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Reynolds number effects on pressure fluctuations and cavitation inception in a turbulent shear layer KARUNA AGARWAL, OMRI RAM, JIN WANG, YUHUI LU, JOSEPH KATZ, Johns Hopkins University — Cavitation inception in turbulent shear layers occurs in quasi streamwise vortices located between the primary spanwise structures, and the cavitation inception indices increase with the Reynolds number. To investigate these phenomena, we measure the pressure distributions in these vortices and the flow mechanisms involved. The experiments are performed behind a backward facing step at Reynolds numbers based on step height and freestream velocity of $1.6\text{x}10^4$ and $5.8\text{x}10^4$. Tomographic imaging and 3D particle tracking in a volume of 12.5x7.5x4.5 mm^3 provides the 3D time-resolved velocity distributions. Data are interpolated by constrained cost minimization to obtain divergence free velocity and curl-free material acceleration fields at a resolution of 200μm. The pressure is calculated by spatially integrating the material acceleration. The appearance of the intermittent quasi-streamwise structures agrees with that of the cavitation. The minimum pressure coefficients are lower than -0.3, and they last longer than the cavity growth times scales. Statistical analysis shows that with increasing Reynolds number, the pressure minima are more preferentially located within the quasi streamwise vortices, persist for longer durations, and are more strongly correlated with vortex stretching.

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