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Wall-resolved LES and RANS/LES hybrid analyses in turbulent heat exchanger with modified oblique wavy walls KENICHI MORIMOTO, SHU-QUN JIN, JUNYU CHEN, The University of Tokyo — High-performance turbulent heat exchangers play a key role in diversified energy systems/devices. In our recent work, double-pipe turbulent heat exchangers with V-shaped oblique wavy walls, with which the ratio of the heat transfer to the pressure loss is much larger than that for conventional techniques, have been proposed. The present study aims to clarify the detailed mechanism of the turbulent heat transfer enhancement, and to explore a practical numerical approach to deal with turbulence anisotropy and unsteady flow separation at high Reynolds number condition. Here we perform wall-resolved large eddy simulations based on dynamic sigma model in which a dynamic procedure is originally applied to both the velocity and thermal fields. Also we perform improved delayed detached eddy simulation (IDDES) with k-ω SST model as a near-wall model. It is shown that, with the present wall undulations, large-scale vortical structures are embedded in a steady manner inside the turbulent boundary layer, leading to remarkable enhancement of the heat transfer performance. The global and local quantities as well as turbulent statistics are compared between RANS, LES and hybrid approaches. The feasibility of RANS/LES hybrid approach is explored for further shape-optimization study.

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