

Fundamental studies of wind turbines have fundamental importance and so I welcome this new instalment of the author's long involvement with basic aerodynamic issues for horizontal-axis wind turbines and propellers in terms of actuator disks. The classification of flow regimes shown in figure 4 – which is taken from van Kuik (2018b, reference in the manuscript) - provides a link between propellers and turbines and has some counter-intuitive features, such as wake expansion for propellers adding energy to the flow, and a minimum power producing tip speed ratio for wind turbines. What is new in this contribution is the analysis of the velocities through the disk which provides new and important information. I am particularly interested in the radial velocity, which has received little attention in wind energy research, apart from Madsen et al. (2010, reference below), Micallef et al. (2013), and Sørensen (2015, reference in manuscript). Limacher & Wood (2020, reference below) showed that $v^2 - a^2$, where v is the normalized radial velocity and a is the axial induction factor, integrates to zero over the radial plane including the disk and argued that this requires $v \approx a$ at the edge of the disk, which appears to be consistent with the results in figure 9.

I did not find any errors in the analysis, the writing, though terse, is good, and the figures are of high quality. My only recommendations are: (a) that the link between the author's previous work be made clearer – as implied by my comment on figure 4 – and (b) that the previous work on the radial velocity be discussed. My hope is that this work will inspire measurements of these flow regimes that are not of direct interest for modern, power producing turbines, but are fundamental to our understanding of how wind turbines work.

Additional References

Limacher, E. J., & Wood, D. H. (2020) Derivation of an Impulse Equation for Wind Turbine Thrust. Wind Energy Science (submitted) <https://www.wind-energ-sci-discuss.net/wes-2019-93/>

Madsen, H. A., Bak, C., Døssing, M., Mikkelsen, R., Øye, S.: Validation and modification of the blade element momentum theory based on comparisons with actuator disc simulations. Wind Energy, 13(4), 373-389, 2010.

Micallef, D., van Bussel, G., Ferreira, C. S., & Sant, T. (2013). An investigation of radial velocities for a horizontal axis wind turbine in axial and yawed flows. Wind Energy, 16(4), 529-544.