8th. World Congress on Computational Mechanics (WCCM8)
5th European Congress on Computational Methods in Applied Sciences and Engineeering
(ECCOMAS 2008)
June 30 –July 5, 2008
Venice, Italy

CROSSWIND EFFECTS AROUND A SIMPLIFIED CAR BY DETACHED EDDY SIMULATION

E. Guilmineau[1], O. Chikhaoui[1], G.B. Deng [1] and M. Visonneau[1]

[1] Fluid Mechanics Laboratory, CNRS UMR 6598, Ecole Centrale de Nantes
BP 92101, 44321 Nantes Cedex 3, France
Emmanuel.Guilmineau@ec-nantes.fr

Key Words: *Turbulence Modeling, DES, Vehicle Aerodynamics, Crosswind Effects.*

ABSTRACT

This study deals with crosswind effects on a simplified car body called Willy model. This configuration is realistic compared to a van-type vehicle. This model with no sharp corner on the fore body and a square base is more convenient for the analysis of unsteady separations limited on its leeward side and base (Fig. 1).

The performance of Detached Eddy Simulation (DES) using SST model [2], as a predictive tool for such a complex flow, is investigated. The results are compared to those obtained by Reynolds Averaged Navier-Stokes equations (RANS) using EASM turbulence model. Experimental data using the same configuration at the same Reynolds number (0.9×10^6) are used for reference. Various yaw angles, β, are investigated from $\beta = 0°$ to $\beta = 30°$. Computations using DES-SST model have been performed using ISIS-CFD flow solver. The grid used consists of 6.65 million cells providing a near-wall resolution of $y^+ = 0.5$ on the body where no-slip boundary conditions are used.

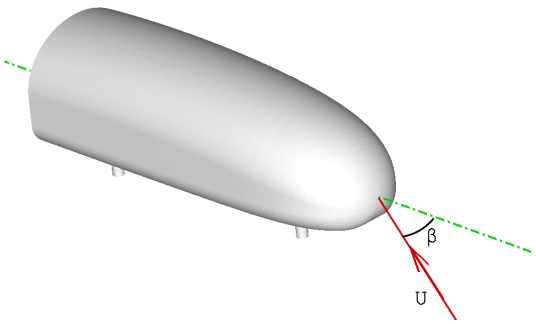
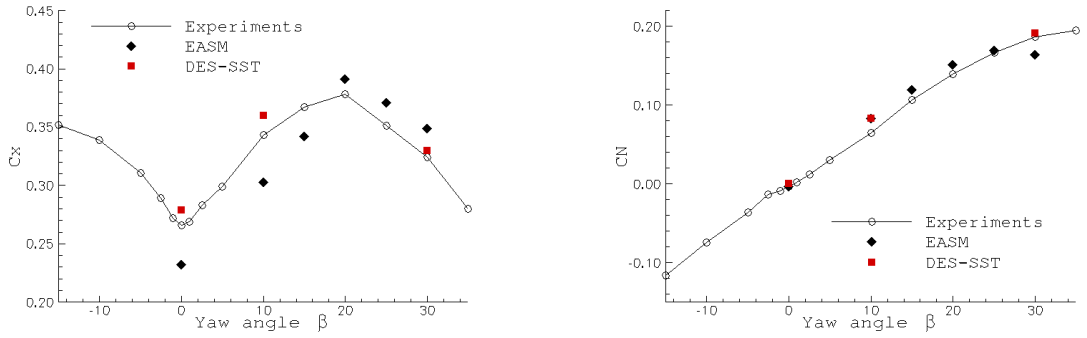


Figure 1: Overview of the configuration

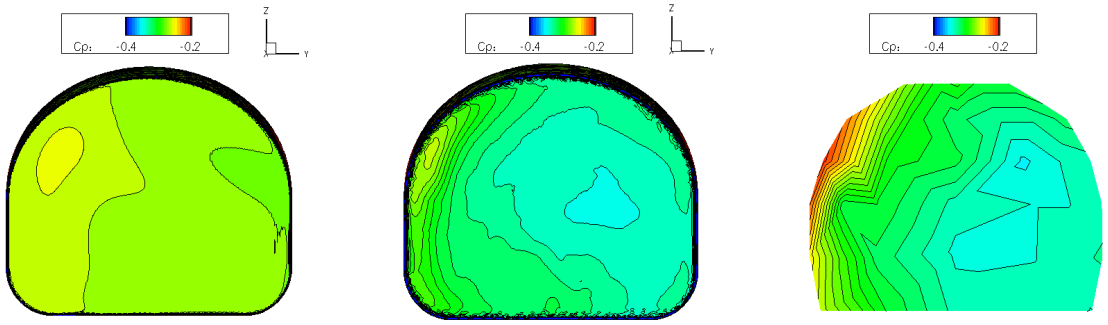
The drag coefficient and the yawing moment are given in Figure 2. We note that the results obtained with DES are in better agreement with the experimental data than the results obtained by RANS simulations, particularly for large yaw angles.

These differences of drag between the numerical simulations are due to the prediction of the base pressure, see Figures 3 for $\beta = 10°$ and Figures 4 for $\beta = 30°$. For the yaw angle $\beta = 10°$, the RANS simulation predicts a pressure that is quasi-uniform while with DES, results are in better agreement with the experimental data. For the yaw angle $\beta = 30°$, the results obtained by both simulations are very different. The maximum pressure obtained by DES is located in an area close to the experimental one, which is not the case with the RANS simulation.



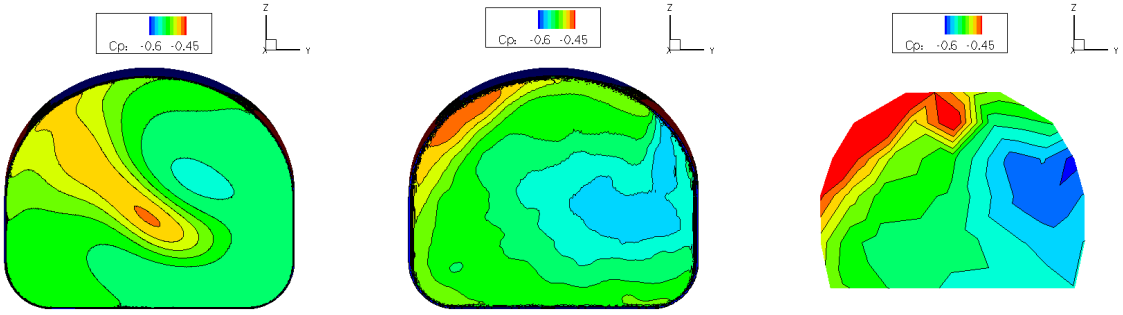
(a) Drag coefficient (b) Yaw moment

Figure 2: Forces coefficients versus yaw angle



(a) EASM (b) DES-SST (c) EXP

Figure 3: Comparison of base pressure coefficient $\beta = 10°$



(a) EASM (b) DES-SST (c) EXP

Figure 4: Comparison of base pressure coefficient $\beta = 30°$

REFERENCES

[1] E. Guilmineau and F. Chometon. "Effect of Side Wind on a Simplified Car Model: Experimental and Numerical Analysis". Submitted to *Journal of Fluids Engineering*, 2007.

[2] M. Strelets. "Detached eddy simulation of massively separated flows". *AIAA Paper*, 2001-0879.