



Performance analysis of vertical axis wind turbine with optimised pitch angle variation

L. Kushwaha¹, P. Venkaiah¹ and B. K. Sarkar^{1,*}

¹NIT Meghalaya, Laitumkhrah, Shillong, Zip Code 793003, India

* Corresponding Author: E-mail: bikash.sarkar@nitm.ac.in

Abstract. Wind power generation systems are growing rapidly globally due to awareness of green power generation. Wind turbine can be classified in two ways, 1. Horizontal axis wind turbine and 2. Vertical axis wind turbine based on the orientation of the turbine with respect to the wind direction. Comprehensive study of the horizontal axis wind turbine has been done, as it is more promising form in wind industry. Vertical axis wind turbine system has scope to improve further to improve its application. Vertical axis wind turbine has several advantages over horizontal axis wind turbine like insensitive of wind direction, easy installation and maintenance, low tip speed ratio etc. Low tip speed ratio cause of high angle of attack, low parasitic drag and less aerodynamics noise production. The main challenges of the vertical axis wind turbine are continuously varying angle of attack, which leads to unsatisfactory self-starting and poor power generation, and ripple in power generation. The problems can be reduced by implementing pitch control with optimized pitch variation due to the variation of azimuth angle and tip speed ratio. In the present study modified, double multiple stem tube (DMST) model has been utilized for obtain the aerodynamic thrust and power output from turbine. The modified DMST model has been obtained by the combination of DMST and BEM model, which can provide better approximation with the consideration of tip loss factor. Optimized pitch variation has been considered to obtain higher power with less power ripple. Matlab Simulink has been used for simulation study of vertical axis wind turbine performance. The effect of pitch control and tip speed ratio on power generation has been studied. Optimized pitch angle position with less tip speed ratio found suitable operating condition for power generation. VP-VAWT and FP-VAWT at four different tip speed ratio, which are, 4, 4.5, 5 and 5.5. Comparison is done in variable and fixed pitch and it is found that all the parameters are higher and higher in the upwind zone as compare to the downwind zone.