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Dynamics of large-scale coherent structures in developing and fully developed channel flow over a rough wall KYOUNGSIK CHANG, Hanseo University, GEORGE CONSTANTINESCU, University of Iowa — LES of fully developed and developing channel flow are conducted to study the formation and structure of the streaks for the case when the rough bed consists of an array of identical sinusoidal waves with an amplitude of 0.1λ, where λ is the wave wavelength. The channel depth is λ, its width is 10λ and the channel Reynolds number is 6,700. Consistent with experimental investigations, the average spanwise spacing of the streaks predicted by LES is close to 1.5λ in the case of a fully developed flow. A developing channel flow simulation with steady inflow conditions reveals the streaks form as a result of the break up of the quasi two-dimensional spanwise-oriented eddies forming in the shear layers past the crests of the first waves into arrays of pronounced hairpin vortices. These hairpins scale with the size of the waves which is of the order of the channel depth. Streaks are observed starting in the region where the flow transitions to turbulent. In average, the streaks become larger as one moves downstream until fully developed conditions are reached.

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