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Vortex Identification around Ahmed body in turbulent flows

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ABSTRACT

A vortex is intuitively described as the rotational/swirling motion of fluids. In the last three decades, many vortex identification methods have been proposed. In this study the λ-method, Q-method, Δ-method, swirling method and swirling enhanced methods has been employed for vortex identification around an Ahmed body in turbulent flows. Each method has been presented mathematically and investigated for an Ahmed body with multiple angle configurations. These methods have been deployed to analyse large coherent structures in the flow around an Ahmed body using OpenFOAM. Vortices in three-dimensional and turbulent wakes are detected through the use of this different vortex identification methods. A LES turbulence Smagorinsky model was selected with transient pisoFOAM solver with inlet velocity of 40m/s. The mesh was done using cartesianMesh in Openfoam controlling the element size to return a good y+ value and also visible vortex. The minimum element size used was 5 mm(refinement around the Ahmed Body) and the max size was 150mm.The vortex properties of main lateral vortices are identified and discussed on the basis of structure detected by each method. The flow is highly turbulent, the three-dimensional and complex velocity profiles with y^+ values around the Ahmed body are presented and discussed. The three-dimensional vortex visualization is presented using isosurface techniques and discussed for each method. Furthermore, each different angle configuration is completed and validated with existing experimental results with respect to drag (C_d) and lift (C_l) coefficients. After running pisoFoam, some vortex was formed in already known areas (the eddies of the rear part of an Ahmed body) and some of them behind the ahmed body that is going to be discussed in this document. the location and also the propagation in time is going to be presented.