Abstract

This paper is mainly devoted to a specific method of measurement data acquisition and image reconstruction called Doppler tomography (DT). It is an innovative and relatively little known method that allows imaging stationary cross sections of objects. For measurements a two-transducer continuous wave ultrasound probe is used. It is set in motion to obtain the Doppler effect.

It should be emphasized that Doppler tomography differs significantly from the well-known and described measurement of blood flow velocity in blood vessels. Both methods use an ultrasound probe and the Doppler effect, but the first one reconstructs an image of a still cross-section of an object (e.g. tissue), while the second one depicts the velocity of blood flowing in blood vessels.

The first part of the dissertation is devoted to the description of the principle of Doppler tomography. The method of image reconstruction using the selected algorithm is described in detail. Basic concepts such as Doppler signal, sinogram and others are explained. This section also presents basic simulations of image reconstruction and presents the results of imaging simulations based on the calculated measurement signal. A special custom program in the LabVIEW environment was developed to perform the simulations. It allowed to investigate the influence of DT parameters such as the number of Doppler bands on imaging quality. Necessary modifications of the method allowing for more efficient image reconstruction have also been presented. In addition, two algorithms developed for Doppler tomography that allow significant improvement of the image quality are presented. The influence of other parameters, such as frequency of ultrasound wave transmission, frequency of probe rotation or temperature of water in which the examined object is located, on the imaging quality was also examined.

The next part is devoted to reconstruction of real images of a selected object. The measurement system allowing for reconstruction of real images is presented and discussed. The construction of the ultrasound probe developed specifically for Doppler tomography is presented. Problems related to the possibilities of improving the good quality of the acquired image are also discussed.

In the last part of the paper, the direction of further research and development of the DT method is discussed with an emphasis on the introduction of necessary corrections in the already existing measurement system.