Reply to the Reviewer #1

The paper presents a numerical method based on a commercial code to predict aerodynamic characteristics and noise emissions of HAWT. The CFD solution is coupled with FWH method to assess the noise spectrum at the observer locations. Different turbulence models are tested, and their results are compared with LES and experimental acquisitions. The paper faces a very interesting problem related to the annoyance of wind turbines located near populated areas. The main aspects of the noise prediction method are touched by the authors, but the description of the single step is quite shallow and not complete.

Authors Reply: The authors would like to thank the reviewer for the time to review our paper. The comments that the reviewer provided have contributed to the enhancement of our paper. We have taken the opportunity to make several improvements in the text, in order to strengthen the paper. A list of point-by-point replies to the reviewer's comments is reported in the following.

Comment 1: For instance, the numerical method description is a general discussion of basic CFD concepts without a deeper discussion of the motivation behind setup choices. Classical PDE equations are reported with some typos (e.g. in Eq. 2 the time derivative term is missing), and also the turbulence model description is too detailed: references to the different model formulation should be enough. Same story for the FWH formulation.

Authors Reply: Thanks for pointing out. Deeper discussion of the motivation behind setup choices have been added in the Numerical method section. Also, the PDE equations were revised in the Method section and we did not add any more references based on reviewer's suggestion.

Comment 2: Concerning the numerical model validation by using NREL HAWT, some important aspects of numerical simulation are missing: numerical schemes for diffusive and convective fluxes, detailed description od BCs., discussion about convergence criteria and so on. Moreover, is not crestal clear by looking at Fig. 3 that fine mesh performs better in terms of accuracy. Could the authors better explain their conclusions?

Authors Reply: Numerical schemes for diffusive and convective fluxes, detailed description on BCs., discussion about convergence criteria has been added in the Numerical method section. The conclusions of the comparison with the experimental and numerical C_p distributions have been added. The C_p calculated using the coarse mesh was lower in the leeward position of the front end than the experimental results. The calculated velocity was relatively small when C_p was considerably increased. Compared with the experimental values and LES data, the simulated pressure was relatively large. When the simulation used the fine mesh, C_p agreed well with the LES model and the experimental data. Furthermore, the C_p of the fine mesh near $x/c = 0$ agreed with the LES data. The predicted pressure coefficients were observed to be considerably high in the front end and trailing end. When the fine mesh was employed, no obvious difference was observed in the front end and trailing edge between the results of the standard k-ε model and LES model. We added the detailed conclusion in the CFD model section.

Comment 3: Moving to the INER 25-kW turbine, some aspects of the operating conditions are not so clear: why the rotational speed is expressed in m/s? Should it read rad/s or rpn? When the authors discussed the aerodynamic results, they compared the different turbulence model, without discussing the results in detail. Could the author make a thorough discussion of this? Finally, the comparisons on Fig.12 show some discrepancies, could the authors comment on that?

Authors Reply: Thanks for pointing out. We have modified the rotational speed in rpm. The discussion of the comparison with the different turbulence model and the discrepancies in Fig. 13 in the new manuscript were added in the Aerodynamics results section. In these four model, the velocity was too high in the blunt area on the front of the blade, which was inconsistent with the experimental results predicted by realizable k-ε model. This is because the turbulent viscosity was a coefficient in the standard k-ε model. The physical quantity of rotation was added with the realizable k-ε model and was calculated using the square root of the fluid strain rate, which is the average vorticity of the fluid. Standard k-ε model is the general used in CFD to simulate mean flow characteristics for turbulent flow conditions. However, it does not calculate the flow field with high accuracy, especially in displaying reverse pressure gradients and strong curvature in flow field or blades. The SST- k-ω model provides a better prediction of flow separation and recirculation than most RANS based models, which accounts for its accuracy in adverse pressure gradients. The SST k–ω turbulence model showed itself suitable for the numerical simulation of small scale wind turbines (Rocha et al., 2016; Akar et al., 2019). The V2f model has been successful in simulating a variety of non-equilibrium flows. In conclusion, the SST k-ω and V2f models are superior for simulating the flow field of small scale HAWT.

Comment 4: Concerning the noise prediction section, t is not clear how the CFD simulations used for noise predictions are performed. Do they rely on steady or unsteady simulations? Also, the FWH setup is not completely described: where the FWH surface is placed? Which is the sampling rate of the FFT?

Authors Reply: The flow field and the sound field from blades depend on unsteady simulation. We added the information in Aerodynamics results section. The FW-H surface was placed on the blades. According to the Nyquist-Shannon sampling theorem, the sampling rate must be at least twice the maximum frequency present in the signal. In this case, the maximum frequency in the frequency domain is 1200 Hz. Therefore, the minimum required sampling rate would be 2400 Hz. Therefore, the sampling rate of the FFT is approximately 1 / 0.000416 = 2403.85 Hz. We added the discussion in Verification of aeroacoustic results section. Thanks for pointing out.

Comment 5: Moreover, is quite strange to see noise spectra with negative value in dB (that is under the human hearing threshold). In addition, is there a blade passing frequency in the spectra? If so, please discuss a bit on this aspect.

Authors Reply: With increasing distance, the decibel number of the monitoring point ~25 m away from the tower dropped to 0 dB in case 1, so we deleted all values below 0 dB and the lines that the noise often below 0 db in Noise simulation of the INER 25-kW wind turbine section.

Yes, in the field of engineering and rotating machinery, such as wind turbines, compressors, and fans, a phenomenon known as Blade Passing Frequency (BPF) can be observed in the spectra. We added some discussion in Noise simulation of the INER 25-kW wind turbine section.

Comment 6: Finally, an English revision of the wording is highly suggested.

Authors Reply: We regret there were problems with the English. The new manuscript has been carefully revised by a professional language editing to improve the grammar and readability. Thank you for the valuable comment.