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Spatial characteristics of secondary flow in a turbulent boundary layer over longitudinal surface roughness[1] HYEON GYU HWANG, JAE HWA LEE, Ulsan Natl Inst of Sci Tech — Direct numerical simulations of turbulent boundary layers (TBLs) over spanwise heterogeneous surface roughness are performed to investigate the characteristics of secondary flow. The longitudinal surface roughness, which features lateral change in bed elevation, is described by immersed boundary method. The Reynolds number based on the momentum thickness is varied in the range of Re_θ =300-900. As the TBLs over the roughness elements spatially develop in the streamwise direction, a secondary flow emerges in a form of counter-rotating vortex pair. As the spanwise spacing between the roughness elements and roughness width vary, it is shown that the size of the secondary flow is determined by the valley width between the roughness elements. In addition, the strength of the secondary flow is mostly affected by the spanwise distance between the cores of the secondary flow. Analysis of the Reynolds-averaged turbulent kinetic energy transport equation reveals that the energy redistribution terms in the TBLs over-the ridge type roughness play an important role to derive low-momentum pathways with upward motion over the roughness crest, contrary to the previous observation with the strip-type roughness.

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