Abstract of dissertation: **Wavefront shaping with acoustic lenses**

Mgr inż. Tomasz Nowak
Promotor: prof. dr hab. inż. Andrzej Dobrucki

The doctoral dissertation presents the ongoing research on a lens that allows to control the shape of the acoustic wave front for any source. The technical solution has been described in terms of innovation in relation to similar ideas present in the literature. A geometric model describing the principle of operation was presented, numerical simulations were carried out and measurements were made in the experimental part. Additional calculations and measurements were carried out to distinguish the results into the near and far fields.

The dissertation is based on a designed sample lens for a specific isodynamic transducer, which is characterized by an approximately homogeneous velocity distribution over the entire surface of the diaphragm, making it a source of a flat acoustic wave. The task of the lens was to give the flat wavefront a specific curvature by dividing it into unit channels of different lengths, achieving a specific distribution of delays in the cells of the output matrix. The lens in the numerical model was reproduced in reality using 3D printing with high accuracy.

The thesis assumes the possibility of shaping the wavefront in two planes of the lens, 'vertical' and 'horizontal'. Simulations and measurements showed the possibility of independent influence on both. For the near field, in most cases the experimental results were consistent with numerical models, and the dissertation presents hypotheses about the reasons for discrepancies for some of the results.

Visualization of the pressure distribution in the acoustic field in the simulation part verifies the thesis directly. The results of measurements in the far field of the experimental part confirm it indirectly, by characterizing the source in terms of directivity as a function of frequency, comparing a transducer without a lens with a transducer equipped with a lens. The results obtained are not possible without achieving a curved acoustic wave front, the transducer with a lens functions in a similar way to the source in the form of a section of a pulsating ellipsoid.