Wind Energ. Sci. Discuss., referee comment RC2
https://doi.org/10.5194/wes-2022-2-RC2, 2022

Comment on wes-2022-2

Georg Raimund Pirrung (Referee)

Referee comment on "Experimental analysis of the dynamic inflow effect due to coherent gusts" by Frederik Berger et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2022-2-RC2, 2022

General comments

In general the article is very interesting, well written and shows some novel results. I didn't expect to see the observed decreased load amplitudes due to dynamic inflow effects for the sinusoidal gust, and it is nice to see that these could be reproduced with the FVW solver.
I agree that this effect could not be reproduced by any 'conventional' dynamic inflow model that filters the induced velocity.

However I have to admit that I don't quite follow the reasoning for the modification of the Øye model.
As the other reviewer pointed out, the change corresponds to adding an extra term of (1-k)/2*t_slow*(du0/dt) on the right hand side of Equation (12). I reach the same conclusion. This term could easily be multiplied by a tuning parameter, by the way.
Essentially, through this additional term, any change in the inflow velocity will directly drive the time filter for the 'intermediate induced velocity' in the Oye model.
It clearly seems to behave well compared to the measurements and FVW computations in this particular case. The issue for me is that - because I don't understand why it should be implemented like this from a 'physical' perspective - I am unsure if it will also behave well for different amplitudes, frequencies or mean wind speeds.
So it would be very good if the argumentation for the modification could be made stronger, and possibly if a few additional comparisons between BEM and FVW for different frequencies, amplitudes or mean wind speeds could be added.

Specific comments

- several places: to proove -> to prove; prooved -> proved

- p7 l 156 radially averaged -> azimuthally averaged (I assume)?
- p 11 l 253: 'The stall angle is estimated based on the highest lift coefficient...'. Do I understand correctly that the 'stall angle' is the maximum lift angle? Or how was it estimated?
- p 12 l 257: shy off -> shy of
- p 12 l 269 'The faster time constant tau_fast can be attributed to the sudden change in the trailed vorticity and the slower time constant tau_slow to the effect of the wake inertia.' I am not sure about this formulation. As I understand it the faster time constant (with high radial dependency) is due to the trailed vorticity change close to the rotor plane. When that change in trailed vorticity is convected further downstream, it has a more 'global' effect on the whole rotor with less radial dependency and slower rate of change.
- p 12 Equation (13): there is a 'd' missing in the 'du_ind/dt' term
- p 13 l 311 'The second simulation environment is the FVWM model implemented in QBlade (Marten et al., 2016).' How are the gusts actually handled in QBlade? Are they superimposed instantaneously on the wind speed everywhere (including in the wake) or are they convected somehow?
- p 18 Figure 8: It seems that I don't understand this figure. Shouldn't for example a crossing of the curves in plot a) ($u_{ax, qs}=u_{ax, exp}$) be matched by a crossing in plot d) (because u_ind = u_0 - u_ax, and u_0 is the same in a) and d))
- p20 l 441: 'The observed dynamic difference has a duration of about 0.3s, being twice the typical time constant for dynamic inflow phenomena'. I don't quite understand where the 0.3 comes from and how it relates to the time constants. Also I don't quite follow where the typical time constant comes from. For a=0.33 for example, t_slow in Equation 14 is almost equal to 2 R/u_0. The time constant for dynamic inflow is generally said to be proportional to R/u_0, but there can be a factor involved.
- p 21 l 465: 'The reconstructed steady thrust based on these axial velocity measurements (see Sect. 2.4) shows a good match to the one based on the strain gauge measurement.' Are you talking about comparing Figure 9 and Figure 6? Please add the references to those figures.