

Effects of blade tapering on the performance of vertical axis wind turbines analysed through advanced visualization techniques

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Abstract :

Harnessing the wind energy effectively and efficiently, to fulfil the ever increasing energy demands, has long been an area of active research. This research study is aimed at exploring the blade design of a small-to-medium sized Savonius type Vertical Axis Wind Turbine (VAWT) for urban applications, as the published research in this area is severely limited. A commercial Computational Fluid Dynamics (CFD) based solver has been used to numerically simulate airflow around a conventional (cup-shaped) 2-bladed VAWT over a wide operational range (i.e. Tip Speed Ratio (TSR) from 0.4-1) in order to identify the peak performance point. Blade tapering has been shown to affect the performance of a wind turbine. As such, in the present study, three different VAWT configurations have been used with blade tapering corresponding to Delta, Rhomb and Cross shaped blades. It has been observed that tapering the blades of a Savonius VAWT significantly reduces the torque coefficient of the turbine, while there is a slight decrease in the power coefficient. Comparing the three tapered blade configurations, the delta blades depict higher performance than the competitor designs.

Mots clefs : Vertical Axis Wind Turbine, Computational Fluid Dynamics, Tip Speed Ratio, Torque Coefficient.