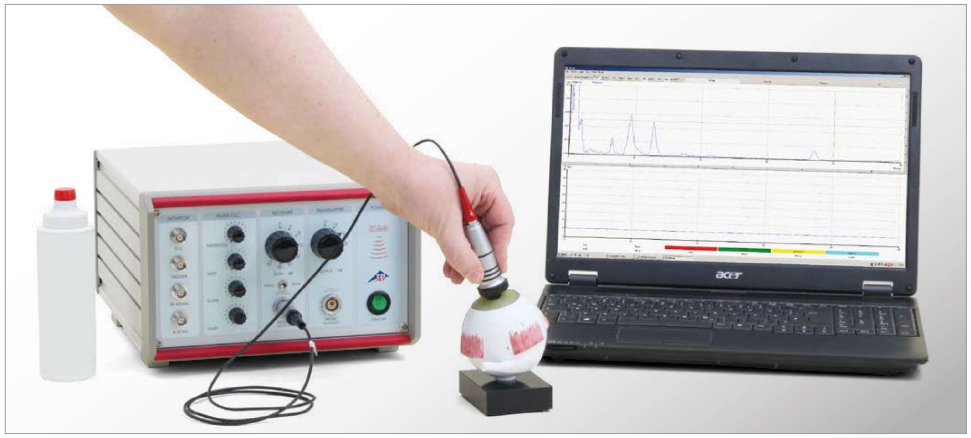
UE9020100 | ULTRASONIC BIOMETRY



EXPERIMENT PROCEDURE

- Measure the biometric ratios in the human model eye by using a pulse-echo method.
- Calculate the geometry of individual objects in the eye.

OBJECTIVE

Determining the internal dimensions in a model eye

SUMMARY

In this experiment a typical application of A-scan ultrasound biometry in medical diagnostics used in ophthalmology is given. At an eye dummy all parts of the healthy eye are measured and correction calculations shall be done.

REQUIRED APPARATUS

Quantity	Description	Item Number
1	Ultrasonic Echoscope GS200	1018616
1	Ultrasonic Probe 2MHz GS200	1018618
1	Model Eye for Ultrasonic Biometry	1012869
1	Ultrasonic Coupling Gel	1008575

BASIC PRINCIPLE

Ultrasound is used also in ophthalmology. Its largest importance lies in the area of biometry, in the measurement of distances in the eye. The distance between cornea and retina is very significant for the calculation of the characteristics of the artificial lens implanted to patients with cataract. Sonography is necessary in this case since the cornea or the lens are too cloudy for the use of optical methods. Investigations of the aqueous, vitreous humor and the thickness of the lens are nowadays often done with new methods of laser light or ultrasonic B-mode imaging.

The given measured time of flight of the echoes of the A-scan cannot be calculated as distance in a simple way, because of different velocities in the different media (cornea, lens, vitreous humor). Therefore a corrective calculation is necessary. Two velocities are given for the dummy: -lens: 2500 m/s, -humors: 1410 m/s. These values and the time of flight from the measured A-scan image shall be used to determine the distances with the help of the following equation:

(1) $$s = v\frac{\Delta t}{2}$$

In medical diagnostics "averages" are often used known from experience. This average velocity shall be calculated for the dummy with the following equation:

(2) $$v = \frac{v_1\left(t_1 + (t_3 - t_2) + v_2\,(t_2 - t_1)\right)}{t_3}$$

Ultrasonic coupling gel is used to connect the probe to the cornea of the dummy. Slowly move the probe over the cornea to look for the optimal signals (2 large lens peaks and one smaller from the retina). After measuring the time of flight of the peaks the real distances can be calculated.

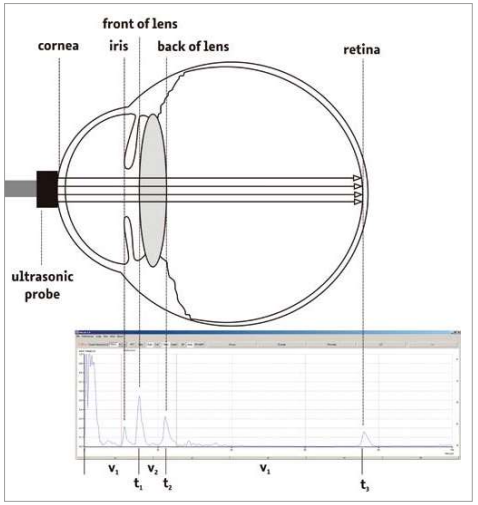


Fig. 1: A-mode image and schematic diagram of the human eye

EVALUATION

The time of flight of each peak was measured and the averaged velocity was calculated with the equation (2). The result was adjusted to the A-scan device, it was switched to the depth scale and the depth of each peak was measured.

velocities in m/s				
(aqueous/ vitreous humor)				1410 m/s
(lens)				2500 m/s
values:	**front of lens**	**back of lens**	**retina**	
time in 10^{-6} s	13.7	21.1	74.8	
average velocity				1518 m/s
measured depth in mm	11.9	15.9	42.5	
real depth in mm	9.66	18.91	56.77	
thickness/ distance in mm	9.66	9.25	37.86	