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Correlation of Near-Wall Turbulence Structures with Heat Transfer in Ribbed-Pipe Flow[1] HYUNGSU AHN, CHANGWOO KANG, KYUNGSOO YANG, DOOHYUN PARK, Inha University — Ribbed-pipe flow is one of the most commonly used flow configurations to enhance heat transfer, albeit, at the expense of increased pressure drop. The ribs mounted on the pipe wall differently alter the flow depending on the pitch, the distance between two neighboring ribs. When the pitch is short, fluid is trapped inside grooves, resulting in a low heat-transfer rate. When the pitch is long enough, however, the ribs disturb the flow by shedding vortices, resulting in heat-transfer enhancement. We aim at elucidating the correlation of near-wall turbulence induced by the shed vortices with the increased heat-transfer rate on the ribbed-pipe wall. Our analysis is based on our LES data base obtained for Re=24,000, Pr=0.71, PR(pitch ratio)=2, 4, 6, 8, 10, 18, BR(blockage ratio)=0.0625. Here, the bulk velocity and the pipe diameter are used as the velocity and length scales, respectively. Our presentation focuses on the near-wall distributions of the higher-order turbulence statistics including but not limited to rms of temperature fluctuation, cross-correlations, rms of vorticity, and turbulent heat fluxes. Octants and JPDF are also presented in order to clarify the prevailing heat-transfer mechanism in the immediate vicinity of the ribbed-pipe wall.

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