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**Adoint-based shape optimization of heat transfer surface in turbulent flows with DNS-based eddy viscosity & diffusivity** YUKINORI KAMETANI, YOSUKE HASEGAWA, Institute of Industrial Science, Univ. of Tokyo — A new adjoint-based shape optimization algorithm for turbulent heat transfer problem is proposed. In this algorithm, direct numerical simulation (DNS) of relevant velocity and thermal fields is first conducted. Based on the statistics obtained from DNS, the spatial distribution of the eddy viscosity and the eddy diffusivity are determined so as to reproduce the local productions of turbulent kinetic energy and temperature fluctuation, respectively. Then the Reynolds-averaged Navier-Stokes (RANS) equations are constructed with the eddy viscosity and the eddy diffusivity obtained from DNS, and their adjoint equations are derived to achieve shape optimization. For validation, the present algorithm is applied to a wavy fin between two parallel walls under the conditions of a constant mean pressure gradient and uniform heating in fluid. A cost functional is consist of a bulk velocity and a bulk temperature for drag reduction and heat transfer enhancement, respectively. First, it is confirmed that the RANS simulation with the current DNS-based eddy viscosity and diffusivity can reproduce the mean velocity and temperature fields. It is found that the shape optimization is successfully achieved. In the obtained optimal shape, heat transfer is enhanced by the increase of heat transfer area near the reattachment and circulation region of the separated flow behind the wave crest. Meanwhile, pressure drag is reduced by holes near the channel walls which reduce the cross-sectional area in the streamwise direction.

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