Measuring 3D Velocity Vectors using the Transverse Oscillation Method

Experimentally obtained estimates of three-dimensional (3D) velocity vectors using the 3D Transverse Oscillation (TO) method are presented. The method employs a 2D transducer and synthesizes two double-oscillating fields in receive to obtain the axial, transverse, and elevation velocity components simultaneously. Experimental data are acquired using the ultrasound research scanner SARUS. The double-oscillating TO fields are investigated in an experimental scanning tank setup. The results demonstrate that the created fields only oscillate in the axial plus either the transverse or the elevation direction. Velocity measurements are conducted in an experimental flow-rig with steady flow in two different directions (mainly in x or y direction). Velocity estimates are obtained along the z axis. All three velocity components (v_x, v_y, v_z) are measured with relative biases and standard deviations (normalized to expected value) below 5% and 12%, respectively. For an expected velocity magnitude of 25.2 cm/s, the method estimates 24.4±3.1 cm/s and 25.1±1.9 cm/s for the two directions. Under similar conditions, Field II simulations yield 25.1±1.5 cm/s and 25.4±1.6 cm/s. The experimental results validate the results obtained through simulations and verify that the 3D TO method estimates the full 3D velocity vectors simultaneously as well as the correct velocity magnitudes.

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