye-Sears effect) in a liquid. The sound velocity in the liquid (water) is determined using the dependence of the diffraction maxima on the wavelength of the diffracted laser light and the frequency of the ultrasonic wave.



Related topics

Debye-Sears effect, diffraction of light, diffraction grating, diffraction maxima, wavelength, sound velocity, standing and travelling wave

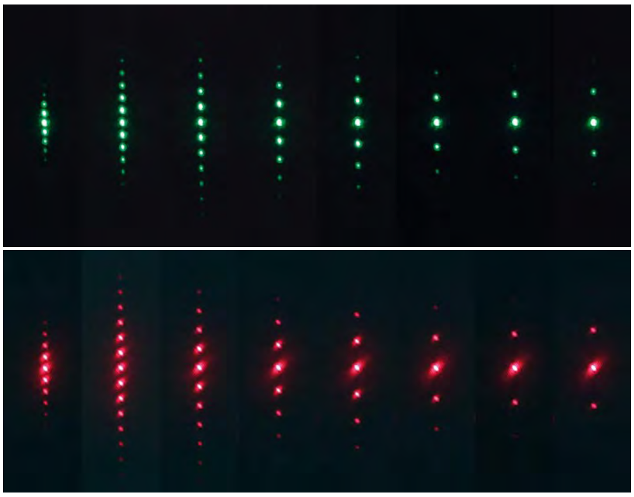
In 1932, Debye and Sears showed that light experiences a diffraction when passing through a liquid excited to high-frequency vibrations. Ultrasound can be made more or less "visible" using this effect. The density maxima and minima produced in the liquid by a standing or travelling ultrasonic wave here function like an optical diffraction grating. The grating constant of such a grating produced by an ultrasonic wave corresponds to the wavelength of this ultrasonic wave. It can be determined by means of the diffraction patterns of the light of a laser beam of a known wavelength. Because the wavelength is defined by frequency and sound velocity, the Debye-Sears effect can be used in this experiment structure in order to determine the sound velocity in the liquid being scanned with sound (e.g. water) with high accuracy.

Equipment

cw generator SC600	20100
Debye-Sears set	20200
Laser module (green)	20211
- optional: laser module (blue)	20212
AOM sample reservoir	20225
Cover for AOM sample reservoir	20223

Results

The graphic shows typical diffraction patterns for green and red laser light at a standing ultrasonic wave in water at sound frequencies from 3 MHz to 10 MHz (increment: 1 MHz). As the ultrasonic frequency is raised, the distances between the individual diffraction maxima also increase, although the longer-wave red laser light is more strongly diffracted. The number of orders of diffraction is largely determined by the transmission characteristics of the sound probe and the frequency-dependent attenuation.



Related experiments

PHY12 Projection of standing waves
PHY17 Acousto-optical modulation at standing waves
IND04 Concentration measurement with resonance cell

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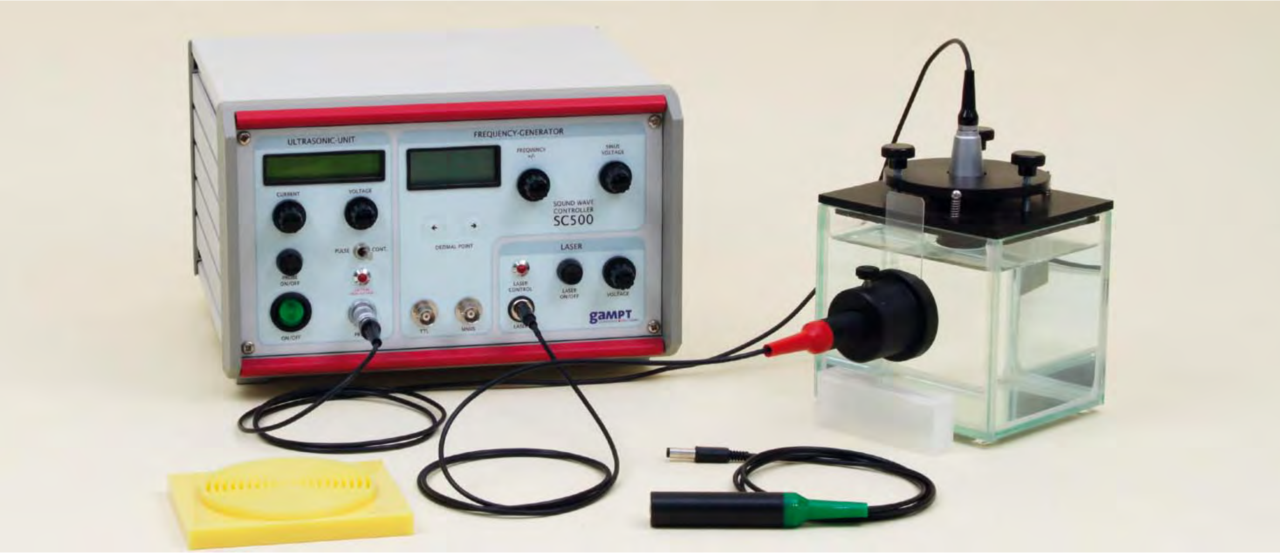
PHY12 Projection of standing waves

In the experiment a standing ultrasonic wave in a liquid is imaged by means of divergent laser light. The dependence of the brightness modulation of the projection images produced upon the wavelength of the light and the frequency of the ultrasonic wave is investigated and the sound velocity in the liquid (water) is determined.



Related topics

Sound wavelength, sound velocity, standing and travelling wave, divergent monochromatic light, refraction indices, focal length of an optical lens

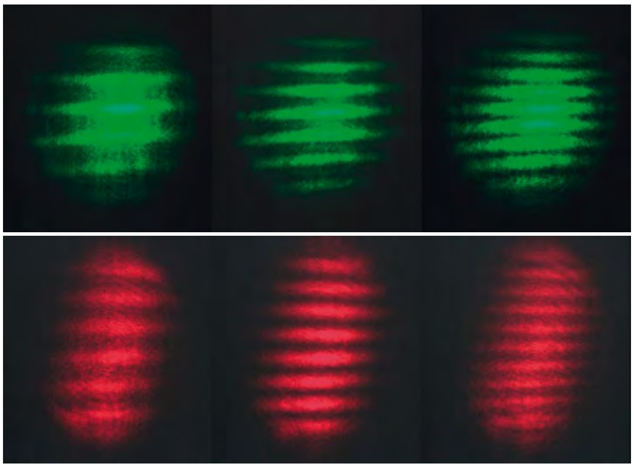
A standing ultrasonic wave in a liquid can be imaged by means of divergent monochromatic light. Due to the standing wave, sound pressure differences are produced in the liquid which are periodically repeated along the sound axis. The localised differences in density caused in this way result in locally differing and periodically repeating refraction indices along the sound axis. When monochromatic light is used, the projection of the standing wave therefore shows a light-dark modulation with periodically repeating brightness maxima which correspond to the density differences. The spacing of these brightness maxima can be used to determine the sound wavelength and thus the sound velocity in the liquid.

Equipment

cw generator SC600	20100
Debye-Sears set	20200
Laser module (green)	20211
- optional: laser module (blue)	20212
Projection lens	20230
Acoustic absorber	20227

Results

The projection images of standing ultrasonic waves in water (here at 2.8 MHz, 3.5 MHz and 4.5 MHz) obtained with green and red laser light show the reduction of the spacing of the brightness maxima to be expected with increasing sound frequency. The difference between green and red laser is here caused by the wavelength dependence of the refraction indices.



Related experiments

PHY11 Debye-Sears effect
PHY17 Acousto-optical modulation at standing waves

PHY13 Ultrasonic Doppler effect

The experiment provides an introduction to the basics of flow measurement on the basis of the acoustic or ultrasonic Doppler effect and examines its dependence on flow velocity and Doppler angle.

Related topics

Frequency shift, scattering, Doppler effect, Doppler angle, Doppler sonography, flow measurement

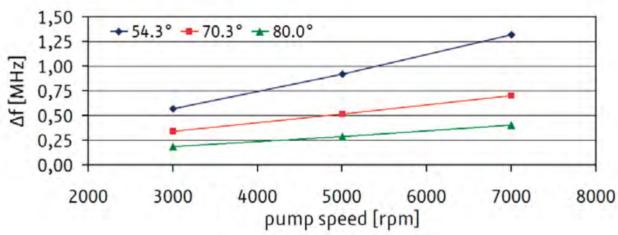
The term "Doppler effect" refers to the change in the perceived frequency of waves while the transmitter and receiver are in motion in relation to each other. This effect is used to image moving structures. For example, ultrasound can be used to determine the flow velocity and/or the flow rate of a flow of liquid. Here the frequency shift of an ultrasonic wave, which is coupled into the flow of liquid at a particular Doppler angle, is measured with scattering of the wave on small particles, such as impurities. In the experiment, the dependence of the Doppler frequency shift Δf on the flow velocity v (movement speed of the scattered particles) and the Doppler angle α is investigated for different fundamental frequencies f_0 by a variation of the pump power, the transmission frequency and the incidence angle. For a pulse-echo system with one ultrasonic probe the following relationship applies, presented in simplified form: $\Delta f \sim f_0\, v \cos(\alpha)$.

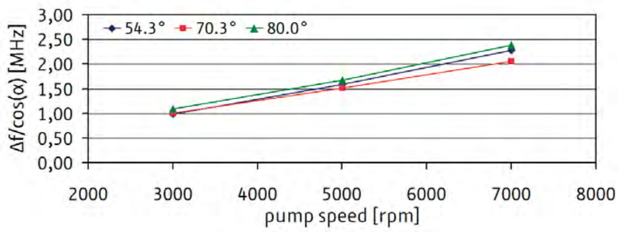
Equipment

Ultrasonic Doppler device FlowDop200	**NEW!**	50400
Ultrasonic probe 1 MHz		10151
Ultrasonic probe 2 MHz		10152
Ultrasonic probe 4 MHz		10154
Flow measuring set		50201
Centrifugal pump MultiFlow		50130
Doppler fluid		50140
Ultrasonic gel		70200

Results

The graphics show the frequency shift and the ratio Δf/cos(α) in dependence on the pump power for different Doppler angles at the transmission frequency 2 MHz. The Doppler frequency shift determined increases as the rotational speed rises and as the Doppler angle becomes smaller. The quotient Δf/cos(α) (the flow velocity v) is constant for even pump powers, i.e. no angle-dependent faulty measurement occurs.





Related experiments

PHY15 Fluid mechanics
IND05 Doppler flow measurement
MED03 Basics of Doppler sonography
MED05 Vascular ultrasound (angiology)
MED06 Peripheral Doppler blood pressure measurement

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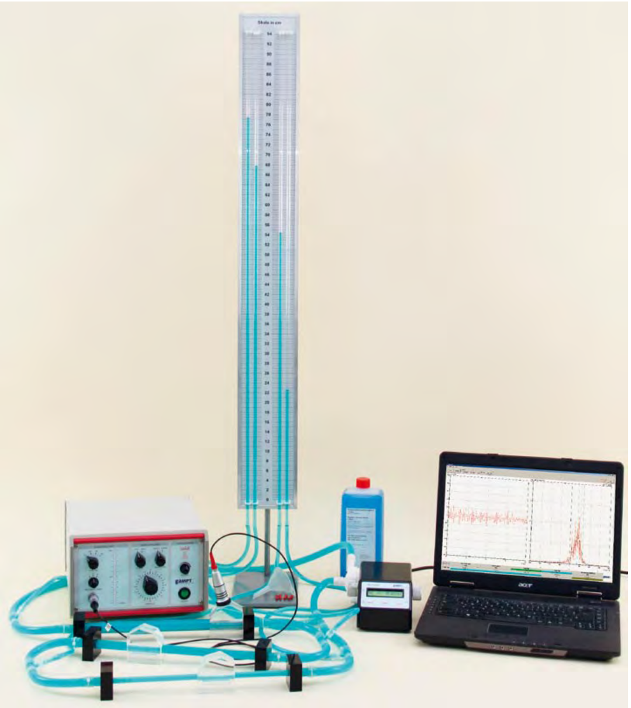
PHY15 Fluid mechanics

Flow measurements according to the ultrasonic Doppler method are used to demonstrate fundamental laws governing the flow of liquids in pipes and their dependence on the flow velocity and the pipe geometry.

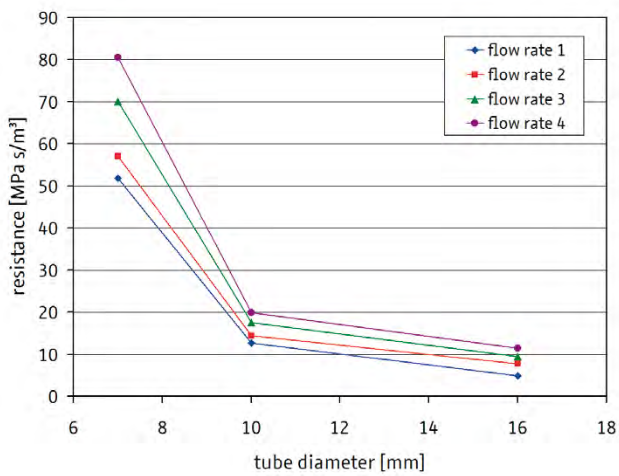


Equipment

Ultrasonic Doppler device FlowDop200	**NEW!**	50400
Ultrasonic probe 2 MHz		10152
Flow measuring set		50201
Standpipes		50150
Centrifugal pump MultiFlow		50130
Doppler fluid		50140
Ultrasonic gel		70200

Results

From the measured flow velocities and the respective cross section areas, the corresponding flow can be calculated. With this experiment structure, this is almost identical for all pipe diameters with the same settings of the centrifugal pump and thus fulfils the continuity equation.
As a further result, the determined flow resistance R is shown in the diagram below for different pipe diameters and for different flows. This shows the strong dependence, to be expected according to the Hagen-Poiseuille equation, on the pipe radius r: $R \sim 1/r^4$.



Related topics

Laminar and turbulent flow, continuity equation, Reynolds number, Bernoulli's equation, Hagen-Poiseuille equation, flow velocity, flow resistance, pressure scales, static and dynamic pressure, viscosity

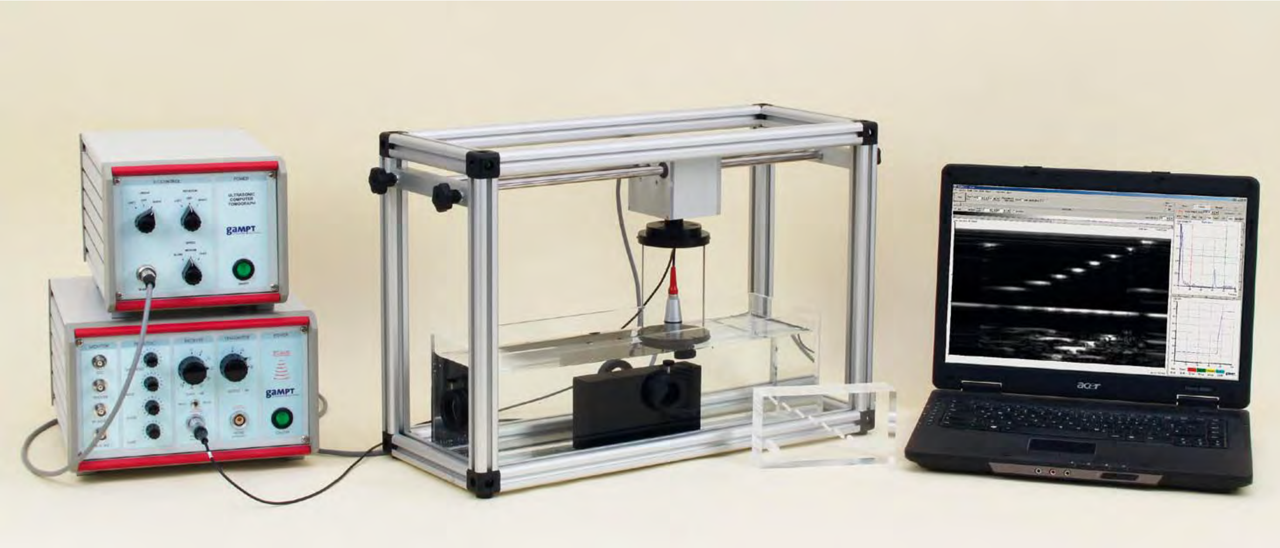
With this experiment structure, the Doppler frequency shift can be measured for different pump speeds at measurement sections with different pipe diameters. At the same time, the corresponding pressure drops can be measured by means of standpipes. In this way, it is possible to obtain clear evidence of the laws that apply to a liquid with laminar flow. From the flow velocities determined according to the Doppler method, the pipe geometries and the measured pressure drops, it is possible to determine flow rates, flow resistances and the dynamic viscosity of the Doppler liquid by formulaic application of the continuity equation, Bernoulli's equation and the Hagen-Poiseuille equation. By calculating the Reynolds numbers for the different flow velocities and pipe diameters, it is possible to check whether stationary laminar flow states were prevalent during the measurements.

Related experiments

PHY13 Ultrasonic Doppler effect
IND05 Doppler flow measurement
MED03 Basics of Doppler sonography
MED05 Vascular ultrasound (angiology)
MED06 Peripheral Doppler blood pressure measurement

PHY16 Mechanical scan methods

A computer-controlled scanner is used to record ultrasonic B-scan images of a simple sample with two ultrasonic probes of different frequencies. The image quality of the B-scan presentations is analysed regarding focus zone, resolution power and possible artefacts.



Related topics

Ultrasonic echography, pulse echo method, A-scan, B-scan, resolution power, mechanical scanning, image artefacts

To obtain a B-scan image with an ultrasonic transducer it is necessary to shift it and/or the sound beam along the desired line for the cross-sectional image. Compared with the hand-guided approach to scanning, mechanical and electronic scanning methods offer better image quality due to a good resolution power and a freely selectable line density. Due to the low imaging frequency, however, electronic multi-element scanners are used for real-time images and moving structures. Due to the use of ultrasonic probes of different frequency in combination with mechanically guided uniform scanning, both the axial and the lateral frequency-dependent resolution power can be examined and rated in the experiment.

Equipment

Ultrasonic echoscope GS200	10400
CT scanner	60200
CT control unit UCT200	60210
Ultrasonic probe 1 MHz	10151
Ultrasonic probe 2 MHz	10152
Test block (transparent)	10201
- optional: test block (black)	10204
CT reservoir	60120
Ultrasonic gel	70200

Results

The illustration shows the B-scan presentation of an acrylic block with drilled holes of different size and arrangement, recorded with a 2 MHz probe. By an investigation in the water bath, where the drilled holes are filled with water, echoes from both the upper edge and bottom edge of the drilled holes can be recognised. In the bottom echo, one can see the sound shadows of the holes located above.

Related experiments

PHY08 Ultrasonic B-scan
PHY10 Characteristics of sound field
PHY20 Determination of focus zone
MED02 Ultrasonic imaging at breast phantom (mammasonography)
IND08 Detection of discontinuities

PHY17 Acousto-optical modulation at standing waves

The acousto-optical effect of the amplitude and phase modulation of light diffracted at a standing ultrasonic wave is investigated. The effect is used to determine sound velocity in water.

Related topics

Acousto-optical effect, standing ultrasonic wave, sound wavelength, diffraction, optical grating, grating constant, amplitude modulation, phase shift

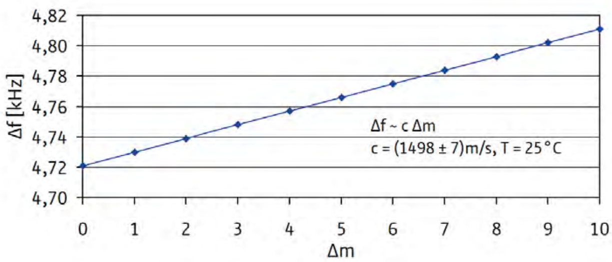
Commensurate with the Debye-Sears effect (PHY11), light is diffracted at a standing or travelling ultrasonic wave in a liquid or a solid body. The diffraction maxima produced with the diffraction at a standing ultrasonic wave are amplitude-modulated, although a phase shift of 180° occurs between the maximum of 0th and a maximum of nth order. This effect is used in acousto-optical modulators (AOMs). Using photodiodes and an oscilloscope, amplitude modulation and phase shift can be demonstrated.
A change in the sound frequency influences the modulation amplitude. The modulation amplitude is always biggest when the distance h between ultrasonic transducer and sound reflector corresponds to a multiple m of half of the sound wavelength. This makes it possible to determine the sound velocity c in the medium according to $c = 2\,h\,\Delta f / \Delta m$ (Δf: frequency difference between maximum modulation amplitudes).

Equipment

cw generator SC600	20100
Debye-Sears set	20200
Beam splitter	20301
2 adjustable reflectors	20302
2 photodiode receivers	20303
Oscilloscope	-

Results

To determine the sound velocity in water, the 0th order of diffraction is aligned to a photodiode and a first maximum amplitude is searched for. Afterwards, the sound frequency is gradually increased and the frequencies of the following maximum amplitudes are determined. For the measuring points entered in the diagram, there arises a sound velocity in water of (1498 ± 7) m/s (T = 25 °C). The laser beam is splited with a beam splitter to determine the phase shift. The second partial beam is aligned to a second photodiode so that another diffraction maximum can be obtained with it. At the oscilloscope, the phase shift between the two different orders of diffraction can be determined.



Related experiments

PHY11 Debye-Sears effect
IND04 Concentration measurement with resonance cell

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PHY19 Phase and group velocity

In the experiment, the phase and group velocity of an ultrasonic wave in water is investigated. The phase velocity is measured for several frequencies in dependence on the wavelength. The group velocity is determined by the measurement of the time of flight of a short ultrasonic pulse.

Related topics

Wavelength, frequency, phase velocity, time of flight, sound pulse, group velocity, frequency dependence, dispersion

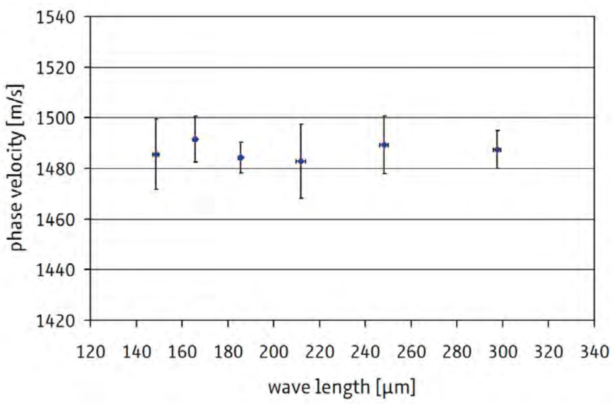
The term dispersion describes the dependence of a wave characteristic of the wavelength and/or frequency.
The characteristic/quantity investigated in the experiment is the phase velocity of an ultrasonic wave in water. For this, a hydrophone is moved along the sound axis of an ultrasonic probe. The hydrophone signal is set on an oscilloscope. By measuring the change in the probe-hydrophone distance and the respective number of phase runs at a fixed frequency f, it is possible to determine the wavelength ? and thus the phase velocity $c_P = \lambda \cdot f$. This measurement is carried out for several spacings and different frequencies.
To determine the group velocity, the ultrasonic generator is operated in pulse mode so that short ultrasonic pulses are generated from the multifrequency probe. By measuring the time of flight t of an ultrasonic pulse for a certain distance s between ultrasonic probe and hydrophone it is possible to determine the group velocity $c_G = s / t$.

Equipment

cw generator SC600	20100
Hydrophone set	10451
Multifrequency probe	20139
Ultrasonic gel	70200
Oscilloscope	-

Results

For the measurement result shown in the diagram, the phase velocity was determined at 6 different frequencies, each time for 5 different spacings between multifrequency probe and hydrophone. For water, in the investigated frequency range (5-10 MHz), no dependence of the phase velocity on the wavelength was found. A value of 1485 m/s was determined as the group velocity (time of flight of the sound pulse: 67.3 µs, probe-hydrophone spacing: 10 cm).

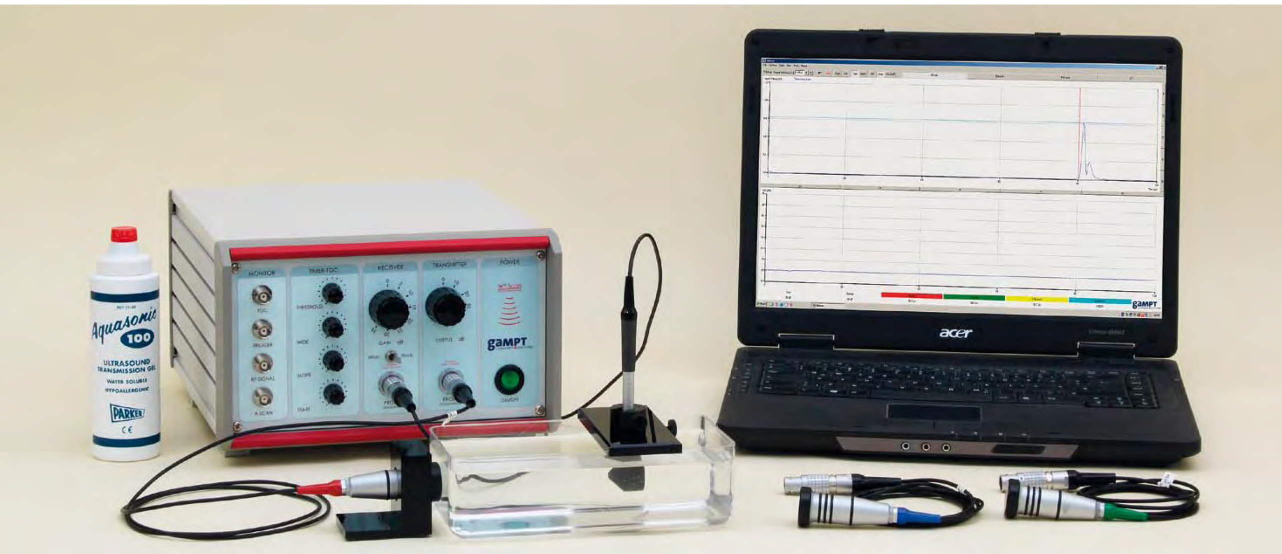


Related experiments

PHY04 Acoustic attenuation in liquids
PHY10 Characteristics of sound field
PHY20 Determination of focus zone

PHY20 Determination of focus zone

In the experiment, two ultrasonic probes of different frequency are characterised by a scanning of their sound fields with a hydrophone with regard to their near field length, focus zone and axial resolution power.



Related topics

Velocity of sound, wavelength, interference, Huygens' principle, near field, far field, near field length, focus zone, axial resolution power, hydrophone

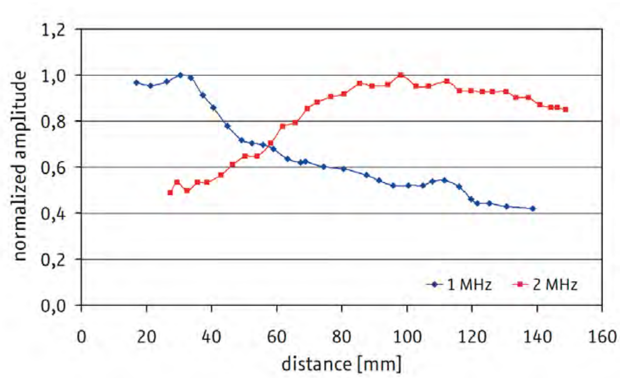
Ultrasonic probes show a different axial and lateral resolution power in dependence on their frequency. Whereas the axial resolution power is limited by the frequency of the ultrasonic probes, the lateral resolution and location of the focus zone are caused by the geometry of the sound fields. Due to interferences according to the Huygens' principle, there occurs a sound field at a round ultrasonic probe that can be divided into two areas: the near field, which shows complex conditions with strong amplitude modulations, and the far field, which appears as a sound beam with decreasing amplitude. The near field length is defined as the last maximum of the sound pressure amplitude on the acoustic axis. In the experiment, the sound pressure amplitudes for two ultrasonic probes (1 MHz and 2 MHz) are measured with a hydrophone along the sound propagation axis. From the measurement curves, the focus zones of the probes are determined and compared with the values for the near field length which can theoretically be calculated from the radii of the transducer ceramics and the wavelengths of the ultrasonic frequencies.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 1 MHz	10151
Ultrasonic probe 2 MHz	10152
Hydrophone set	10451
Ultrasonic gel	70200

Results

The calculated near field lengths with a measured sound velocity in water of 1477.64 m/s (18.5 °C) are 43.3 mm (1 MHz) and 86.6 mm (2 MHz). The values - obtained from the measurement curves - for the maxima of the signal amplitudes are approx. 30 mm (1 MHz) and 100 mm (2 MHz). More exact results are not to be expected, due to the relatively simple experiment structure. The measurements show, however, that the focus zone of the 2 MHz probe is considerably further away from the probe. The measurements are thus perfectly sufficient for the estimation of the focus area of a probe.



Related experiments

PHY04 Acoustic attenuation in liquids
PHY10 Characteristics of sound field
PHY19 Phase and group velocity

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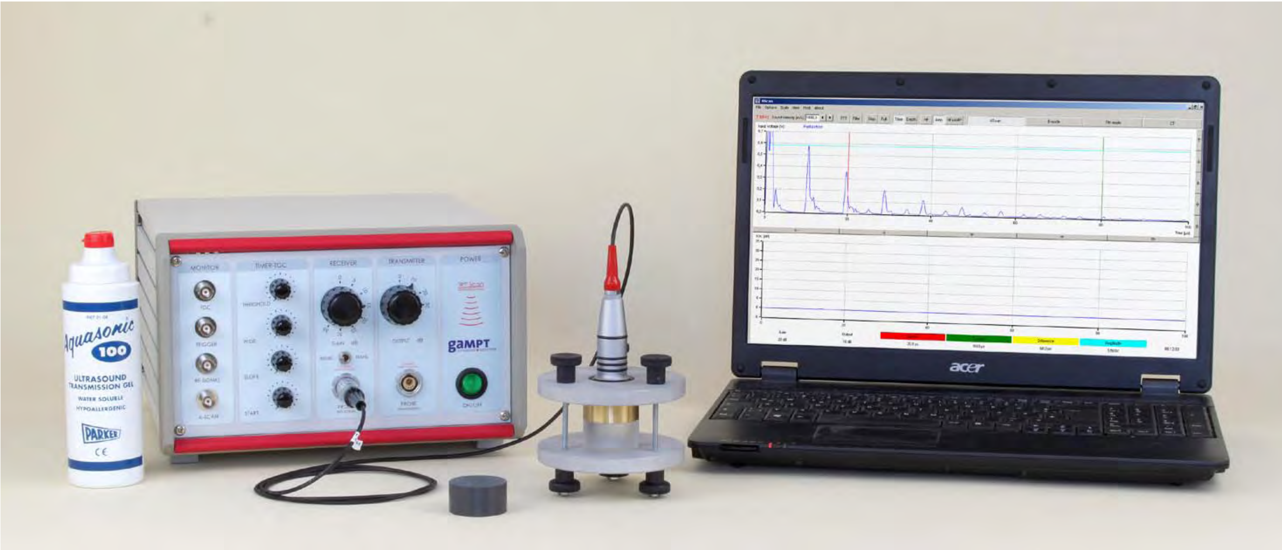
PHY21 Reflection and transmission at boundaries

In the experiment, the effects of reflection and transmission of ultrasonic waves at boundaries are investigated. The reflection coefficient is determined for different combinations of the materials acrylic, PVC and brass.



Related topics

Propagation of ultrasonic waves in solids, pulse echo method, reflection/transmission at boundaries, reflection coefficient, acoustic impedance, sound attenuation

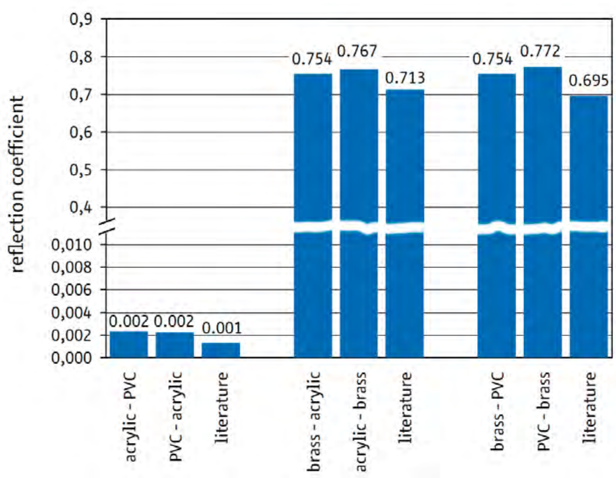
If an ultrasonic wave strikes the boundary of two materials of different characteristic acoustic impedance, it is partially or almost completely reflected. The part of reflected acoustic energy depends on the size of the difference between the characteristic acoustic impedances of the respective materials and is described by the reflection coefficient. Due to the low density and sound velocity of air, the reflection coefficient at a solid-air boundary is almost 1. Thanks to this, in the experiment the reflection coefficients for different combinations of the materials acrylic, PVC and brass can be determined by comparative measurements with the reflection coefficient against air. Furthermore, it is possible to achieve a qualitative description of the attenuation characteristics of the materials by comparing the investigated reflection echoes.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 2 MHz	10152
Acoustic impedance samples	10208
Ultrasonic gel	70200

Results

The reflection coefficients for acrylic/PVC-brass and brass-PVC/acrylic are almost the same and are probably above the theoretical values, due to a less than 100% coupling to the material junctions. The coefficients for acrylic/PVC and PVC/acrylic are almost equal and are almost zero due to the low difference between their characteristic acoustic impedances. The attenuation is lowest in brass. The largest number of multiple reflections occurs here. PVC shows the greatest attenuation, because the reflection peak of the PVC-acrylic measurement is substantially smaller with the same reflection coefficient than the reflection peak in the acrylic/PVC measurement.



Related experiments

PHY03 Acoustic attenuation in solids
PHY22 Phase shift and resonance effects
IND08 Detection of discontinuities
MED02 Ultrasonic imaging at breast phantom (mammasonography)

PHY22 Phase shift and resonance effects

In the experiment, ultrasonic signals from reflections at boundaries of different materials are recorded and analysed regarding their phase position. Furthermore, the influence of thin layers upon the reflection and transmission of ultrasonic waves is investigated using λ/4 and λ/2 plates.

Related topics

Reflection, transmission, reflection coefficient, characteristic acoustic impedance, phase shift, λ/4 and λ/2 layer

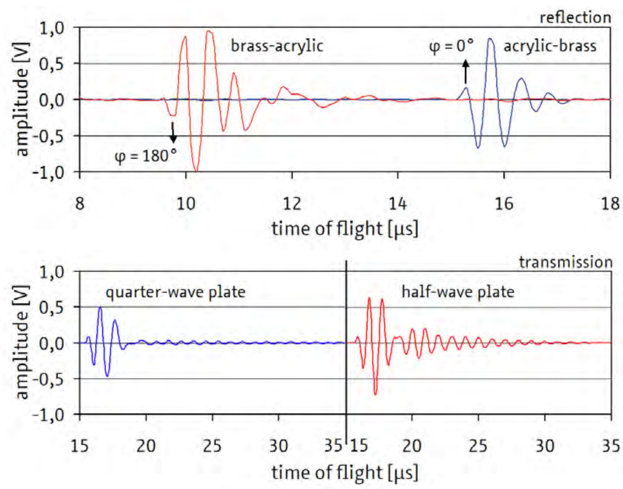
If a plane ultrasonic wave from a medium with the characteristic acoustic impedance Z_1 strikes a plane boundary to a second medium with the impedance Z_2, it is partially or completely reflected on this. The reflected part of the sound energy depends on the ratio of the impedances and is described by the reflection factor. The reflected wave generally also has another phase. In the case of perpendicular sound incidence, the phase change only takes two values: 0° for $Z_1 < Z_2$ and 180° for $Z_1 > Z_2$. Based on such a phase shift, the impedance ratio of two adjacent materials can be qualitatively described. Particularly interesting effects occur when sound passes through thin layers, the thicknesses of which are a quarter or a half of the sound wavelength. λ/4 layers are used e.g. as matching layers in order to minimise reflections and to transfer the largest possible share of sound energy from one medium into the other medium.

Equipment

Ultrasonic echoscope GS200	10400
2 ultrasonic probes 1 MHz	10151
Ultrasonic probe 2 MHz	10152
Test cylinder set	10207
Acoustic impedance samples	10208
Lambda plates	10209
Ultrasonic gel	70200

Results

The first graphic shows echo signals from an acrylic-brass and brass-acrylic boundary with perpendicular sound incidence. The characteristic acoustic impedance $Z = c\,\rho$, determined from the sound velocity c and the material density ρ, was 36.8 Mrayl for brass and 3.25 Mrayl for acrylic. The second graphic shows measurements in transmission at an acrylic cylinder. Each time, a thin aluminium plate ($c_L \approx 6309$ m/s) with a thickness of λ/4 (approx. 1.5 mm) and/or λ/2 (approx. 3.1 mm) was arranged between the transmitting probe and the cylinder.



Related experiments

PHY05 Spectral investigations
PHY21 Reflection and transmission at boundaries

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PHY23 Dispersion of ultrasonic waves (Lamb waves)

In the experiment, the phenomenon of formation and propagation of guided ultrasonic waves (Lamb waves) is investigated. The frequency-dependent velocity (dispersion) of Lamb waves in thin glass plates is measured. The Lamb waves are stimulated and determined by means of angle beam probes.

Related topics

Longitudinal waves, shear waves, Lamb waves, wave modes, phase velocity, group velocity, dispersion, law of refraction

The phenomenon of Lamb waves causes by superimposing of ultrasonic transverse and shear waves in thin plates, whose thickness is smaller than the ultrasonic wave length. What is interesting about lamb waves is that they, on the one hand, show a frequency-dependent change of their propagation velocity (dispersion). On the other hand, lamb waves are present in the form of symmetrical and anti-symmetrical modes which propagate within the material independent of each other.

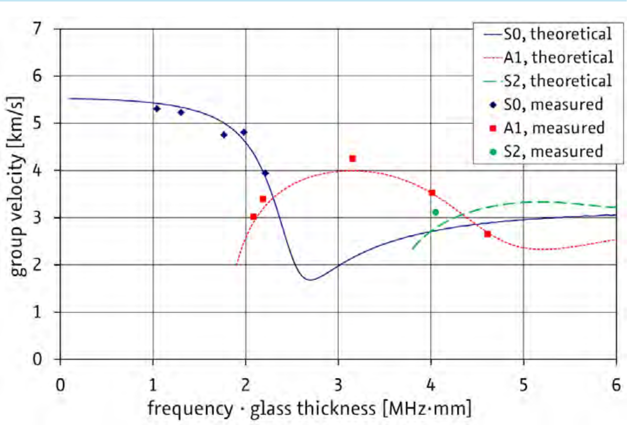
In the experiment, different Lamb wave modes are stimulated in thin glass plates using specific angle beam wedges and their frequency and group velocity are determined. The formation of different oscillation modes of a plate, the influence of plate thickness and the connection of Lamb waves with transverse and shear waves in conjunction with the elastic constants of the material is discussed.

Equipment

Ultrasonic echoscope GS200	10400
2 ultrasonic probes 1 MHz	10151
2 ultrasonic probes 2 MHz	10152
2 ultrasonic probes 4 MHz	10154
Lamb wave set	10300
Ultrasonic gel	70200

Results

S0, A1 and S2 modes were stimulated in the glass plates by combination of different incidence angles and sound frequencies. In the dispersion chart below, the determined group velocities are entered depending on the product of frequency and thickness of the respective glass plate. Furthermore, the chart shows the theoretical curse of curve (numerical solution) of the dispersion properties of the stimulated Lamb wave modes.

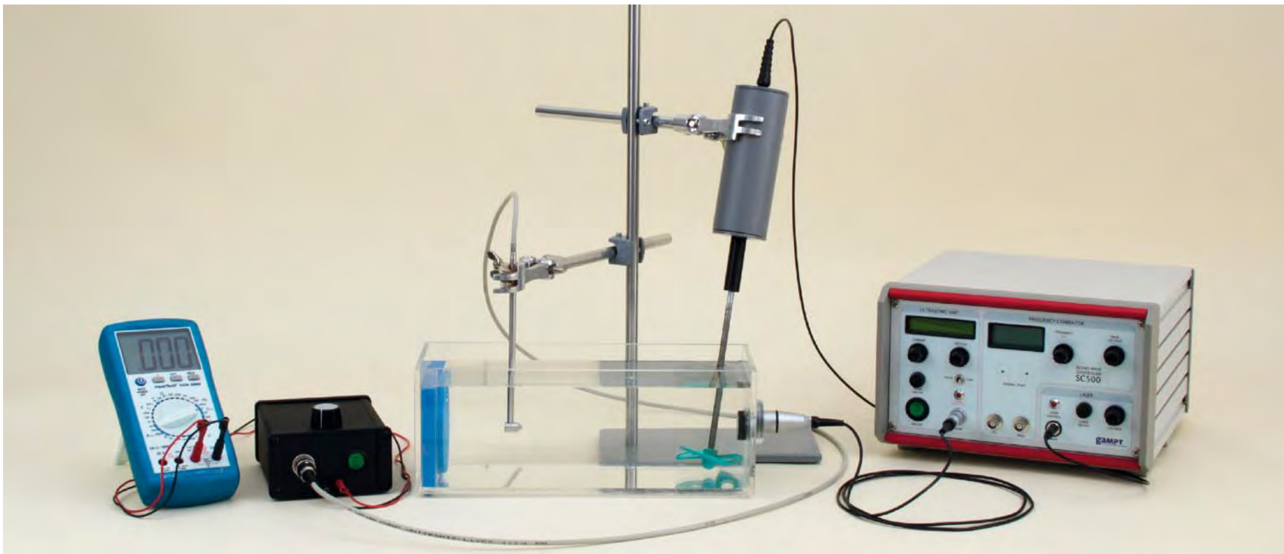


Related experiments

PHY02 Sound velocity in solids
PHY07 Shear waves in solids
PHY19 Phase and group velocity
IND02 Detection of cracks with Rayleigh waves
IND08 Detection of discontinuities

PHY24 Thermoacoustic sensor

The experiment is an introduction into the problem of the power measurement of ultrasound, using the example of the thermoacoustic sensor. The connections between the acoustic parameters and the significance of sound power measurements for dosimetry in diagnostic and therapeutic ultrasonic applications are discussed.



Related topics

Acoustic energy parameters, sound pressure, sound particle velocity, sound intensity, sound power, ultrasonic dosimetry, thermoacoustic sensor

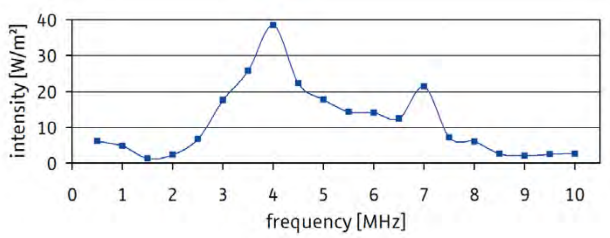
Ultrasonic intensity measurements are of decisive importance for patient safety in the quality assurance of therapeutic ultrasonic sources. The thermoacoustic sensor offers a simple option for the otherwise laborious measurements of sound intensities by means of hydrophones and acoustic radiometers. The sensor is based upon the conversion of the incident sound energy into heat inside a small absorber. This way the sound intensity can be measured as a temperature change in the absorber material by means of a thermocouple. The sensor is structured as a bridge circuit so that external temperature influences can be compensated for. The temperature change is output via an amplifier circuit as a voltage value. In the experiment, the emitted sound intensity of an ultrasonic probe is measured at different frequencies and different exciting voltages. Problems of sound generation with piezoelectric ceramics, resonance effects and propagation phenomena such as near field length and standing waves are discussed. The emitted sound intensity of the probe is calculated based upon the calibration curve of the sensor. Because the energy conversion in the sensor is frequency-dependent, the measurement values must be correspondingly corrected.

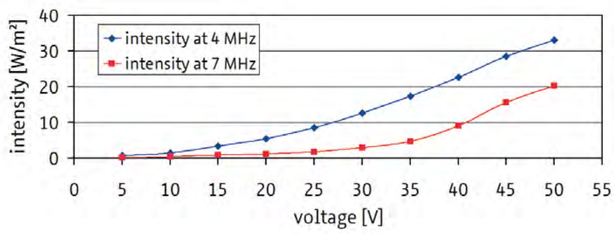
Equipment

cw generator SC600	20100
Multifrequency probe	20139
Thermoacoustic sensor	20400
Measuring reservoir	20430
Acoustic absorber	20227
Stirrer for SC500/SC600	20450
Tripod set	10310

Results

For the multifrequency probe, the sound intensities have been determined at different frequencies. The measurement shows two intensity maxima which result from the overlaying of the frequency responses of the probe and of the generator. For both resonance points, the ultrasonic intensities were measured in dependence on the exciting voltage.



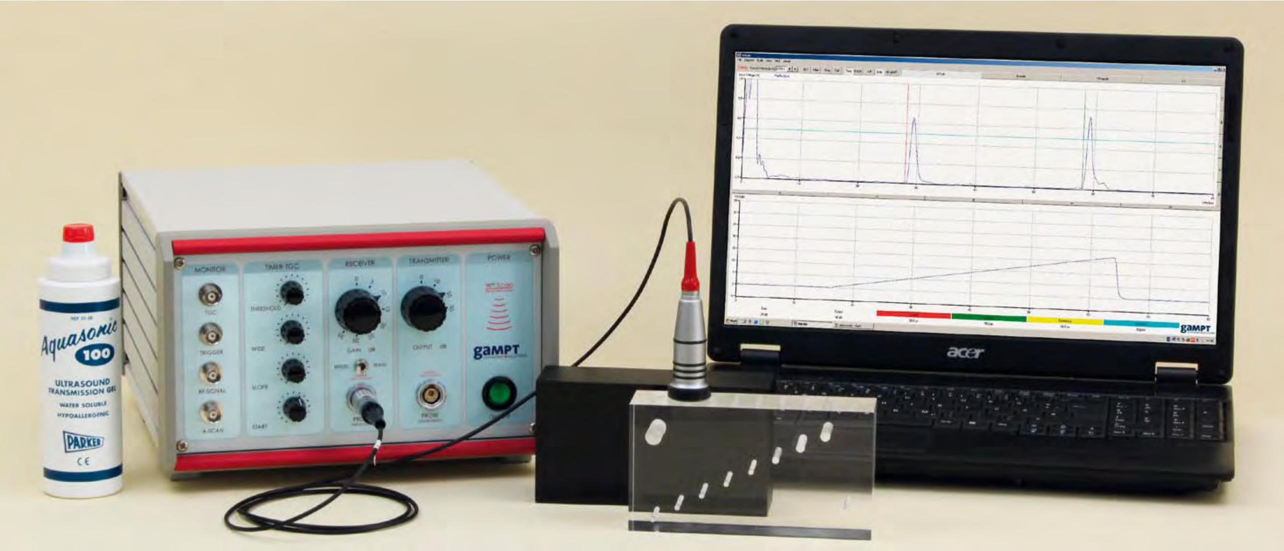


Related experiments

PHY10 Characteristics of sound field
PHY20 Determination of focus zone

IND01 Non-Destructive Testing (NDT)

In order to localise and determine the size of discontinuities in accordance with the pulse echo method, the ultrasonic device is calibrated for a normal ultrasonic probe. For this, a DGS diagram (distance-gain-size) is compiled and a horizontal evaluation line is set in the DGS diagram for a series of equally sized replacement reflectors of different depths using time gain control (TGC).



Related topics

Sound velocity, reflection, pulse echo method, discontinuity, replacement reflector, normal probe, DGS diagram, time gain control

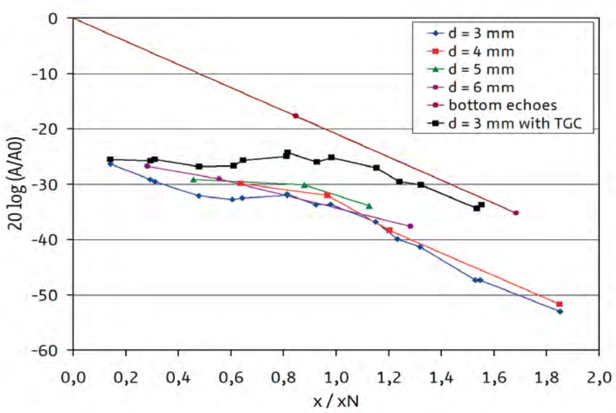
For ultrasonic tests according to the pulse echo method with perpendicular sound coupling, standard normal probes are used. The localisation of discontinuities is here carried out by reflection of the sound wave, with the time of flight of acting as a measure of the depth of the discontinuity. In contrast, an exact determination of size is usually problematic due to material attenuation and sound field characteristics. The size of discontinuities of large spatial extension can be determined by scanning. The size of small discontinuities is determined by comparison with idealised replacement reflectors from a distance-gain-size diagram. In the experiment, such a DGS diagram is to be produced using a test block with defined replacement reflectors (drilled holes of different size and depth).

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 2 MHz	10152
Test block (transparent)	10201
- optional: test block (black)	10204
Ultrasonic gel	70200

Results

In the DGS diagram, the echo amplitudes of the replacement reflectors are presented in relation to the amplitude of an infinitely extended reflector in the spacing zero and its distances x relative to the zero field length x_N. For the series of the diagonally arranged, equal-sized replacement reflectors, a horizontal evaluation line was determined and entered using TGC (time gain control).

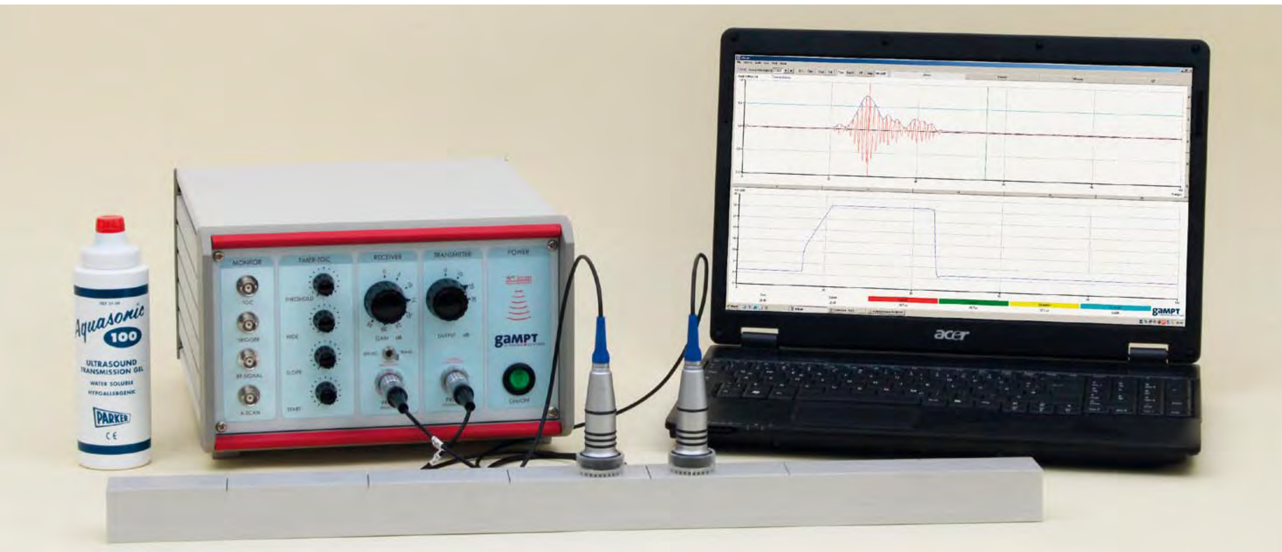


Related experiments

- PHY01 Basics of pulse echo method (A-scan)
- PHY02 Sound velocity in solids
- PHY06 Frequency dependence of resolution power
- IND08 Detection of discontinuities

IND02 Detection of cracks with Rayleigh waves

In the experiment, the formation and propagation of Rayleigh waves is investigated. The sound velocity of the Rayleigh waves is ascertained and the dependence of the transmission amplitude of the Rayleigh waves on the crack depth is determined based on cracks of different depths.



Related topics

Longitudinal wave, surface acoustic wave, Rayleigh wave, sound velocity, sound wavelength, crack depth, reflection, transmission, mode conversion

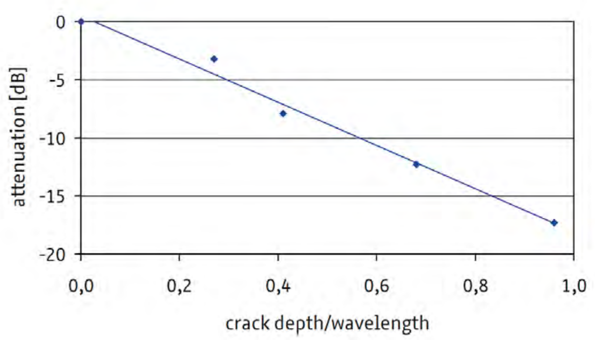
Rayleigh waves are surface waves that propagate along the free boundary of a solid. They represent a combination of longitudinal and transversal particle shifts. They can be used to detect surface faults. In the experiment, a test block with defined cracks as surface faults is investigated. The Rayleigh waves are produced by mode conversion from longitudinal waves by means of a 90° probe, where a special attachment with a comb-shaped structure is used. The velocity of the Rayleigh waves is ascertained as a difference calculation from time of flight measurements for different probe spacing. The reflection or transmission amplitude of a Rayleigh wave can be set in relation to the crack depth in the case of crack depths in the range of their wavelength. By comparing transmission amplitudes without and with crack, the crack depth can be estimated.

Equipment

Ultrasonic echoscope GS200	10400
2 ultrasonic probes 1 MHz	10151
Pair of Rayleigh wave attachments	10230
Rayleigh wave test block	10232
Ultrasonic gel	70200

Results

For the aluminium test block, a Rayleigh wave velocity of approx. 2920 m/s was ascertained. For the probe frequency of 1 MHz, a wavelength of approx. 2.92 mm results. For the determination of crack depth, the probes acting as transmitters and/or receivers were each placed at a distance of 5 cm away from the investigated crack. In the diagram, the attenuation of the transmission signal is entered for different crack depths; the crack depth is here entered in relation to the wavelength. For the investigated crack depth range, there results an almost linear correlation between crack depth and attenuation of the transmission amplitude, corresponding to the exponential amplitude decrease of the Rayleigh wave with the penetration depth.



Related experiments

PHY07 Shear waves in solids
IND01 Non-Destructive Testing (NDT)
IND07 Crack depth determination (TOFD)
IND08 Detection of discontinuities

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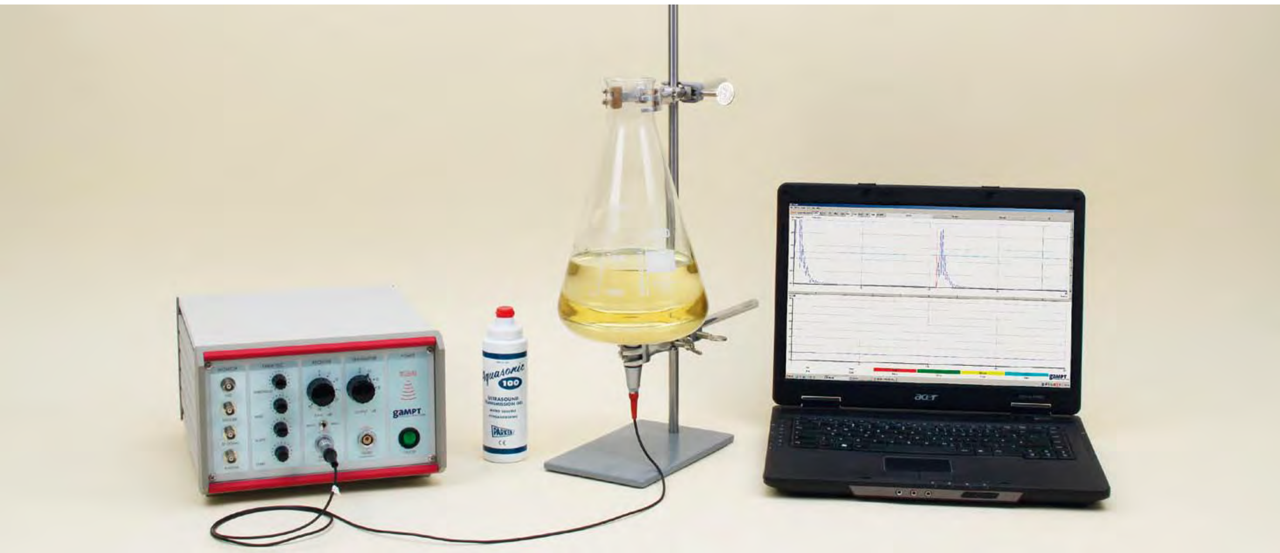
IND03 Level measurement

In the experiment, an ultrasonic level measurement is built for a two-phase liquid tank of any desired shape. A calibration curve is recorded for the filling volumes and checked on the basis of a defined fill-up. An ultrasonic limit switch is tested for the maximum tank filling.



Related topics

Sound velocity, transit time, acoustic impedance, pulse echo method, initial echo, multiple reflection, continuous measurement, limit monitoring

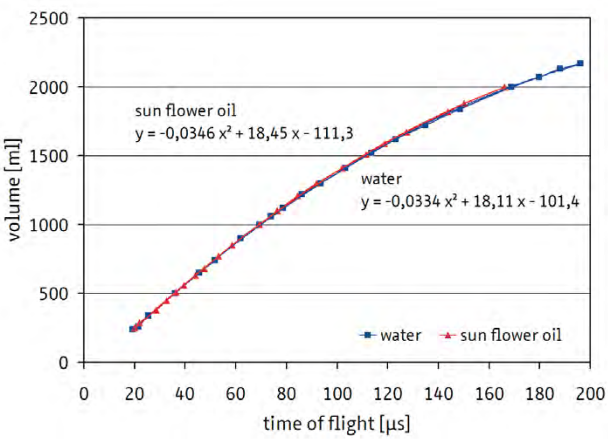
With a large number of industrial processes, especially of the automation of industrial procedures, filling level meters e.g. at tank farms, reactors, collecting tanks etc. are required. As well as different mechanical, capacitive, optical and electromagnetic sensors, in many areas ultrasonic sensors are used for level measurement. They can be used in almost any medium, including where several materials are layered on top of each other, where there is foam formation and even in very aggressive liquids, because the measurement can be carried out from outside through the container wall. In the experiment, a level measurement arrangement is configured for continuous measurements. For two different liquids (water and oil), the minimum detectable filling level is determined and a volume calibration is carried out for each. With the aid of the calibration, a level measurement is carried out on a two-layer system of the two liquids. In addition, suitable ultrasonic signals for a limit switch are recorded and analysed.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 2 MHz	10152
Tripod set	10310
Erlenmeyer flask	10330
Ultrasonic gel	70200

Results

For the calibration of the level measurement, the times of flight for different filling volumes of water and/or oil were measured. To determine any filling volumes desired, calibration curves were adapted to the measurement values. Second order polynomials sufficed as curve fits. Due to the slight difference between the sound velocities of water and of the oil used, the calibration curves here have a very similar course.



Related experiments

PHY01 Basics of pulse echo method (A-scan)
PHY04 Acoustic attenuation in liquids
PHY21 Reflection and transmission at boundaries

IND04 Concentration measurement with resonance cell

The dependence of the sound velocity in a salt solution upon the concentration is investigated. The sound velocity in a resonance cell is measured with the aid of the acousto-optical effect of the diffraction of light at a standing ultrasonic wave.

Related topics

Sound propagation, Debye-Sears effect, standing sound wave, optical diffraction grating, wavelength, sound frequency, sound velocity, amplitude modulation, resonance cell

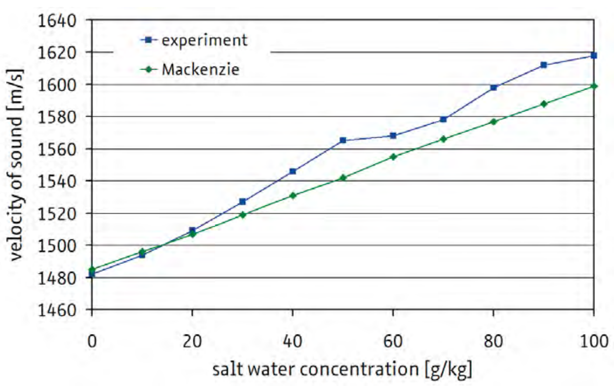
In electrolytes, when there is an increase in concentration there occurs a reduction of compressibility and an increase in the density. This leads to a concentration-dependent increase in sound velocity. The sound velocity in the electrolyte can be determined by means of the diffraction of light at a standing ultrasonic wave (PHY17). The interference maxima that are produced in the diffraction are amplitude-modulated as a result of the periodic change of the wave. The amplitude modulation takes place at twice the frequency of the standing wave. A change in the sound frequency influences the modulation amplitude. This is always biggest when the distance h between ultrasonic probe and reflector corresponds to a multiple m of the half sound wavelength. The sound velocity c in the medium can be calculated as follows: $c = 2\,h\,\Delta f / \Delta m$ (Δf: frequency difference between maximum modulation amplitudes). The measurement values are compared with values that are calculated by means of the empirical formula for sound velocity in sea water of Mackenzie (JASA, 70, 807-12).

Equipment

cw generator SC600	20100
Debye-Sears set	20200
Adjustable reflector	20302
Photodiode receiver	20303
Oscilloscope, common salt, magnetic stirrer, thermometer	-

Results

In the diagram, the measurement values and the comparative values calculated in accordance with Mackenzie's formula are entered. In the investigated concentration range, a substantial increase in sound velocity can be observed as the salt concentration is raised. In the range of 0-30 g/kg, the measurement values correspond closely to the theoretical values according to Mackenzie.



Related experiments

PHY11 Debye-Sears effect
PHY17 Acousto-optical modulation at standing waves

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IND05 Doppler flow measurement

In the experiment, the dependence of the Doppler frequency on the flow for a fixed measurement arrangement as regards pipe diameter and Doppler angle is investigated. With the dependence determined, a simple flow meter is calibrated and the flow is measured while a pump is used.

Related topics

Doppler effect, Doppler frequency shift, Doppler angle, flow measurement

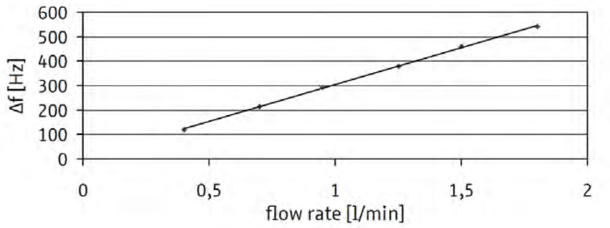
Due to the dependence of the Doppler frequency shift on the flow velocity and the proportionality between volume flow and average velocity in a fixed cross section, the Doppler effect can be used for flow measurement. The precondition is that the liquid shows a sufficient number of scatterers, in which the scattering angle is not equal to 90°. In the first part of the experiment, the Doppler frequency shift is determined for different flows of the fixed measurement arrangement, which are produced with the aid of the pump speeds. From the dependence found between flow and Doppler frequency shift there arises a calibration factor for a simple flow meter. In the second part of the experiment, different flows are produced with the pump, the respective Doppler frequency shift is measured and the volume flow is calculated for the respective pump setting with the aid of the calibration factor.

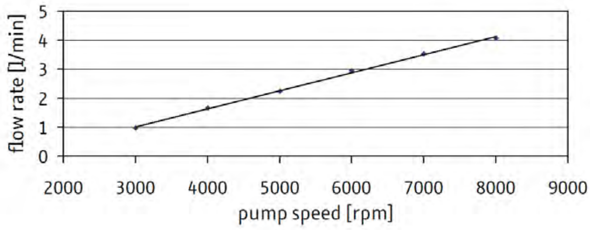
Equipment

Ultrasonic Doppler device FlowDop200	**NEW!**	50400
Ultrasonic probe 2 MHz		10152
Double reservoir		50170
Doppler prism 3/8“		50112
Flow pipe 3/8“		50152
Centrifugal pump MultiFlow		50130
Ultrasonic gel		70200
Timer		-

Results

In the experiment, a linear correlation is found between Doppler frequency shift and volume flow. From the increase of the linear regression lines it is possible to derive a calibration factor, using which the volume flow can be calculated for any measured Doppler frequency shift.



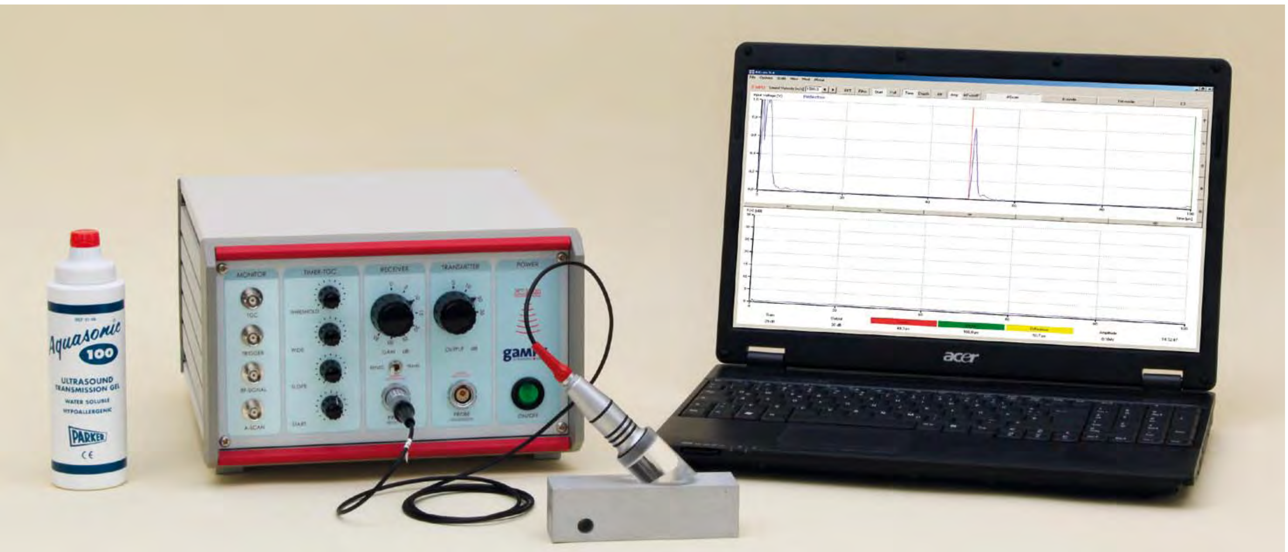


Related experiments

PHY13 Ultrasonic Doppler effect
PHY15 Fluid mechanics
MED03 Basics of Doppler sonography
MED06 Peripheral Doppler blood pressure measurement

IND06 Angle beam testing

The experiment demonstrates the use of ultrasonic angle beam probes for localising discontinuities. Measurements are carried out with delay lines with different angles of incidence, and a delay line is set for the locating of discontinuities in aluminium.



Related topics

Pulse echo method, A-scan, reflection, incidence angle, refraction angle, sound velocity, longitudinal wave, shear wave, refraction, angle echo, skip distance

Discontinuities often do not run parallel to the surface of the test object, so it is practical or even necessary to pass sound waves through at a specific angle, i.e. investigating with angle beam probes. While the calibration of normal probes for depth measurement only requires the time of flight and sound velocity, in the case of angle beam probes other geometrical factors - such as the incidence angle, the length of the delay line, the sound exit point and the additional exciting of shear waves - must be taken into account due to the oblique sound coupling. Unlike in real practice, in which standardised calibration blocks are used for calibration, in the experiment a simplified test block of aluminium is used. Due to the use of different angle beam wedges in combination with a normal probe, the ultrasonic echoes for different incidence angles can be investigated.

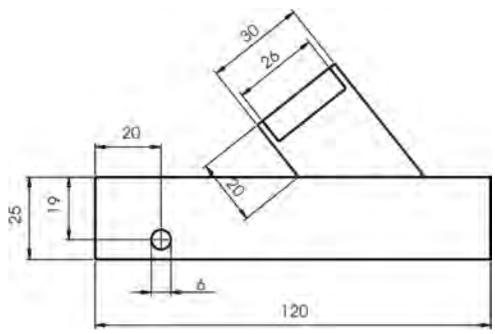
Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 2 MHz	10152
Angle beam wedge 38°	10234
- optional: angle beam wedge 17°	10233
- optional: angle beam wedge 56°	10235
Test block for angle beam probe	10240
Ultrasonic gel	70200

Results

For the 38° and 17° angle beam wedges and the aluminium test block, in a measurement arrangement as schematically presented in the graphic, approximately the following values occur.

Wave mode	trans.	trans.	long.	Unit
Incidence angle	38	17	17	°
Sound exit point	16.8	14.7	16.0	mm
Skip distance	48.9	36.8	46.0	mm
Refraction angle	44.5	18.5	40.7	°
Sound velocity	3091.2	3093.2	6436.6	m/s
Delay line	18,9	12.9	13.0	mm



Related experiments

PHY01 Basics of pulse echo method (A-scan)
PHY08 Ultrasonic B-scan
IND07 Crack depth determination (TOFD)
IND08 Detection of discontinuities

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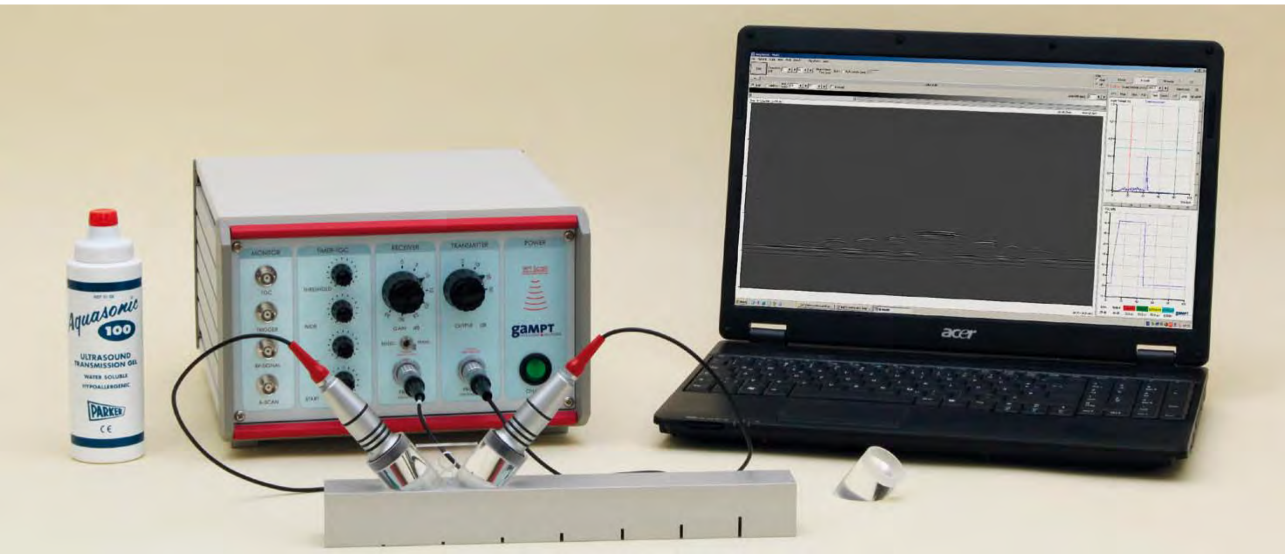
IND07 Crack depth determination (TOFD)

Crack depth determination is carried out upon an aluminium test block with defined cracks. The two methods used, the echo amplitude method and the TOFD method (time of flight diffraction), are comparatively evaluated regarding their performance and detection limits.



Related topics

Non-destructive testing (NDT), sound velocity, shear waves, ultrasonic diffraction, angle beam testing, angle echo, skip distance, TOFD method, ultrasonic B-scan

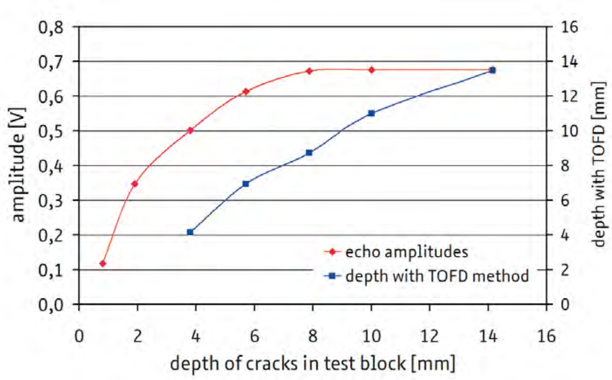
In the fracture mechanical evaluation of components regarding two-dimensional separations (cracks) accurate information is required on the defect geometry such as crack depth, crack length and crack depth position. Surface cracks can be detected with great sensitivity with angle beam probes. In this process, echoes are searched for that occur in the angle between crack and surface. Depending on the crack size and crack depth, two different methods are used which are to be investigated and evaluated in the experiment. On a test block, a) a groove characteristic line is determined for the crack depth determination in accordance with the echo amplitude method and b) the crack depths are determined with the TOFD method (time of flight diffraction). Based on the results, the suitability and sensitivity of the two methods, as regards crack geometry, can be assessed. In addition, another crack depth estimation can be carried out and analysed by recording a TOFD B-scan image using the TOFD probe.

Equipment

Ultrasonic echoscope GS200	10400
2 ultrasonic probes 2 MHz	10152
Angle beam wedge 38°	10234
Transceiver delay line (TOFD)	10237
Crack depth test block	10241
Ultrasonic gel	70200

Results

With the echo amplitude method, with the aid of an amplitude-depth characteristic line (reference block), crack depths can be estimated that are smaller than half the diameter of the transducer (8 mm). For larger cracks, the echo amplitude moves into saturation and no longer shows any crack-depth dependence. Deeper cracks can be analysed with the TOFD method. It provides no results, however, for small crack depths (1 and 2 mm). A complete crack depth test results from the combination of both methods.

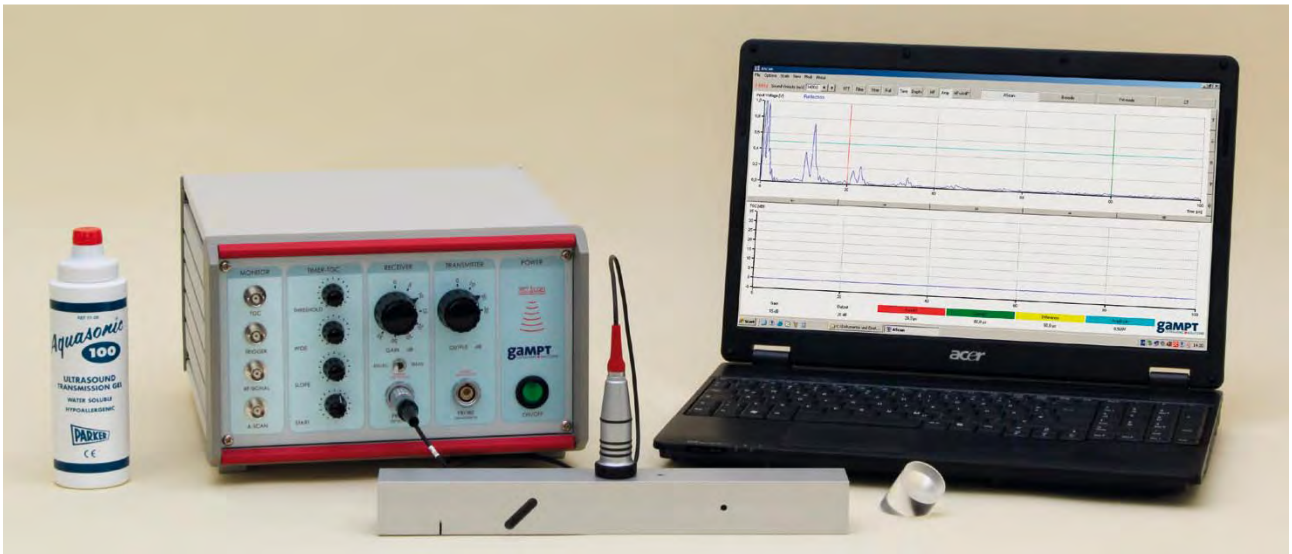


Related experiments

IND01 Non-Destructive Testing (NDT)
IND02 Detection of cracks with Rayleigh waves
IND06 Angle beam testing
IND08 Detection of discontinuities

IND08 Detection of discontinuities

Using a test block with different types of discontinuities (defects), the applicability and performance of different discontinuity locating techniques of non-destructive testing with ultrasound are analysed and the choice of the correct locating technique for specific testing tasks is discussed.



Related topics

Ultrasonic echography, discontinuity, reflection, incidence angle, refraction angle, A-scan, B-scan, normal probe, angle beam probe, signal-to-noise ratio

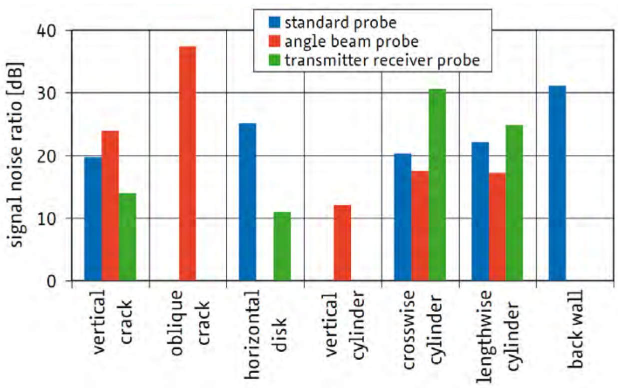
Different methods of locating and size determination are necessary depending on the type of discontinuity. In the experiment, a test block with idealised discontinuities is investigated with a normal probe, an angle beam probe and a transmitter-receiver probe (TR or dual-element probe). B-scan images of the test block are recorded with each probe and analysed. In a second series of tests, the signal-to-noise ratio for the discontinuities found is determined with each probe. Based on the results, the detectability of the discontinuity types with the individual locating methods is evaluated and their selection is discussed as regards special test tasks of practical application.

Equipment

Ultrasonic echoscope GS200	10400
2 ultrasonic probes 2 MHz	10152
Angle beam wedge 38°	10234
Transceiver delay line (TOFD)	10237
Discontinuity test block	10242
Ultrasonic gel	70200

Results

The results summarised in the diagram show that different discontinuity types require differentiated locating methods. For example, small discontinuities can only be located by the analysis of the scattering signals with the transmitter-receiver probe. From the oblique crack, one can only receive an echo signal with the angle beam probe, and from the back wall only with the normal probe. In addition, the boundaries of the modelled discontinuities become clear. So in practice, a perpendicular crack will not be detectable with the normal probe or will be substantially more difficult to detect than the saw cut in the test block intended to model such a crack.



Related experiments

PHY08 Ultrasonic B-scan
IND01 Non-Destructive Testing (NDT)
IND06 Angle beam testing
IND07 Crack depth determination (TOFD)

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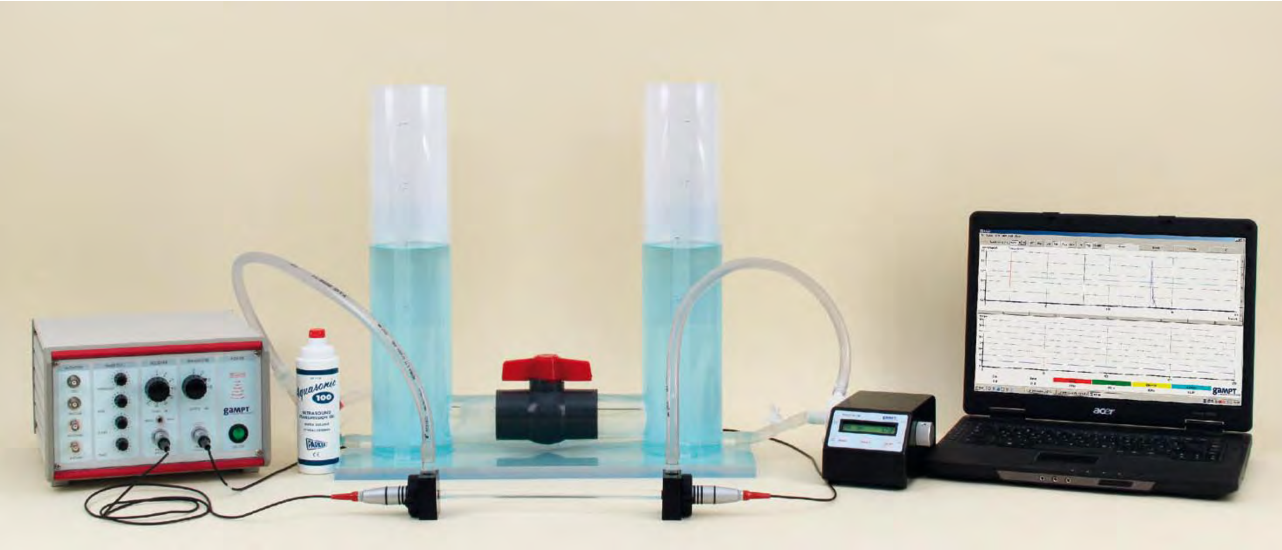
IND09 Transit time flow meter

The experiment demonstrates the carrying out of flow measurements using the ultrasonic transit time method. In this experiment, the connection between ultrasonic transit time difference in measurement with and against the flow direction and the flow velocity is determined and the volume flow is calibrated by volumetric measurement.



Related topics

Ultrasound velocity, transit time measurement, volume flow, flow velocity, transmission method, continuity equation

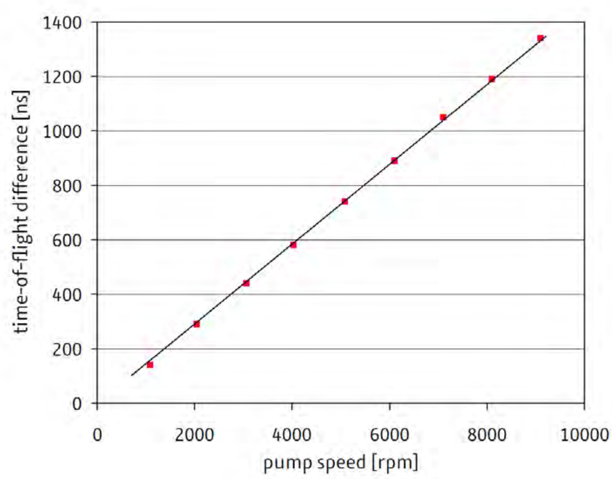
If an ultrasonic wave passes through a moving medium, the velocities of the sound wave and of the medium overlap vectorially. If the medium moves from the ultrasonic transmitter to the receiver, the velocities combine and the sound path transit time is shorter than in the medium at rest. If the medium flows from the receiver to the transmitter, the transit time is prolonged. From the transit time difference, the average flow velocity of the liquid can be calculated for a known sound velocity. The volume flow can be calculated with this.
In the experiment, the dependence of transit time and thus of the volume flow on the pump speed is calculated for a given measurement length, thus giving the device constant of the transit time flow meter. The method is suitable for any gases and liquids without them having to contain scattering particles as are necessary for the Doppler measurement.

Equipment

Ultrasonic echoscope GS200	10400
2 ultrasonic probes 2 MHz	10152
Centrifugal pump MultiFlow	50130
Double reservoir	50170
Transit time pipe	10180
Ultrasonic gel	70200
- optional oscilloscope	-

Results

The diagram shows the measured transit time difference for measurements with and against the flow direction in dependence on the pump speed.

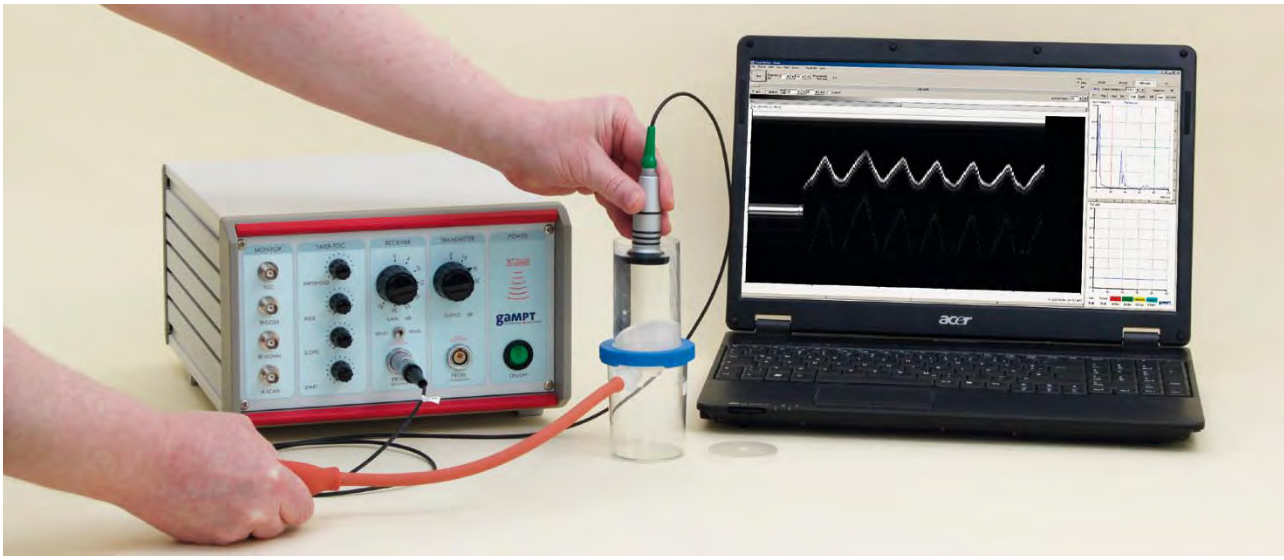


Related experiments

PHY15 Fluid mechanics
IND05 Doppler flow measurement

MED01 Ultrasonic TM-mode (echocardiography)

In the experiment, the movement of the cardiac wall is simulated with a simple heart model. This movement is examined by means of the time-motion method (TM-mode). The heart rate and the cardiac output are determined using the TM-mode recording.



Related topics

Ultrasonic echography, reflection, pulse echo method, time-motion mode, presentation of movement sequences, cardiac wall movement, echocardiography

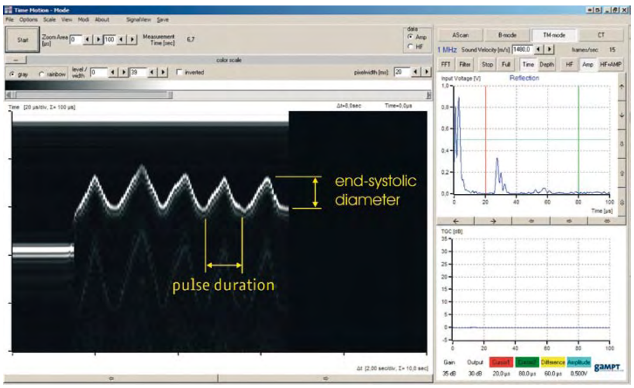
In echocardiography, the time-motion mode (TM-mode), also known as motion mode (M-mode) for short, is used to investigate movement sequences of the heart and its structures. As with a B-scan representation, the amplitudes of the ultrasonic signal echo of an A-scan are imaged on the vertical axis in grey or false colour values. The time-staggered echoes that are produced with a high pulse repetition rate are shown next to each other on a horizontal time axis. In this way a graph is produced that reproduces the movement of the examined structure over time. In the experiment, movement is produced by hand using a membrane. This simulates the periodically repeating movement of a cardiac wall or heart valve. A TM-mode image of the simulated cardiac wall movement is recorded using the measurement software. This can be analysed and evaluated as regards the characteristic quantities for the description of heart activity.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 4 MHz	10154
Heart model	10220
- optional: tripod set	10310

Results

The screen shot of the measurement software in the TM-mode shows, on the left side, the TM-mode recording of a cardiac wall movement simulated with the simple heart model. The pulse duration and the end-systolic ventricular diameter can be determined from this recording. The heart rate and the end-systolic heart volume and the cardiac output can be derived from these two values. In the case of the model, the end-diastolic volume is here assumed to be zero.

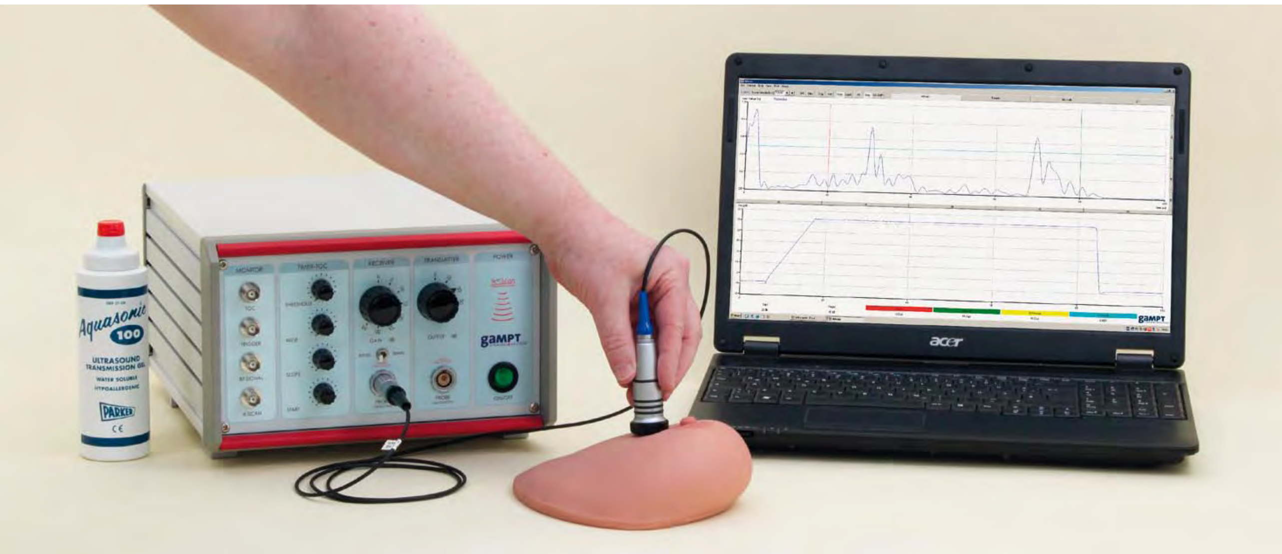


Related experiments

PHY01 Basics of pulse echo method (A-scan)
PHY08 Ultrasonic B-scan
MED03 Basics of Doppler sonography
MED05 Vascular ultrasound (angiology)

MED02 Ultrasonic imaging at breast phantom

The examination of a realistic breast phantom with tumours and their localisation and the estimation of their size in the B-scan method demonstrate a typical application of ultrasound in medical diagnostics.



Related topics

Reflection, scattering, ultrasonic imaging methods, pulse echo method, A-scan, B-scan, mammasonography, tumour size

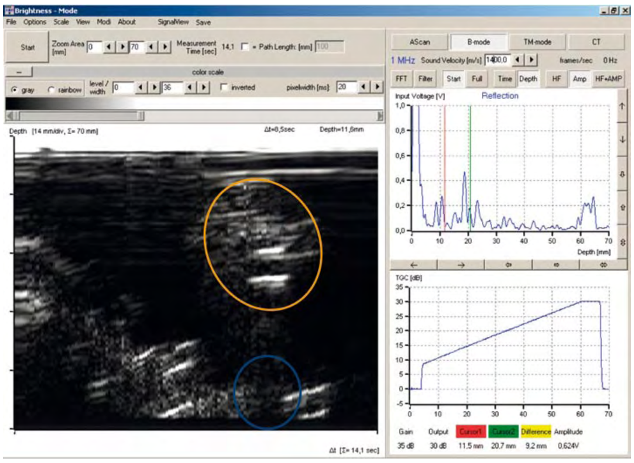
Mammasonography - the ultrasonic examination of the breast - is, together with mammography (X-ray examination) the most important imaging method for the diagnosis of benign and malignant changes in the breast tissue. It is used in the early detection of breast cancer. The strength of sonography lies in particular in the distinguishing of changes consisting of solid tissue and cavities filled with liquids (cysts). This method can be used, for example, to guide a biopsy from the breast. Immediately before an operation, the ultrasonic examination can show the exact location of the findings and thus make it possible for the physician to make a targeted intervention. In the experiment, a realistic breast model is first of all examined for any pathological changes by palpating with the fingers. The two tumours included are found during this and their approximate location is determined. The found areas are then examined with the ultrasonic probe in the A-scan mode, suitable device parameters and a suitable orientation of the ultrasonic probe are set. Using the settings found, a B-scan image of the breast model is recorded and analysed along a selected line.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 1 MHz	10151
Breast phantom	10221
Ultrasonic gel	70200

Results

The ultrasonic B-scan image recorded with the measurement software shows the tumours with an oval shape and slightly inclined axis. The attenuation in the tumour tissue is increased, causing a sound shadow on the back wall of the breast phantom.



Related experiments

PHY01 Basics of pulse echo method (A-scan)
PHY08 Ultrasonic B-scan
MED04 Biometry at the eye phantom

MED03 Basics of Doppler sonography

In the experiment, the physical and signal-theoretical basics are acquired that are necessary for blood flow examinations by means of the ultrasonic Doppler method. Using a realistic arm phantom, the dependence of the colour-coded Doppler spectra on signal amplitude, flow velocity, direction of blood flow and choice of the measuring window with the pulse Doppler method are investigated.

Related topics

Ultrasonic scattering, Doppler effect, frequency shift, directional dependence, pulse Doppler, cw Doppler, Doppler sonography, blood flow velocity

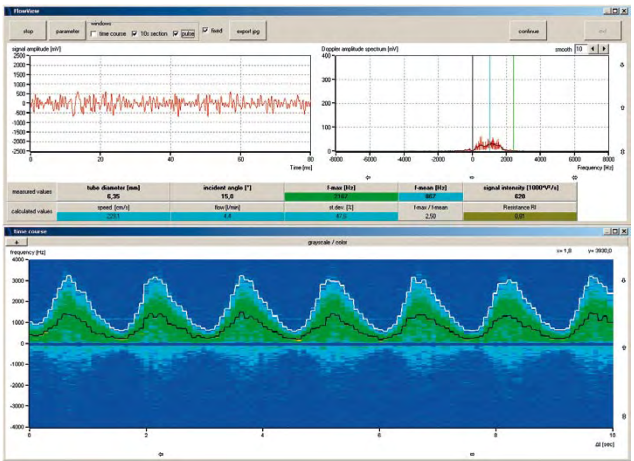
In Doppler sonography, the ultrasonic scattering signal of moving particles (here blood cells) is detected and evaluated. Due to the movement of the blood cells in relation to the ultrasonic probe the signal has a frequency shift and can thus be well separated from the signals of the more or less stationary vascular walls and organ boundary surfaces. The frequency shift is here dependent on, among other things, the direction of the blood flow and its velocity. If, in the chronological progression of the measurement (time, x-axis), the scattering intensity (signal amplitude, colour) is presented in dependence on the size of the frequency shift (velocity, y-axis), one receives the so-called Doppler spectra. These show characteristic changes in dependence on the scattering amplitude (number, size, type of blood particles), flow direction (to the probe, away the probe) and velocity of the scatterers. In addition, with a pulse Doppler, localisation of the vessel is possible by variation of the measuring window.

Equipment

Ultrasonic Doppler device FlowDop200 **NEW!**	50400
Ultrasonic Doppler probe	50435
Centrifugal pump MultiFlow	50130
Arm phantom	50160
Ultrasonic gel	70200

Results

Using the software, the signal processing of the Doppler shift raw signal (top left) using the Fourier analysis (top right) to the colour-coded Doppler frequency spectrum (bottom) is shown, and it is possible to carry out the qualitative (pulse shape) and quantitative (average and maximum frequency, signal intensity) analysis of the measurements.



Related experiments

PHY13 Ultrasonic Doppler effect
PHY15 Fluid mechanics
IND05 Doppler flow measurement
MED05 Vascular ultrasound (angiology)
MED06 Peripheral Doppler blood pressure measurement

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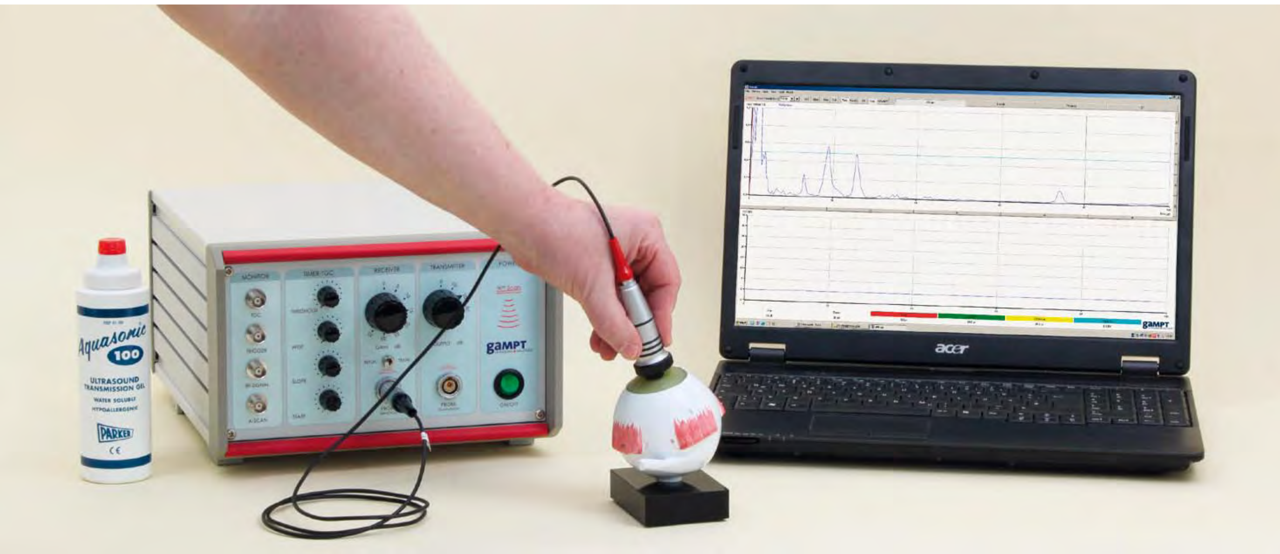
MED04 Biometry at the eye phantom

The measurement of times of flight of ultrasonic signals at an eye phantom at an enlarged scale demonstrates a typical biometric ultrasonic application based on the A-scan method in medical diagnostics in ophthalmology.



Related topics

Ultrasonic echography, pulse echo method, time of flight, sound velocity, reflection and transmission, reflection and transmission coefficient, A-scan, sonography at the eye, biometry

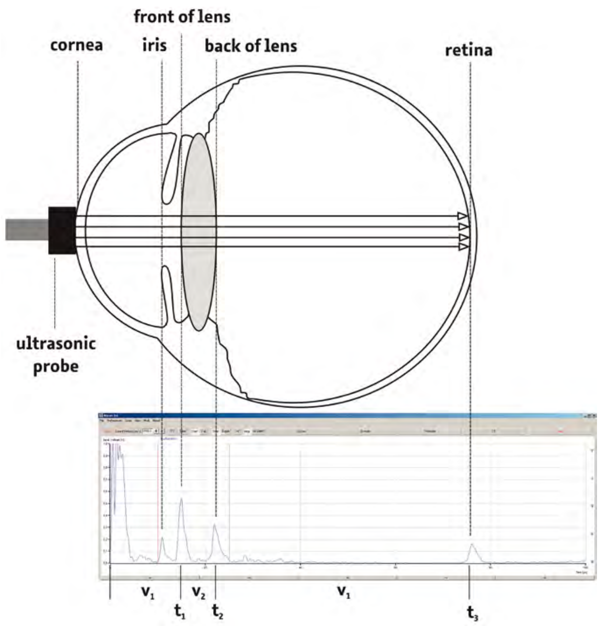
Ophthalmology is another area of medicine in which ultrasound is used. Here, ultrasound is especially important for the biometric surveying of the eye, i.e. the measurement of distances in the eye. For example, the distance between cornea and iris is very important for the calculation of the characteristics of an artificial lens, such as is implanted for patients with cataracts. Because the cornea or lens is too cloudy for optical methods, it is here necessary to use ultrasonic methods. Although new methods with laser light and the ultrasonic B-scan method are now used, time of flight measurements of the ultrasonic echoes of an A-scan at the eye offer a simple way to measure the eye. When calculating the sound paths from the measured times of flight it is to be noted that different sound velocities occur in the cornea, the lens, the vitreous humour and in the other areas of the eye. In the eye phantom provided, the sound velocity in the lens is around 2500 m/s and in the vitreous humour it is around 1410 m/s.

Equipment

Ultrasonic echoscope GS200	10400
Ultrasonic probe 2 MHz	10152
Eye phantom	10222
Ultrasonic gel	70200

Results

The illustration shows a schematic presentation of the eye phantom and an A-scan image recorded with the measurement software. The individual ultrasonic echoes are here assigned to the sites of their origin in the eye phantom.



Related experiments

PHY01 Basics of pulse echo method (A-scan)
PHY21 Reflection and transmission at boundaries
MED02 Ultrasonic imaging at breast phantom (mammasonography)

MED05 Vascular ultrasound (angiology)

The experiment demonstrates the performing of blood flow examinations by means of the ultrasonic Doppler method. The differences between continuous venous and pulsatile arterial flow are presented using a realistic arm phantom. Furthermore, the influence of a stenosis and the air chamber function on pulsatility is investigated.

Related topics

Ultrasonic scattering, frequency shift, Doppler effect, Doppler sonography, continuity equation, pulse curves, stenosis, air chamber function

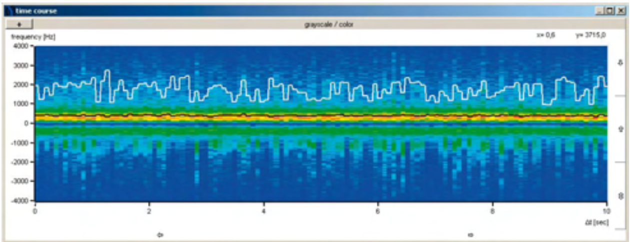
Doppler sonography is based on the effect of the frequency shift between the sent and the received ultrasonic signal in a sender-transmitter system in which transmitter and receiver are moving in relation to each other. Using the Doppler effect, moving structures, such as e.g. flowing blood, can be investigated and their relative velocities determined and visualised. In the experiment, blood flow is investigated by means of a Doppler probe at a realistic arm phantom. A narrowing of the vessels is built into the arm phantom to simulate the influence of a stenosis. In this way, differences between healthy and altered vessels can be clearly presented in the spectral image. In addition to continuous mode the pump used can also be operated in a pulsatile mode to simulate arterial blood flow. In the experiment, the influence of the stenosis and air chamber function upon pulsatility is investigated.

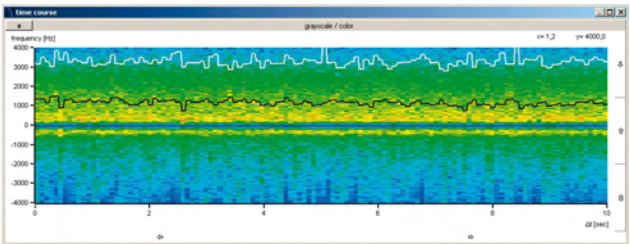
Equipment

Ultrasonic Doppler device FlowDop200	**NEW!**	50400
Ultrasonic Doppler probe		50435
Centrifugal pump MultiFlow		50130
Arm phantom		50160
Ultrasonic gel		70200

Results

The measurement software provides different windows for the analysis and visualisation of the recorded Doppler signals. The example screen shots of the measurement software show in comparison the typical Doppler spectral images for a continuous venous flow (top) and the flow in the area of a stenosis (bottom).





Related experiments

PHY13 Ultrasonic Doppler effect
PHY15 Fluid mechanics
IND05 Doppler flow measurement
MED03 Basics of Doppler sonography
MED06 Peripheral Doppler blood pressure measurement

MED06 Peripheral Doppler blood pressure measurement

The experiment demonstrates the relationship between blood pressure measurements and blood flow examinations by means of the ultrasonic Doppler method. For this, using a realistic arm phantom and a modified blood pressure cuff the vessel is loaded with defined pressure and the blood flow parameters (average and maximum frequency) are measured.

Related topics

Doppler sonography, blood flow velocity, pulse curves, indirect and non-invasive blood pressure measurement, peripheral occlusive diseases

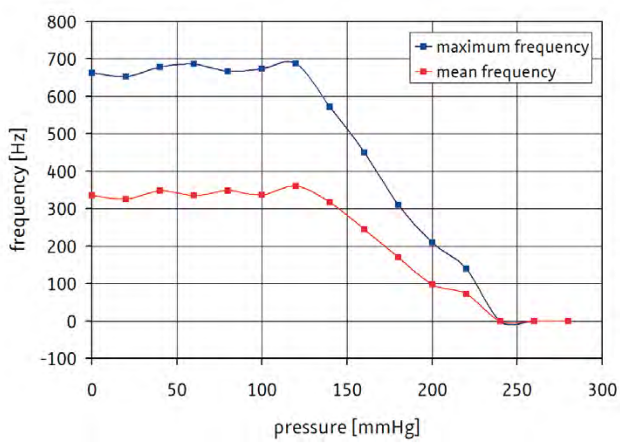
Ultrasonic Doppler methods (Doppler sonography) are the most important methods in the non-invasive diagnosis of peripheral occlusive diseases. The determination of the vascular occlusive pressure (blood pressure measurement) is performed analogously to conventional blood pressure measurement according to Riva-Roci and Korotkoff. With the Doppler method, it is, however, possible to record flow conditions quantitatively more accurately, at different vessels and also in the case of occlusions. The systolic occlusive pressure used for the diagnosis can thereby be determined substantially more accurately. The method is primarily used in the diagnosis of peripheral arterial occlusive diseases. In the experiment, the technical carrying out of the measurement and the qualitative and quantitative alteration of the blood flow curves for different occlusive pressures are investigated. With the centrifugal pump it is here possible to investigate pulsatile as well as continuous flows.

Equipment

Ultrasonic Doppler device FlowDop200 **NEW!**	50400
Ultrasonic Doppler probe	50435
Centrifugal pump MultiFlow	50130
Arm phantom	50160
Blood pressure cuff	50300
Ultrasonic gel	70200

Results

The diagram shows the dependence of the average and maximum frequency upon the pressure on the blood vessel for a stable flow velocity.

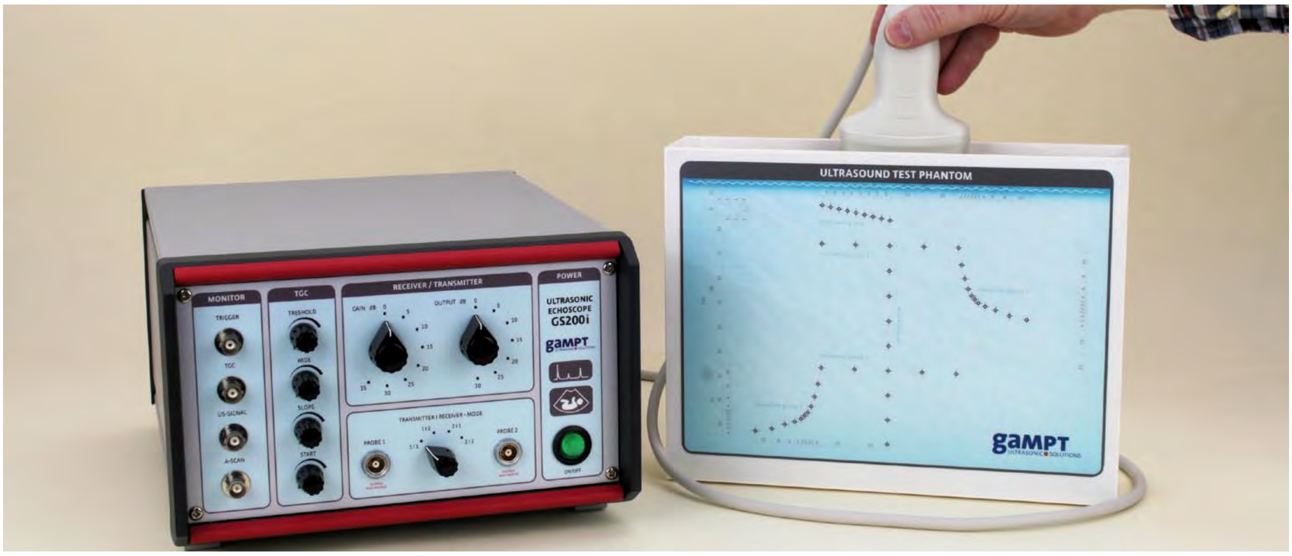


Related experiments

PHY13 Ultrasonic Doppler effect
MED03 Basics of Doppler sonography
MED05 Vascular ultrasound (angiology)

MED07 Ultrasound test phantom

In the experiment, an ultrasound test phantom is examined with a normal beam probe and / or an array probe. On the basis of bar-shaped targets, which are arranged in the form of functional groups, the accuracy and performance of the used ultrasound system is assessed in terms of resolution, dead zone and further parameters.



Related topics

Time of flight of sound, sound velocity, acoustic attenuation, sound field, reflection, A-scan, B-scan, grey tone coding, resolution, focusing, transmitting power, total gain, TGC, dynamic range, dead zone

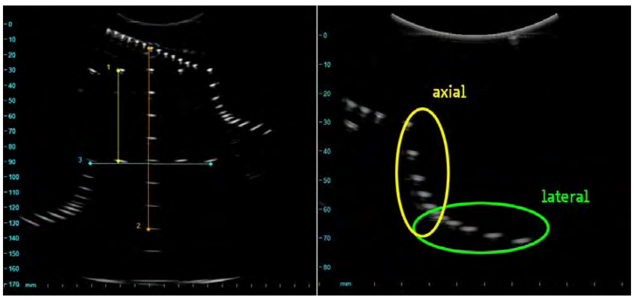
Ultrasonic test phantoms are used for quality assurance and routine check of the accuracy and performance of ultrasound imaging systems.
Such ultrasound test phantoms are also excellent test objects for introduction to two-dimensional ultrasound imaging.
The tissue-equivalent material of test phantoms for medical ultrasonic systems usually has physical characteristics which are similar to the acoustic characteristics of the human tissue. Various test structures can be embedded in the material which allow for the objective and comparable evaluation of the display characteristics of ultrasonic devices.

Equipment

Ultrasonic echoscope GS200i **or** ultrasonic B-scan device Gi210 **NEU!** (both incl. array probe)	10410 10412
Ultrasonic probe 4 MHz	10152
Ultrasound test phantom	10420

Results

GS200i: Using the the 2 MHz normal normal beam probe, A-scan and hand-guided B-scan images of the phantom are recorded. From time-of-flight measurements of the echoes of the vertical and horizontal test groups, an actual sound velocity in the phantom of approximately 1465 m/s is determined.
GS200i or Gi210: Axial distance measurements in the B-scan images taken with the array probe (left figure) show a measurement error of approximately 5% assuming a sound velocity of 1540 m/s. This value is an average of the velocities of sound in various human tissues and is used as the default in many medical ultrasound systems.



The investigation of the axial and lateral resolution test groups (right figure) shows improvements in the resolution of the measurement system as the frequency of the sound increases, and its deterioration as the depth of measurement increases.

Related experiments

PHY01 Basics of pulse echo method (A-scan)
PHY08 Ultrasound B-scan
MED08 Ultrasound fetal phantom
MED09 Mammasonography
MED10 Gallbladder ultrasound

MED08 Ultrasound fetal phantom

With the aid of the ultrasound fetal phantom, biometric measurements can be simulated, as they are carried out during a pregnancy examination. Furthermore, image artifacts are examined in the ultrasound image, which are generated by phenomena of ultrasonic propagation or by steps of signal and image processing.

Related topics

Ultrasound diagnostics, sonography, B-scan, fetometry, transmitting power, total gain, TGC, dynamic range, measurement depth, image artifacts

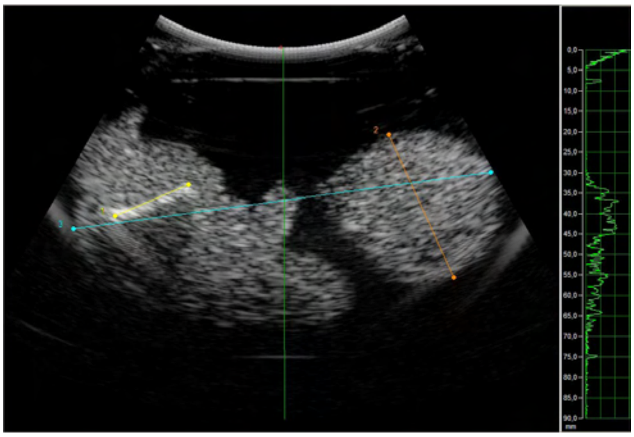
Sonographic examinations during pregnancy are standard today. In addition to assessing the position of the child and the placenta, the amount of amniotic fluid or the heartbeat, the fetus is also measured (fetometry = biometry of the fetus). Depending on the age of the fetus different biometric variables (head circumference, femur length, etc.) are determined. With the help of these quantities the age of a fetus can be estimated. If the age is known, the physician can use the measurements to assess whether the fetus has developed according to his age or whether there may be malformations or developmental delays.
In combination with the GS200i or Gi210 echoscope and a convex multi-element ultrasound probe for the abdominal region, the fundamentals of sonographic fetometry can already be mediated in pre-clinical training at GAMPT's ultrasonic fetus phantom.

Equipment

Ultrasonic echoscope GS200i or Ultrasonic B-scan device Gi210	**NEU!**	10410 10412
Ultrasound fetal phantom		10430

Results

After selecting suitable measurement parameters and the optimal setting of the ultrasound image of the fetus, this is measured. Based on the determined fetometric parameters (crown rump length: approx. 105 mm, occipitofrontal and biparietal diameter: approx. 44 mm and 30 mm, head circumference: approx. 118 mm, femur length: approx. 25 mm), the age of the fetus ist estimated to be about 17 weeks.



Below the femora, dark areas may appear in the ultrasound image. These acoustic shadows are an example of artifacts in sonograms, which must be considered in their evaluation.

Related experiments

PHY01 Basics of pulse echo method (A-scan)
PHY08 Ultrasound B-scan
MED07 Ultrasound test phantom
MED09 Mammasonography
MED10 Gallbladder ultrasound

MED09 Mammasonography

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MED10 Gallbladder ultrasound

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The Company

GAMPT

Gesellschaft für Angewandte Medizinische Physik und Technik

(Company for Applied Medical Physics and Technique)

Founded in 1998 by employees of the *Institut für Medizinische Physik und Biophysik* of Martin Luther University Halle-Wittenberg, the name **GAMPT** now stands for comprehensive expertise in the field of ultrasonic measuring technology. We design our own projects and work together with partners from business and research to find solutions. A growing network of customers and partners in Germany, Europe, Asia and the USA is a reflection of many successful collaborations.

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Based on many years of experience in supporting students in the widest variety of subject areas in physics practical work, we develop and produce equipment and experimental sets, with which clearly demonstrative training can be carried out in practical applications of ultrasonic technology in medicine, physics and materials science.

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