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Vortical structures in a flume R. GURKA, Dept. of Mech. and Mat. Engr., Univ. of Western Ontario, A. LIBERZON, Inst. of Hydromechanics and Water Resources Mgmt., ETH Zurich, Switzerland, G. HETSRONI, Faculty of Mech. Engr., Technion, Israel — We report the results of statistical spatial characterization of coherent structures in turbulent boundary layer in a flume. The characterization approach is based on the proper orthogonal decomposition (POD) of vorticity, elucidating large-scale coherent patterns in a turbulent boundary layer. The method was successfully applied to the two- and three-dimensional experimental data extracted from particle image velocimetry (PIV), and multi-plane stereoscopic PIV (XPIV) respectively, and the three-dimensional data from direct numerical simulation (DNS) in a channel flow. The large-scale structure was obtained by using linear combination of POD eigenmodes of vorticity. POD allows for methodological analysis of the properties of the educed structure in the different measurement planes (orthogonal in the case of 2D PIV and parallel in the case of XPIV) and in the different cross-sections of the DNS data. Based on the statistical approach we suggest a conceptual model of large-scale coherent structures in a turbulent boundary layer flow that incorporates the experimental and the numerical results. The proposed conceptual model is a spiral vortical structure attached to the wall and expanding in both the spanwise and the wall-normal directions. Its shape resembles a funnel structure and a 'double-cone eddy' concept. The relationship of the model to the structures in the near wall region is presented.

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