A tip loss correction model for wind turbine aerodynamic performance prediction

The tip loss is an important phenomenon in wind turbine aerodynamics and has to be modelled separately in the blade element momentum (BEM) method for predicting the wind turbine aerodynamic performance. Instead of following the conventional trend of thought, the present study for the first time regards the interference factors as a summation of two parts. One is determined by the downwash due to the three-dimensional effect and the other is determined by rotation. Two corresponding factors of FS and FR are proposed to represent the effects of the two parts, respectively. This way of consideration implies a new model for the BEM method, providing appropriate tip loss predictions. The new model is validated in BEM computations of the NREL Phase VI rotor, the Swedish WG 500 rotor, and the NREL 5MW reference rotor, with a radius of 2.675m, 5.029m and 63m, respectively. It shows a good accuracy in a wide range of tip speed ratios from 1.58 to 11.3, and presents a good robustness in the cases involving high angles of attack and in the cases involving high axial interference factors. That makes the new model attractive for tip loss correction in BEM.

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