Wake control of a 3D bluff body

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Abstract
Bluff bodies are characterized by massive flow separation responsible of most of the pressure drag. Three main contributions roughly determine the total amount of the body drag : 30% is due to the rolling tire, 45% derive from the rear base and 25% comes from the underbody flow and interferences. In the case of large and medium size trucks employed for short and long distance of transportations the fuel consumption can be considerable reduced through the control of the flow separation from the base. The afterbody geometry plays a key role for the drag contributions as showed by Ahmed [1]. Aider et al. [2] used passive vortex generators while piezoelectric vortex generators were investigated by Orazi et al. [3]. Continuous blowing slots as done by Rouméas et al. [4] have been also used on a semi-infinite body. The present investigation considers a simplified 3D car with square-back rear shape. The wake control consist in the injection of continuous jets through four rectangular slots mounted around the perimeter of the rear part. Furthermore, four curved slots are disposed near the wheel to control the flow separation in this region. The flow analysis is performed by means of CFD commercial code (STAR CCM+® by Cd-Adapco). Results of this preliminary investigation will be presented. The effects of the independent rear slots orientation (φ_i) and of the jet velocity (V_i) are analyzed as well as the effects of the jets around the wheels. The study will be also carry out on a physical model that will be tested in a wind tunnel. In figure 1 the expanded model and a portion of the longitudinal section of the rear part of the body are shown.

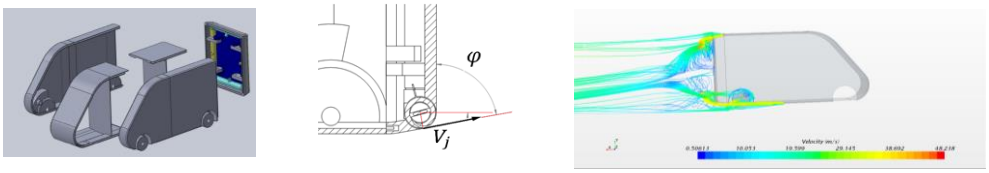

Figure 1. Expanded model and longitudinal section of the rear part of the body.

According to the jet orientation and to the jet momentum the wake structure assume two typical configurations namely a strucure with streamwise vortices characterized by high drag and a structure with a toroidal vortex attached to the base characterized by low drag.

References

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