

Review of the manuscript “An engineering model for 3D turbulent wind inflow based on a limited set of random variable” by Fluck and Crawford.

General comments:

This manuscript proposes a method of decoupling temporal randomness from the spatial variability of a turbulent wind speed field. The spatial variability of wind speed is modelled deterministically, whereas the temporal fluctuations are addressed through the traditional approach of the random phase angles. The authors compared their results two other methods (TurbSim software and modified Veers method).

The manuscript is well written and the illustrations are nice. I believe the manuscript is well suited for Wind Energy Science, but few clarifications need to be addressed before the manuscript can be published in this journal. My comments are separated in three sections: (1) moderate (the most important) comments, (2) minor comments and (3) comments related to the grammar and style of writing. My moderate comments are focused around (1) the underlying hypothesis that temporal variability in wind dynamics is more important than the spatial variability and (2) the applicability of the proposed method to highly transient (in both space and time) wind events.

Therefore, I assign a moderate revisions for this manuscript. Although I have a long list of comments, I believe most of them can be implemented in relatively short amount of time.

Moderate comments:

1. P8 & 9. What are the references and studies that would confirm your statement that the temporal variability is more important than the spatial variability of the wind in a dynamic wind analysis? You need to provide some proofs for your observations 1-3. Reading your observations 1 and 2, I conclude that both are of the same importance, but on Page 10 (L5-10) you claim that temporal variability is more important based on the observations 1 and 2.
2. P9 & 10. Regarding Eq. (3), you established that  $\Delta\theta_{mk}$  is random variable (P9, L19), but later you decided to neglect the fact it is a random variable (P10, L2). What is a justification that a random process can be replaced by a deterministic constants? I guess this comment boils down to my previous comment.
3. P9 and later in the text. The concept of  $\Delta\theta_{mk}$  means that the correlation between two points is space is always the same for a given frequency and those two points. For example, at a frequency bin centered around 10 Hz, and for the points P1 and P2,  $\Delta\theta_{mk}$  is always the same number. Similarly, for a frequency bin around, say, 0.1 Hz and the points P1 and P2,  $\Delta\theta_{mk}$  is once again always the same value (but not the same as the one for 10 Hz). If I am correct, please provide an example like this that would simplify the concept to the reader (not necessarily this one; I am sure you can formulate it better).
4. P10. L9. Is there a study that showed the temporal variability is more important than the variability of the spatial structure of wind field?
5. Figure 7. Why is there a large difference between your model and TurbSim model for the times lags less than 10 s? Why does your model give higher cross-correlations for small time lags than TurbSin for time lags less than approximately 10 s, but the cross-correlations are relatively similar for time lags larger than about 20 s? Please discuss this observation in text.

6. Your Figure 10 is a very valuable part of your paper. You should emphasize more on this figure. For example, it is one of the answers for my major comments above. However, I believe you still need to provide the strong proof that your assumption is valid in a more general case.

7. Lastly, what do you think how valid your method would be for the case of highly unsteady winds (e.g. gust fronts, downbursts, etc.). I would like to see a critical dissection on this topic in Section 3.5. You can start with the following references:

Chay MT, Albermani F, Wilson R. 2006. Numerical and analytical simulation of downburst wind loads. *Engineering Structures* **28**(2): 240–254. DOI: 10.1016/j.engstruct.2005.07.007.

Chen L, Letchford CW. 2004. A deterministic–stochastic hybrid model of downbursts and its impact on a cantilevered structure. *Engineering Structures* **26**(5): 619–629. DOI: 10.1016/j.engstruct.2003.12.009.

Solari G, De Gaetano P, Repetto MP. 2015. Thunderstorm response spectrum: Fundamentals and case study. *Journal of Wind Engineering and Industrial Aerodynamics* **143**: 62–77. DOI: 10.1016/j.jweia.2015.04.009.

Solari G. 2016. Thunderstorm response spectrum technique: Theory and applications. *Engineering Structures* **108**: 28–46. DOI: 10.1016/j.engstruct.2015.11.012.

See the references in those papers for more literature on the subject of highly space-time varying thunderstorm winds. I believe that you should test your method for one of these wind phenomena in your future work.

#### Minor comments:

1. P4, L24. What is that you want to say in the sentence “Moreover the stochastic wind...” Could not understand it due to the incorrect English.

2. P5, L7-9. This sentence is very difficult to understand. For example, “the existing models we are aware of rely...” What message you want to convey?

3. P5, L12. It should be Veers (1988). Please pay attention how you cite references when it comes to their in-line appearance in text.

4. P6. L2-6. For the most part, you don’t need this small paragraph here. Most of this information is given in the last paragraph on Page 5 and the last sentence with the references can be moved to Section 2.1. Please modify accordingly.

5. P6. L13. First, you should have a comma after “Often”. Second, the sentence sounds incomplete. Try, for example, “In many cases, Kaimal spectrum is used to represent the wind time series in the frequency domain [ref]”. Also, add the reference for the Kaimal spectrum:

J.C. Kaimal, J.C. Wyngaard, Y. Izumi, O.R. Cote. 1972. Spectral characteristics of surface-layer turbulence. *Quarterly Journal of the Royal Meteorological Society*, **98**, pp. 563–589.

6. Figure 2. If I am interpreting this figure correctly, the Kaimal, Veers original (Point P1) and phase increment model all collapse to the same line. Please clarify additionally the caption for this figure.

7. P8, L15. In the footnote, what do you mean by “the block of wind”?

8. P11, L21. What do you mean by “I; the results” and why is  $Veers_{red}$  in bold?
9. P12, L1. Similar to my previous comment, is there a particular reason to have  $Veers_{red,\Delta\theta}$  in bold? You are not writing it in bold afterwards.
10. Figure 5 caption. It should read “See Tab. 1 for additional information.” at the end of the caption.
11. Figure 6. Only the plot in the middle has the legend, which is not consistent with Figure 5. Moreover, please move the legend within the frame of the plot, as it is in Figure 5.
12. Eq. 9. Coherence function is a function and thus it should not be italicized (e.g., sin, cos, ln, etc. are not italicized). Please write Coh without being italicized in Eq. 9 and the line following Eq. 9.
13. Increase the size of Figure 9 and therefore the fonts. Please indicate on the plots that the y-axis are cross power spectral densities.
14. Figure 10 caption. State that BEM stands for Blade Element Theory.
15. References. Sometimes the titles of journal articles have capitalized each word (first letter) and sometimes you used the sentence style (i.e., only the first word capitalized). Please be consistent.

Grammatical and stylistic comments:

1. P2, L3. I believe you should not have a space after “/” in “and/or”
2. P2, L6 & 7: You need a comma after “In a numerical experiment, ...”. In the same sentence, is it “base” or “based”?
3. P2, L 14 & 15. Two consecutive sentences start with “This is ...” Please reword it to increase readability.
4. P3, L1. How about “In wind turbine engineering, the driving force is the turbulent atmospheric wind which is commonly described ...” and then you don’t need the comma after “field”
5. P4, L11. Put a comma after “Instead”.
6. P4, L17, You have “tha a stochastic...” Please correct.
7. P4, L21 & 22. Put a comma after “On a wind farm scale, “. Also, have a comma after “Finally, “
8. P4, L25. It should be “Hence, it is not generally...”
9. P4, L27-29. After “wind models, a transition from ...” you don’t need the other commas in that sentence.
10. P5, L6. Summarizes a few or summarizes of a few? I think the former is more accurate.
11. P5, L11. It should read “In the following, we focus on...” or even better “In this study, we focus on...”
12. P7, L4. Instead of “in the following”, maybe it sounds better if you use “here,”.
13. P8, L13. I believe you don’t need a space after “/” (Similar to my first comment).
14. P11, L8 & L13. Put a comma after “In the following,”
15. P11, L15. Put a comma after “As suggested by Veers equations,.”

16. P11, L20. Put a comma after the closed bracket (i.e., before “we”).

17. P12, L11. Put a comma after “As a test case,.”

18. P15, L8. Put a comma after “Eq. 8,.”

19. P15, L12. Put a comma after “Next,.”