Aerodynamic Pitching Stability of Sedan-type Vehicles Influenced by Pillar-shape Configurations

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ABSTRACT

The present study investigated the aerodynamic pitching stability of sedan-type vehicles under the influence of A- and C-pillar geometrical configurations. The numerical method used for the investigation is based on the Large Eddy Simulation (LES) method. Whilst, the Arbitrary Lagrangian-Eulerian (ALE) method was employed to realize the prescribed pitching oscillation of vehicles during dynamic pitching and fluid flow coupled simulations. The trailing vortices that shed from the A-pillar and C-pillar edges produced the opposite tendencies on how they affect the aerodynamic pitching stability of vehicles. In particular, the vortex shed from the A-pillar edge tended to enhance the pitching oscillation of vehicle, while the vortex shed from the C-pillar edge tended to suppress it. Hence, the vehicle with rounded A-pillar and angular C-pillar exhibited a higher aerodynamic damping than the vehicle with the opposite A- and C-pillars configurations. The underlying aerodynamic damping mechanism has been verified through flow visualization of phase-averaged results.