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A p-ADAPTIVE IMPLICIT DISCONTINUOUS GALERKIN METHOD FOR THE UNDER-RESOLVED SIMULATION OF COMPRESSIBLE TURBULENT FLOWS

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In the last decades Computational Fluid Dynamics (CFD) has become a widespread practice in several industrial fields, *e.g.*, aerodynamics, aeroacoustic. The growing need of high-fidelity flow simulations for the accurate determination of problem-specific quantities paved the way to higher-order methods such as the Discontinuous Galerkin (DG) method. The interest of the scientific community in high-order solvers is confirmed by the EU Horizon 2020 project TILDA (Towards Industrial LES/DNS in Aeronautics - Paving the Way for Future Accurate CFD), (`http://cordis.europa.eu/project/rcn/193362_en.html`), which aims at combining advanced high-order numerical schemes and innovative approaches to the simulation of turbulence with high performance computing. In this context we exploit the attractive feature of DG methods to locally vary the polynomial degree of the solution over the mesh (p-adaptation), to obtain a significant reduction of the simulation CPU time and memory, while not spoiling at all the high accuracy needed by Direct Numerical Simulation and (DNS) and Large Eddy Simulation (LES). Adaptation is here driven by simple indicators. In particular, two different sensors, one based on interface pressure jumps and the other on the decay of the coefficients of the modal expansion, are considered and combined to guarantee a reasonable behaviour both for high- and low-degree polynomial approximations. Moreover, the degree of exactness of quadrature rules is adapted on the computational domain to avoid over-integration of straight-sided elements. Runtime load-balancing relies on the re-partitioning of the computational grid and it exploits the ability of the Metis library to generate "weighted" graphs. The accuracy and efficiency of our approach will be assessed by computing, with linearly implicit time-accurate integration schemes, the implicit LES (ILES) of the flow around the NACA0018 airfoil at different angles of attack.

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