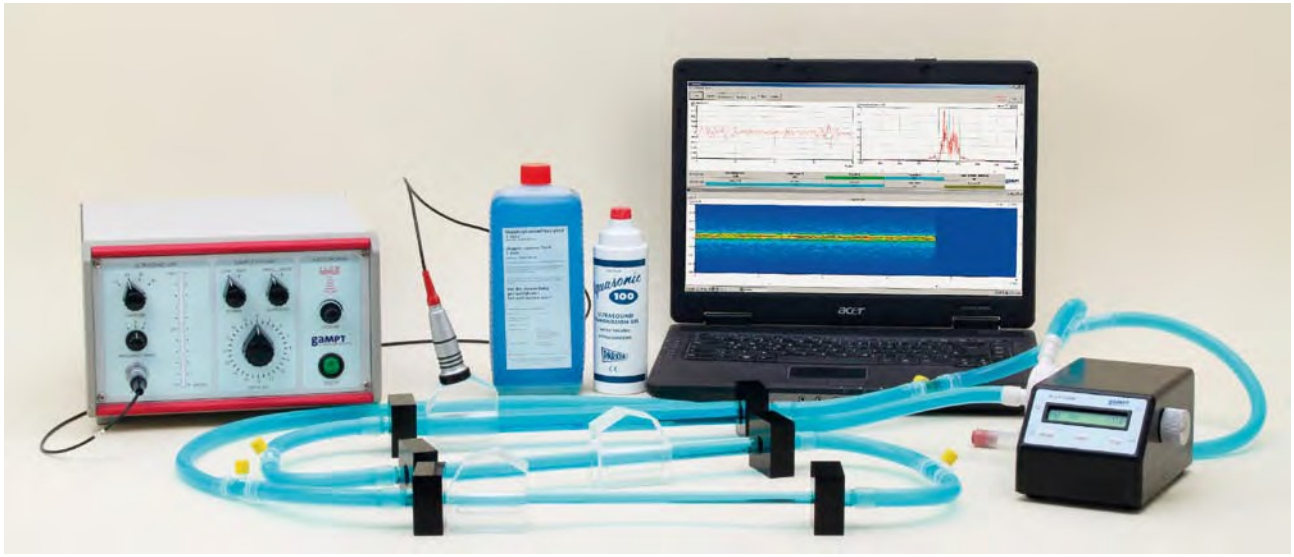
PHY13 Ultrasonic Doppler effect

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

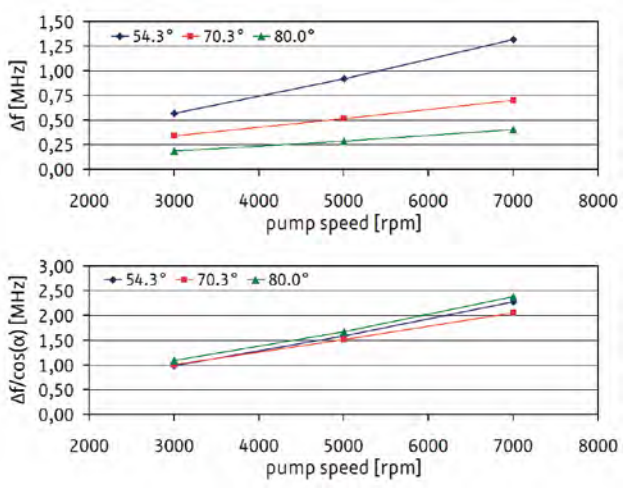
The term “Doppler effect” refers to the change in the perceived frequency of waves while the transmitter and receiver are in motion in relation to each other. This effect is used to image moving structures. For example, ultrasound can be used to determine the flow velocity and/or the flow rate of a flow 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 pulse Doppler FlowDop	50100
Ultrasonic probe 1 MHz	10131
Ultrasonic probe 2 MHz	10132
Ultrasonic probe 4 MHz	10134
Flow measuring set	50201
Centrifugal pump MultiFlow	50130
Doppler fluid	50140
Ultrasonicgel	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

GAMPT mbH · Hallesche Straße 99F · D-06217 Merseburg · Germany · Fon: +49-3461-2786910 · Fax: +49-3461-27869 1101 · www.gampt.de