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WALL-RESOLVED AND WALL-MODELED ILES BASED ON HIGH-ORDER DG METHODS

Ralf Hartmann[1]

[1] DLR, Lilienthalplatz 7, 38108 Braunschweig, Ralf.Hartmann@dlr.de,
http://www.dlr.de/as

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Wall-resolved Large Eddy Simulations (LES) are feasible for small and moderate Reynolds numbers but become computationally expensive if the Reynolds number is too high. In that case wall-modeling must be introduced such that the inner boundary layer (up to 20% of the boundary layer thickness, $y \leq 0.2\delta$) is modeled and the remaining part ($y > 0.2\delta$, including the output boundary layer) is resolved[1].

The wall-modeled LES approach chosen in this work is based on a wall-stress prescribing boundary condition. In particular, the noslip boundary condition is replaced by a slip-wall boundary condition and the freedom gained is used to prescribe the wall shear stress in the viscous boundary flux. The wall shear stress imposed is determined by solving the near-wall velocity profile $u^+(y^+)$ for y^+ with flow data taken from 20% of the boundary layer thickness off the wall where we expect the flow field still to be resolved.

In this talk we discuss various versions of such wall-stress prescribing boundary conditions. Furthermore, a wall-stress model based on an approximate near-wall velocity profile (the Reichardt's function) will be compared to a wall-stress model based on the exact near-wall velocity profile (as extracted from existing DNS results). This allows to separate the error introduced by the wall-stress prescribing boundary condition from the error introduced by the (in general only approximate) near-wall velocity profile. Computed with high-order Discontinuous Galerkin (DG) methods we will compare wall-modeled implicit LES (ILES) results with wall-resolved ILES results (cf. Figure 1), and discuss problems and possible limitations of the approach chosen.

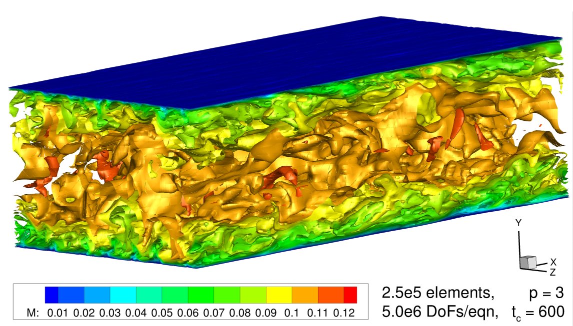

Figure 1: Channel: Mach number isosurfaces.

REFERENCES

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