Determination of a Vortex Generator model meshing related calibration factors

P Martinez-Filgueira*, U Fernandez-Gamiz, J M Blanco Ilzarbe,

* University of the Basque Country UPV/EHU
School of Engineering, Dept. of Nuclear Engineering and Fluid Mechanics
Alda. Urquijo s/n, 48013 Bilbao, Spain
E-mail: pablo.martinez@ehu.eus

ABSTRACT

Vortex generators have proven to be an effective way to delay or suppress the boundary layer separation on wind turbine dedicated airfoils [1] [2]. These small flow control devices generate streamwise vortexes that mix the fluid transferring momentum to the boundary layer. However, numerical simulations of the systems where they are included become computationally expensive due to the high resolution needed to capture the viscous effects of the flow in the cells near the VGs. That is the reason why the BAY Model was developed [3]. This model introduces a momentum source into the Navier-Stokes Equations, and is intended to be used with RANS based computational fluid dynamics solvers. The model is applied in a series of cells introducing a force that creates the vortex. However, the formulation of this model includes a calibration constant, which means that a similar simulation should be performed with a fully meshed VGs in order to determine its value. The model is also dependent on the size of the cells where it is applied and the topology of the region. The aim of the current work is to find the relationship between the cells where the model is applied and its calibration constant. Therefore, the need of carrying out the iterative and long process of calibration is avoided, leading to important savings in both computational resources and time. The test case consist of a ramp where an adverse pressure gradient is generated. The boundary layer detachment is overcome by installing a vortex generator array upstream [4].

REFERENCES

[1] W. A. Timmer and R. P. J. O. M. Rooij. chapter Summary of the Delft University Wind Turbine Dedicated Airfoils. Aerospace Sciences Meetings. American Institute of Aeronautics and Astronautics, 2003.

[2] M. B. Bragg and G. M. Gregorek. Experimental study of airfoil performance with vortex generators. *Journal of Aircraft*, 24(5):305–309, 1987.

[3] E. E. Bender, B. H. Anderson, and G. M. Gregorek. Vortex generator modeling for navier-stokes codes. Proposed paper for the Symposium on Flow Control of Wall Bounded and Free Shear Flow. JointASME/JSME Fluids Engineering Conference, 1999. ASME Paper FEDSM99- 6919.

[4] J. C. Lin, F. G. Howard, and G. V. Selby. Small submerged vortex generators for turbulent flow separation control. *Journal of Spacecraft and Rockets*, 27(5):503–507, 1990.