World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:16, No:08, 2022

Numerical Performance Evaluation of a Savonius Wind Turbines Using Resistive Torque Modeling

Authors : Guermache Ahmed Chafik, Khelfellah Ismail, Ait-Ali Takfarines

Abstract : The Savonius vertical axis wind turbine is characterized by sufficient starting torque at low wind speeds, simple design and does not require orientation to the wind direction; however, the developed power is lower than other types of wind turbines such as Darrieus. To increase these performances several studies and researches have been developed, such as optimizing blades shape, using passive controls and also minimizing power losses sources like the resisting torque due to friction. This work aims to estimate the performance of a Savonius wind turbine introducing a User Defined Function to the CFD model analyzing resisting torque. This User Defined Function is developed to simulate the action of the wind speed on the rotor; it receives the moment coefficient as an input to compute the rotational velocity that should be imposed on computational domain rotating regions. The rotational velocity depends on the aerodynamic moment applied on the turbine and the resisting torque, which is considered a linear function. Linking the implemented User Defined Function with the CFD solver allows simulating the real functioning of the Savonius turbine exposed to wind. It is noticed that the wind turbine takes a while to reach the stationary regime where the rotational velocity becomes invariable; at that moment, the tip speed ratio, the moment and power coefficients are computed. To validate this approach, the power coefficient versus tip speed ratio curve is compared with the experimental one. The obtained results are in agreement with the available experimental results.

Keywords : resistant torque modeling, Savonius wind turbine, user-defined function, vertical axis wind turbine performances
Conference Title : ICWEEA 2022 : International Conference on Wind Energy Engineering and Applications
Conference Location : Paris, France
Conference Dates : August 30-31, 2022