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Three dimensional velocity and pressure measurements in a turbulent shear layer behind a backward-facing step.[1] KARUNA AGARWAL, OMRI RAM, JIN WANG, YUHUI LU, JOSEPH KATZ, Johns Hopkins University — This study characterizes the unsteady pressure field generated by quasi-streamwise vortices that develop between the main spanwise vortices in the near field of a shear layer behind a backward facing step. Our objective is to understand cavitation inception, which occurs in the core of quasi-streamwise vortices located between 45 to 75% of the reattachment length forming 1-2 mm wide and 5-7 mm long cavities. Tomographic imaging followed by 3D particle tracking using the Shake-the-Box method is used for calculating the instantaneous velocity and acceleration fields. These results are interpolated using singular value decomposition, and then refined using Constrained Cost Minimization to generate divergence free velocity and curl-free material acceleration at a spatial resolution of 250 m. The pressure is obtained by spatially integrating the material acceleration. The measurements are performed at Reynolds numbers based on separating boundary layer height Re=7100 and 17700. Analysis examines the effects of Re on the frequency, time evolution, size, strength and the pressure in the quasi streamwise vortices. The preferential location of pressure minima moves from the spanwise vortices at low Re to the quasi-streamwise structures at the higher Re.

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