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Measurement of Pressure Fluctuation and Pressure-Velocity Correlations in a Cavity Shear Layer by Integrating the Material Acceleration[1] XIAOFENG LIU, JOSEPH KATZ, Johns Hopkins University —
A non-intrusive measurement technique that is capable of simultaneously measuring the instantaneous velocity, material acceleration and pressure distribution over a sample area (Liu and Katz, Exp Fluids 41:227-240) has been applied to measure the pressure related turbulence statistics of a 2D cavity flow. This technique utilizes four-exposure PIV to measure the distribution of material acceleration, and integrating it by means of omni-directional virtual boundary integration algorithm to obtain the pressure distribution. Statistics characterizing the mean and turbulent flow properties within the shear layer and the cavity includes rms values of velocity and pressure fluctuations as well as triple velocity correlation terms. In most of the shear layer the fluctuating pressure is negatively correlated with the streamwise velocity fluctuation. However, as the shear layer impinging on the trailing wall of the cavity, the pressure-streamwise velocity correlation reverses its sign and becomes positive. Pressure-velocity correlations are significantly higher than the triple velocity correlation terms. PDF of pressure fluctuations show that the highest fluctuation occurs near the cavity trailing edge, and the pressure peaks agree with measured cavitation inception indices.

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