Review of the paper " An Actuator Sector Model for Wind Power Applications: A Parametric Study".

Submitted to ***Wind Energy Science***
Article number # : wes-2023-16
Article type: Research article
August 1, 2023

Recommendation: Major revisions.

Summary:

The manuscript delves into various implementations of actuator sector models and compares them with actuator line results. The primary goal is to assess the accuracy and computational efficiency of the sector model compared to the line model. The paper demonstrates a good agreement between the actuator line and sector models, particularly in the rotor plane and wake flow. Notably, by employing the sector model, the authors achieved a remarkable 75% reduction in computational time compared to the actuator line model. This efficiency gain was made possible by using a larger time step without significantly compromising accuracy. Furthermore, the study highlights that reducing the time step for the actuator disk/sector does not offer a substantial advantage, given the associated increase in computational time. In conclusion, this manuscript provides valuable insights into the implementation and performance of actuator sector models in comparison to actuator line models. The findings shed light on how to achieve efficient yet accurate simulations in wind turbine modeling, which can be of great interest to researchers and engineers in the field of wind energy. Nevertheless, before this manuscript can be considered suitable for publication, several issues need to be resolved. I have divided my comments into two categories: 'Major Concerns' and 'Minor Concerns'. The 'Major Concerns' pertain to conceptual and technical critiques requiring significant attention, while the 'Minor Concerns' draw attention to certain grammatical errors and typos.

Major concerns:

- **1**: The manuscript lacks clarity in presenting its novelty. Although it considers three key aspects: velocity sampling method, tip correction, and time step, it is not evident how this work distinguishes itself from other peer papers in the field. The authors should provide a more explicit explanation of the unique contributions of their study.

- **2**: In Figure 3 (The illustration of the computational domain: Left: front-view slice at the rotor plane, Right: side-view at the mid plane), it would be helpful to mark the location/position of the wind turbine in both figures for better clarity and understanding.

- **3**: Finding all the simulations is challenging due to a lack of clear representation. It is suggested to add a table that comprehensively presents the changes made in the simulations, making it easier for readers to understand and follow.

- **4**: The conclusions heavily rely on the comparison between the ASM and ALM models. To strengthen the validity of the ALM simulations, it is important to validate them against other benchmark cases.

- **5**: The section 4.2.2 New Position Approach is confusing and lacks sufficient explanation. The authors should provide further details on this approach to clarify its meaning and purpose.

- **6**: Page 19 mentions the use of load distributions from the BEM method with a Prandtl tip correction for comparisons. It is not clear whether the BEM data was obtained from their paper or calculated independently. If calculated by the authors, additional information is needed to better understand the process.

- **7**: On Page 14, Figure 15, the paper includes two benchmark cases, BEM and ALM. It needs to be specified which one will be used to evaluate the performance of the ALS model.

- **8**: In section 4.3 Tip/Smearing Correction Method, three smearing corrections are used. More detailed information about these three different methods is needed to ensure better clarity and understanding.

- **9**: Figure 16 requires a benchmark case for easy comparison, either BEM or the ALM results should be included.

- **10**: There are no figures for 4.4 Time-step Size. The authors should consider adding appropriate figures to support the discussion in this section.

- **11**: On pages 18-19, Figure 22 shows the TKE profile along the streamwise direction, but it would be beneficial to include a figure showing the streamwise velocity for better context and comparison.

References