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Effects of vortical motions on turbulence scalar transport in a turbulent channel flow SURANGA DHARMARATHNE, Texas Tech University, MURAT TUTKUN, Institute for Energy Technology, RONALD ADRIAN, Arizona State University, LUCIANO CASTILLO, Texas Tech University — Direct numerical simulations of a turbulent channel flow at Reynolds number, $Re_\tau = 394$, (based on friction velocity and channel half height) were carried out to investigate the relationship between coherent vortices and turbulence scalar transport. Previous observations from three-dimensional two-point correlations of streamwise velocity fluctuations (u) and scalar fluctuations (θ) suggest that three-dimensional iso-surfaces of correlations are distinctively different in all regions of the turbulent channel. Hence, it can be hypothesized that the scalars are more attracted to vortical structures of the flow and the velocity fluctuations reside in low-momentum regions induced by hairpin packets or vortex clusters. In order to test this, we first employ vortex identification methods (λ_2, λ_{ci}, and $Q-$ criterion) to capture the regions of high vortical activity. Then the three-dimensional correlations between scalar fluctuations and extracted vortices are computed to investigate the validity of the hypothesis. Behavior of the streamwise component of fluctuating flux term ($u\theta$) and the wall-normal component of fluctuating flux term ($v\theta$) are studied to quantify the relation between scalar fluxes and vortices.

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