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HIGH-ORDER DG SOLUTIONS OF SEPARATING AND REATTACHING FLOWS

Andrea Cimarelli, Matteo Franciolini and Andrea Crivellini*

DIISM, Università Politecnica delle Marche, 60131, Ancona, Italy

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One of the main feature of separating and reattaching flows is the combined presence of small scales due to the occurrence of turbulence and large scales due to phenomena of shedding of large-scale vortices. These phenomena nonlinear interact themselves giving rise to a self-sustained cycle. Two main large-scale unsteadinesses are recognized: the shedding of vortices from the leading-edge shear layer and the low-frequency flapping mode of the recirculating region [1]. To understand the nature of these two phenomena, we performed different numerical experiments where the mechanisms at the basis of these two unsteadinesses are systematically removed by the boundary conditions. In particular, we simulate the flow around a rectangular cylinder (*run1*), the flow around an infinite plate with right-angled (*run2*) and circular (*run3*) leading-edge corners. This last case has been simulated also by considering only the top flow domain (*run4*). By comparing *run1* and *run2* we study the coupling between the shedding of vortices from the leading-edge with the shedding in the wake. On the other hand, by comparing *run2* and *run3* we analyse the role of the leading-edge geometry on the shedding unsteadiness. Finally, by comparing *run3* and *run4* we aim at understanding the role of the low-frequency unsteadiness on connecting the top and bottom flow. An implicit LES approach is used to simulate the incompressible flows at a Reynolds number of the order of $3 \cdot 10^3$. The numerics is based on a Discontinuous Galerkin method seventh order accurate in space and on a Linearly-implicit Rosenbrock-type Runge-Kutta scheme third order accurate in time [2]. This approach leads, particularly at large polynomial approximations, to the parallel solution of large and sparse linear system. To reduce the CPU and memory requirements, a solution strategy based on a Newton-Krylov algorithm using a p-multigrid preconditioner coupled to a flexible matrix-free GMRES linear solver is successfully used.

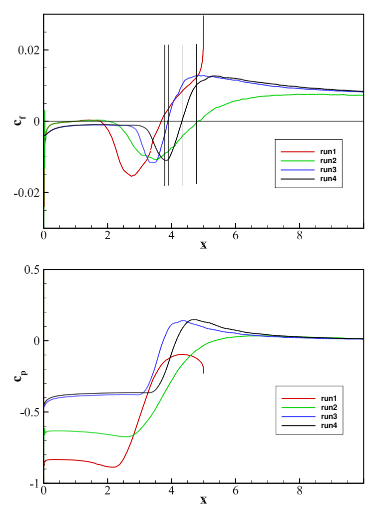

Figure 1: Friction (top) and pressure (bottom) coefficients.

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