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PARALLEL ADAPTIVE MESH REFINEMENT OF TURBULENT FLOW AROUND SIMPLIFIED CAR MODEL USING AN IMMERSE BOUNDARY METHOD

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In the present work, a parallel adaptive mesh refinement (AMR) strategy for large-eddy simulations (LES) is proposed and tested for a fully 3D geometry: turbulent flow over an Ahmed car. This simplified geometry reproduce the basic fluid dynamics features of real cars, i.e. vortex shedding, flow reattachment and recirculation bubbles. The underlying discretization of the Navier-Stokes equations is based on a finite-volume symmetry-preserving formulation, with the aim of preserving the symmetry properties of the continuous differential operators to ensure stability and conservation of kinetic-energy balance [1]. Our AMR scheme applies a cell-based refinement technique [2, 3], with a physics-based refinement criteria based on the variational multi-scale(VMS) decomposition theory and an equalized histogram of the vorticity field. This strategy has been tested in other turbulent problems around bluff bodies in 2D and 3D [4, 5]. To carry out the simulation of turbulent flow around complex geometries with AMR, an immerse boundary method is implemented based on a finite volume approach [6]. Finally, the robustness and accuracy of our methodology is shown on the numerical simulation of the turbulent flow over an Ahmed car at $Re_h = 7.68 \cdot 10^5$ (Figs. 1 and 2) [7, 8].

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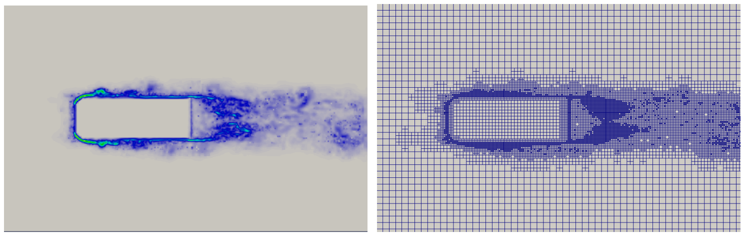
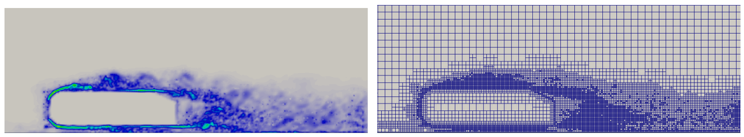


top view



side view

Figure 1: Illustration LES of turbulent flow over an Ahmed car at $Re_h = 7.68 \cdot 10^5$ (left)Vorticity structures (right) computational grid.

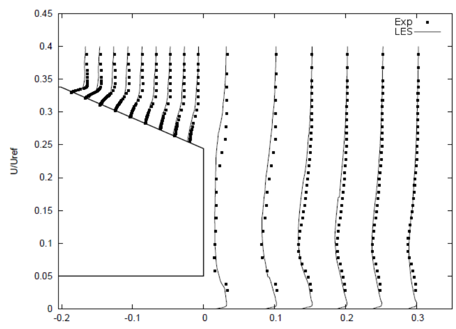


Figure 2: Preliminary results for the mean streamwise velocity profiles in the symmetry plane

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