

Review of the manuscript “Assessing spacing impact on coherent features in a wind turbine array boundary layer” by Naseem et al.

Overview:

This manuscript presents results of an experimental wind tunnel study of four different spacing configurations of a 4 x 3 wind turbine array. The authors investigated the mean and turbulent features of the flow using techniques such as the snapshot POD and anisotropy stress tensor. The manuscript is overall well written, but some major clarifications are needed before it can be published in Wind Energy Science. My main concern about the manuscript is the lack of physical interpretation of POD analysis. Please see my specific comments below.

Specific comments:

1. You should mention in the literature review part in Introduction that the spacing between wind turbines and their layout are also function of orography among other things, and not just wind direction. For example, see the following recent reference and references therein:

Romanic D, Parvu D, Refan M, Hangan H. 2018. Wind and tornado climatologies and wind resource modelling for a modern development situated in “Tornado Alley.” *Renewable Energy* **115**: 97–112. DOI: 10.1016/j.renene.2017.08.026.

Then you can say that your paper, however, is restricted to a flat surface and topographic influences are not considered.

2. In Eqs. (1) and (2), please explain all variables although some of them might be trivial. What are N , A , Ω ? In Line 94, you are explain R that does not seem to appear in the previous equations.

3. Line 102. The sum in the nominator in equation for η_n shouldn't go to the same value as the index n . Please explain these formulas accordingly.

4. What was the blocking ratio for your wind tunnel tests?

5. Line 159. You are using a closed-circuit wind tunnel where the flow is mechanically generated. What do you mean by neutral stratification? You haven't checked for atmospheric stability or at least I don't see any stability parameters in your paper (e.g. potential temperature profiles, Richardson number, etc.).

6. What are the geometric and velocity scales (and thus time scales) in your experiments? You did provide the geometric details of your wind turbine models, but what full-scale wind turbine (or turbines) are you replicating in your wind tunnel experiments?

7. Why is there uncertainty of U_∞ in Line 183? That is, why the value is “about 5.5 m s⁻¹?” Please provide additional explanation.

8. Figure 11. You use the same color in the insets to represent three different ranges of models so the reader needs to guess which line represents which range. Please introduce either additional colors or use symbols or dashed lines.

9. Lines 256–266. You are implying that the 3% difference in the turbulent kinetic energy is large whereas the differences between the cases $C_{6 \times 3}$ and $C_{6 \times 1.5}$ are small. Since you didn't quantify the differences

between the cases $C_{6 \times 3}$ and $C_{6 \times 1.5}$, I would argue that the 3% difference in the turbulent kinetic energy is also small.

10. It is not clear to me from the sentence in Line 256 why did you choose to show only the first, the fifth and the twentieth modes? Why not for example the second mode or eighteenth or any other modes? Please clarify in more details.

11. Are there any physical meanings behind the modes that you showed? What flow physics they show if any? It is very important to relate the pure mathematics of POD with the flow physics. That being said, please provide some physical explanations of the modes. Please note that this comment must be addressed seriously before I give a positive recommendation to this manuscript.

12. It is typical in the field of fluid dynamics and turbulence to use the terms such as hairpin turbulence instead of cigar-like turbulence. This comment however is just a suggestion so you can keep cigar-like terms if you prefer it.

13. Section IV E (Anisotropy Stress Tensor). What are you trying to show in this section that would be of importance in wind energy industry? That is, what are the practical applications of your results? In Line 346 you mentioned that it can have implications in the terms of fatigue loads, but the statement is too general. Please provide more explanations and some references would also be very good.

Grammar:

1. Line 9. “an increase” instead of “an increased”

2. Lines 15–16. “in turn is a function of the surface roughness”

3. Line 22. The reference should be in brackets not an in-line format.

4. If you want to use Roman numbers to denote chapters then remove dots after the numbers.

5. Line 140. “closed-circuit” instead of “closed- circuit”

6. When you write ms^{-1} , please have a space between m and s because without the space it looks like millisecond (an example is in Line 183). The same rule applies to other units.

7. Here I provided just some of the grammatical mistakes that I found. I advise the authors to proofread the manuscript few more times.