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Very large-scale motions in a turbulent boundary layer[1] HYUNG JIN SUNG, JAE HWA LEE, KAIST — Direct numerical simulation of a turbulent boundary layer with Re_θ=2560 was performed to investigate the spatially coherent structures associated with very large-scale motions (VLSMs). Inspection of the three-dimensional instantaneous fields showed that groups of hairpin vortices are coherently arranged in the streamwise direction and that these groups create significantly elongated low- and high-momentum regions with large amounts of Reynolds shear stress. Adjacent packet-type structures combine to form the VLSMs; this formation process is attributed to continuous stretching of the hairpins, coupled with lifting-up and backward curling of the vortices. We employed the modified feature extraction algorithm to identify the properties of the VLSMs of hairpin vortices. Patches with lengths greater than $3\sim4\delta$ account for more than 40% of all the patches and these VLSMs contribute approximately 45% of the total Reynolds shear stress. Finally, the application of linear stochastic estimation to the conditionally averaged flow field demonstrated the presence of packet organization in the form of a train of packets in the logarithmic layer.

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Hyung Jin Sung
KAIST

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