Response to the Review on the Paper wes-2022-13

A WaveNet-Based Fully Stochastic Dynamic Stall Model

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We thank the reviewer for his detailed evaluation of our manuscript. Below we respond to his comments and explain the changes resulting from his comments. Please note that in the revised version of the manuscript, all changes related to reviewer #1's comments are highlighted in purple if uploading a revised version is possible.

Comment 0: Can it replace (supplement) the use of the traditional dynamic stall models as e.g. the Beddoes-Leishman model in aeroelastic simulations with codes as HAWC2, FAST or BLADED?

Potentially, this method can replace classical dynamic stall models. However, as mentioned in the paper, a more extensive database of experiments or LES simulations is required.

Comment 1: Can the simulation time be decreased by reducing the steps of the model looking backward ?

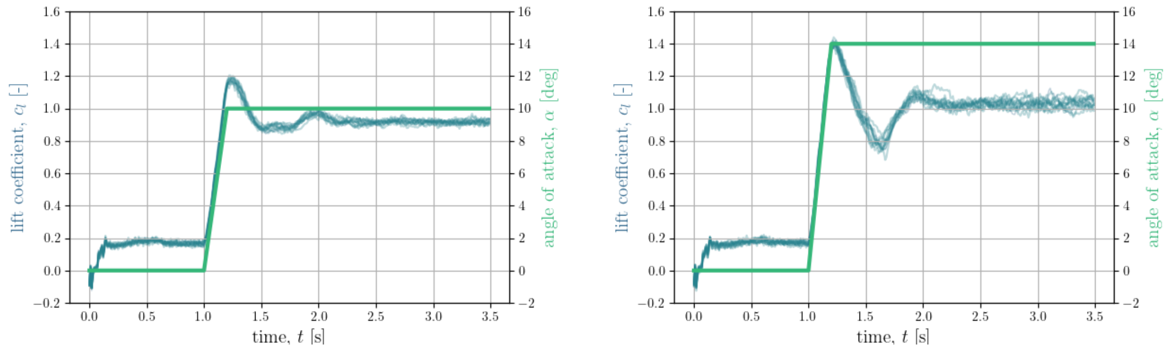
No, or not by much. The overhead comes from Tensorflow and the repeated call to the evaluation routine to step forward in time.

Comment 2: How difficulty is it to train in order to use different time steps ?

It is not very difficult and would only mean a small modification of the model. The time step could be introduced as a global variable, as described in section 7. Due to the high sampling rate, there is plenty of room to re-sample training sets with larger and smaller time steps. As already mentioned in the answer to Reviewer #1, the performance impact can be partly compensated for by the fact that the model can work very quickly in parallel. Therefore, several wing sections can be calculated simultaneously.

Comment 3: […] In all the cases in this referenced paper the AoA was constant but the lift is fluctuating considerably due continuous vortex shedding from the separated flow. The present semi-empirical dynamic stall models are lacking the ability to generate unsteady loading for a constant AoA which might be important in aeroelastic simulations […]. Can the authors comment on the applicability of the present model for such applications?

The model is able to predict continuous vortex shedding even at constant angles as shown in Figure 1. However, it should be noted that the training data for the model did not include static angles of attack for the airfoil. Therefore, the curves shown in Figure 1 are inferred exclusively from the dynamic data. Future experiments should therefore be sure to include static and semi-static settings to accurately model the more common range of operations for wind turbines.



(a) α = 10° (b) α = 14°

Figure 1. Predicted lift coefficient for the S809 airfoil at various constant angles of attack with a short initial pitching motion (12 repetitions).

Comment 4: Consider to expand/modify the comments on LES simulation based on the reviewers comment

Yes, a very good idea. We added the source mentioned and suggested working with LES data when experiments are not available.

Comment 5: What guidance could otherwise be given on choosing the number of steps looking back ?

The decision about how many steps to look back on is appropriate should be left to a grid search. The fact that it is roughly linked to one full cycle in this case might be a coincidence. But probably a good starting point.

Comment 6: Please expand on this as a fixed timestep could limit the use of the model ?

As mentioned in comment 2, the model should be re-trained for real production with a variable time step. This is not a hurdle. A constant time step can still work sufficiently if it is run asynchronous to the rest of the simulation. If the flow simulation has a higher resolution in time, the aerodynamic coefficients would only be updated every 0.01s.

Comment 7: How should the present model improve that compared e-g- with the Beddoes Leishman model ?

As mentioned earlier. In contrast to the Beddoes Leishman model, the WaveNet model is able to simulate unsteady aerodynamic coefficients in the linear part of the CL curve.