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INVESTIGATION OF ADAPTIVE TIME-STEP STRATEGIES FOR HIGH-ORDER ACCURATE TURBULENT SIMULATIONS

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Adaptive time-step algorithms can improve considerably the effectiveness of unsteady flow computations. Several adaptive time-step strategies are available in the literature but in all cases conservative time-step choices (small time steps) lead to a large number of time integration steps, while aggressive time-step choices (large time steps) lead to a large number of rejected time integration steps, and in both cases the efficiency and/or robustness of the adaptive strategy may be far from optimal. An appropriate adaptive strategy should instead guarantee both robustness (small-number of rejected time integration steps) and efficiency (small-number of time-integration steps for a given accuracy).

In this work several adaptive time-step strategies have been adopted for the numerical solution of the unsteady incompressible Navier-Stokes and Reynolds-Averaged Navier-Stoke equations based on a high-order accurate discontinuous Galerkin space discretization. Three different classes of time integration methods have been considered, the linearly implicit Rosenbrock-type Runge-Kutta schemes [2], linearly implicit Rosenbrock-type two-step peer schemes [1] and ESDIRK schemes [2]. In order to assess the method for a DAE system of increasing stiffness, we will present the results obtained for the unsteady laminar or turbulent flow around a circular cylinder at different Reynolds numbers ranging from $\mathrm{Re} = 100$ to $\mathrm{Re} = 5 \times 10^4$. We will show that very significant gains in robustness and efficiency can be obtained, especially for high Reynolds turbulent flow computations.

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