FSM1S_12149

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Ultrasonic Travel-Time Technique for Diagnostic of Grid-Generated Turbulence

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The paper presents a summary of experimental and theoretical work conducted by authors in the area of acoustical wave propagation through turbulent media. The statistics of the travel-time variations of ultrasonic wave propagation along a path are used to determine some metrics of the turbulence. It is shown that the technique can be used to study the effect of turbulence on acoustic waves in terms of the travel time for various mean velocities and for different angular orientations of the acoustic waves with respect to the mean flow. The influence of temperature inhomogeneities on ultrasonic wave propagation is investigated using a set of experiments with a heated grid. Ultrasonic time-of-flight method is utilized to develop a semi-analytical methodology for determination of the correlation functions of turbulent velocity and sound speed fluctuations. Experimental data confirms numerical and theoretical predictions of nonlinear increase of the travel time variance with propagation distance (caustics).

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