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IMPLICIT DISCONTINUOUS GALERKIN METHOD FOR THE EFFICIENT SCALE RESOLVING SIMULATION OF COMPRESSIBLE TURBULENT FLOWS

F. Bassi[1], A. Colombo[2], A. Crivellini[3], F. Massa[2]

[1] University of Bergamo (retired Professor), francesco.bassi@unibg.it
[2] University of Bergamo, Department of Engineering and Applied Sciences,
viale Marconi, 5 - 24044 Dalmine (BG), Italy
{alessandro.colombo, francescocarlo.massa}@unibg.it
[3] Marche Polytechnic University,
Department of Industrial Engineering and Mathematical Science,
via Brecce Bianche, 12 - 60131, Ancona, Italy
a.crivellini@staff.univpm.it

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In this work a high-order Discontinuous Galerkin (DG) solver is employed for the scale resolving simulation of compressible turbulent flows. The underlying numerical method uses an exact Riemann solver for the evaluation of convective numerical fluxes and the Bassi-Rebay (BR2) method for the treatment of the diffusive terms. As the turnaround time of scale-resolving simulations is high and robustness can be an issue, implicit time integration schemes are certainly an appealing option. For this reason, the spatially discretised set of equations is here integrated in time by means of high-order linearly implicit Rosenbrock-type Runge-Kutta schemes. Such schemes entail the assembly of the implicit operator only once per time-step, the solution of a single linear system at each stage, and can be designed to get optimal stability properties, thus preventing severe time-step restrictions. With the purpose of improving the linear system solution process, also reducing the memory footprint of the solver, we investigate the use of a p-multigrid preconditioner coupled with a matrix-free iterative FGMRES solver [1].

The performance of the DG method will be thoroughly assessed by considering the Direct Numerical Simulation (DNS) of the channel flow at $\mathrm{Re}_\tau = 180$ and of the zero-pressure-gradient turbulent boundary layer (TBL) over a flat plate. Scale resolving simulations for the TBL over a smooth backward facing step featuring incipient separation, a test case part of the HORIZON2020 HiFi-TURB project (GA 814837) suite, will be also presented.

REFERENCES

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