Numerical Simulation And Analysis Of Coanda Effect Circulation Control For Wind-Turbine Application Considerations.

ABSTRACT

In the efforts to investigate the performance of Coanda Jet in enhancing lift of an airfoil, a numerical study is carried out. Tangential jets that take advantage of Coanda effect to closely follow the contours of the body are considered to be simple and particularly effective in that they can entrain a large mass of surrounding air. This can lead to increased circulation in the case of airfoils, or drag reduction (or drag increase if desired) in the case of bluff bodies such as an aircraft fuselage. Critical review and analysis is also carried out for the application of Coanda Jet to optimize the aerodynamic performance of wind turbine, using the results of the numerical study and taking advantage of recent efforts to introduce Coanda effect as a novel circulation control technique. For this purpose a simple two-dimensional CFD modeling is utilized to reveal the key elements that could exhibit the desired performance criteria, in particular the lift enhancement and drag reduction, or a combination of both. Three dimensional configurations will be synthesized using certain acceptable assumptions, to compare such results with existing experimental data. Hence in this work the problem is idealized as basic airflow over a two-dimensional airfoil in subsonic flow; by the use of CFD technique, parametric study is carried out to arrive at plausible design considerations and to assess the practicability of Coanda jet in wind turbine design. Parametric study carried out shows the effectiveness of Coanda-jet in producing enhanced lift, which can contribute to increased torque in wind turbine application and increased axial thrust for propeller application. The numerical study also shows that appropriate trailing edge rounding off and tailoring the Coanda-jet thickness and momentum coefficient can produce enhanced lift to drag ratio.

Keyword: Aerodynamics; Wind-energy; Computational fluid dynamics; Numerical method.