Wind Energ. Sci. Discuss.,
https://doi.org/10.5194/wes-2018-51-RC1, 2018

WIND ENERGY SCIENCE DISCUSSIONS

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Interactive comment

Interactive comment on "Advanced CFD-MBS coupling to assess low-frequency emissions from wind turbines" *by* Levin Klein et al.

Anonymous Referee #1

Received and published: 6 August 2018

The paper describes a CFD-MBS coupled method to assess tower base loads and low-frequency noise emissions of wind turbines. The topic is faced from a numerical point of view and demonstrates the applicability of the procedure to identify acoustic sources and to have a better insight on the noise generation mechanisms. The paper is relevant in the field, well written and easy to follow and includes a good and up-to-date description of the state of the art.

The numerical procedure is shown in detail and the computational setups (CFD, structural and FSI models) are well described. The results coming from three different studies are clearly presented and the main finding are well discussed. Maybe the noise results would have deserved to be presented in a more compact way in order to allow an easier comparison of the different effects on the acoustic emissions. The work slightly suffers from the lack of method validation, yet the authors include in the article a lot of references to other works which confirm the validity of their results. The numerical procedure seems to be ready for the application to different wind turbines.

The paper is recommended for publication subject to addressing the minor revisions suggested below:

1) 2.3.2 - Mesh deformation –> The authors stated that surfaces in the CFD domain are deformed following the marker displacements. In the referee's opinion, the internal CFD domain must be deformed to follow the moving surfaces: how does the deformation library handle with this aspect? Could the author add a sentence that explains how the deformation is distributed within the CFD domain?

2) 2.3.3 - Load integration –> In the paragraph the authors wrote: "For the coupling to SIMPACK, the CFD surface is divided into segments based on the deformed marker positions. Loads are integrated for these segments and assigned to the respective markers." Could the authors explain more in detail how a CFD segment area is assigned to a single marker. Do the authors use a sort of reduction technique?

3) 2.3.4 - Communication interface –> The authors employed a typical coupling scheme between Simpack and FLOWer code, yet the two solvers run on different operating systems and the data communication must be handle by means of files. According to the referee, this strategy may lengthen the computational time due to writing and reading time. Would it be possible to run the two solvers on the same cluster exchanging information, for instance, by using an Infiniband connection? Do the authors have an idea of the time reduction in case the solvers exchange conditions by network instead of using files?

4) 2.5.2 - CFD model –> The authors show a detail of the computational grid (Figure 3), yet it would be nice if they may add a picture of the overall CFD domain. The authors mention that the fine mesh consists of 86 M of cells and a picture showing the entire domain may highlight this huge computational domain.

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5) 2.5.6 - Computational approach –> Since the procedure couples an URANS solver with a multi-body code, the aeroelastic interaction (flutter) between fluid flow and moving blades should be captured. Is it correct? Could the authors clarify this aspect within the paper? Moreover, the authors stated that an artificial damping can be introduced to obtain "a fast convergence of deformation and loads to a periodic state": does this periodic state take into account the aerodamping?

6) 2.6 - Evaluation –> The referee agrees that the temporal resolution is strictly commented to the time step. Could the author add the highest frequency solved in the analyses? The author also said "To achieve the same temporal resolution in the acoustic emission, each time step a CFD surface solution was saved as input for the acoustic simulations" and all these information may require a huge amount of disk storage, how do the authors face this aspect? Finally, at the end of the paragraph the authors state that they apply FFT algorithm to the period solution: how do they check the solution periodicity?

7) 3 - Results –> The authors clearly discussed the three different studies and all the explanations are described in detail. Focusing on acoustic emissions, the authors concluded that a) the main source of noise turns out to be the blade-tower interaction, b) it is important to consider the elastic deformation which reduce the gap between blade and tower and c) the turbulence inflow only alters the broadband noise level. The authors show the noise results in term of SPL in observer positions, would it be possible to compute a PWL (sound power level) value from the results to have a global quantity describing the acoustic energy and to globally compare the different cases annoyance at a certain distance from the wind turbine?

8) In the paper the authors often write "acoustic immission". The referee thinks that is was a typo and the authors would have like to write "acoustic emissions". Please revise it in the paper.

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