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DISCUSSIONS

Interactive comment on "How does turbulence change approaching a rotor?" *by* Jakob Mann et al.

Anonymous Referee #2

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This is an interesting paper that pursues a clearly stated question of significant interest: how is turbulence modified at the rotor as compared to the incoming turbulence. The idea to use Rapid Distortion Theory (RDT) is solid and appropriate for the task at hand. The results presented are of interest.

An initial aspect of the paper requires clearer explanation and justification. As it is now, the initial discussion separates between slow and rapid turbulence motions, and makes the claim that RDT can be applied to the higher-frequency fluctuations but it seems to imply that RDT should not be applicable to the slow incoming, larger, slower eddies. (I am referring to the first sentence in 2.2 "Rapid distortion theory for smaller turbulent scales corresponding to more rapid fluctuations is investigated by Batchelor and Proudman.") This is contrary to the known limits of validity of RDT, which assume

that if one moves with the turbulence but the mean flow varies very, very fast compared to the turbulence, then the linearization can be justified to represent the response of the SLOW LARGE eddies. So one expects RDT to work BETTER for the slow, bigger eddies of the inflow turbulence rather than the fast ones since their intrinsic scales are slower and they cannot "nonlinearly react" to the sudden change of flow conditions. The rapid eddies (small ones) can, on the other hand, nonlinearly relax more quickly to the rapid distortion from the rotor and adjust in nonlinear fashion thus violating the fundamental conditions of RDT-validity. It is possible that the authors mean different things when they say "slow" and "large.." and "small". So, I would like to ask that they provide quantitative justification for applicability of RDT by quoting appropriately the ratio of relevant time-scales.

Another aspect that is worthwhile pointing out is to better clarify what is the relationship between this work and RDT when the mean flow undergoes rapid "Axisymmetric expansion (one contracting + 2 expanding direction). This is a tricky case for RDT and turbulence modeling, see original papers Lee 1989 Phys. Fluids A 1, 1541–1557.

Details:

In Figure 7, clearly the LES data are all around 1, and the theory too except for the peak near 11/5 m/s for xi=0. In order to more clearly compare LES to the theory, why are there no LES done for U_inf = 11.5?

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