The CFD Performance Analysis for Horizontal Axis Wind Turbine with Different Blade Shapes and Tower Effect

Abstract

in these paper 3D simulations of four different horizontal axis wind turbine (HAWT) blade shapes with the same radius (0.65m) and airfoil profile (NACA4418) are presented. The first blade shape is optimal twist and tapered (OPT); this blade is designed using blade element momentum (BEM) theory. The second is un-tapered and optimal twist (UOT), this blade has the same twist distribution as the (OPT) but with a constant chord. The third is tapered un-twisted (TUT), this blade has the same chord variations as the OPT blade. The fourth is un-tapered un-twisted (UUT). The effect of nacelle, shaft and tower existence on the performance of the four designs has been investigated also in the present work.

All simulations are performed by using shear stress transport (SST) k-ω turbulence model. The power coefficient of OPT blade reach to 0.317 at TSR = 5. Meanwhile, the maximum power coefficient (Cp=0.3348 at TSR=4) has been recorded in the UOT blade. The TUT and UUT blade recorded a lower power coefficient, this is due to their always operations in stall and turbulence conditions.

Keywords— *HAWT; CFD; TSR; BEM; power coefficient; tower; turbulence; isolated rotor;*