Wind Energ. Sci. Discuss.,
https://doi.org/10.5194/wes-2019-87-RC1, 2020

WIND ENERGY SCIENCE DISCUSSIONS

WESD

Interactive comment

Interactive comment on "Development of a Second Order Dynamic Stall Model" *by* Niels Adema et al.

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Received and published: 21 February 2020

The paper presents and evaluates an improved version of Snel's model for the prediction of airfoil's dynamic stall operation. The main difference (advantage) of the present model, as compared to other dynamic stall models available in the literature (Beddoes-Leishman or ONERA) is the inclusion of a second order equation that accounts for lift variations due to vortex shedding phenomena. The above feature renders the model suitable for predicting loads of parked or idling rotors. The authors validate their model against 2D measurements for airfoils undergoing pitching motion at very high angles of attack in deep stall conditions and against scaled rotor measurements in parked operation. The work presented by the authors is very interesting and up to date. Consistent prediction of VIV of parked or idling rotors is a relevant and very open research question for the wind community while engineering tools capable of reproducing such conditions are indispensable for the industry. Moreover, simulation results presented in the paper (at least the 2D ones) indicate that proposed modifications substantially improve predicting capabilities of the model. Based on the above I recommend publication of the paper after some revision is made to the original text according to the comments below and those discussed in the attached pdf. The main comments that require major changes are listed below: 1) In the reviewer's opinion there is space for improving the structure of the paper. Some of the possible modifications are already indicated in the attached pdf. In addition to the comments in the pdf, section 3.10 is redundant as it repeats more or less the same equations as those of section 3. I would suggest a more clear structure where i) the original model is described ii) the modifications to the equations are listed and explained one by one iii) a section with the test matrix of the tests/experiments and the comparison of the two implementations against test data. 2) The model is formulated on the basis of AoA variations, which is well suited and straightforward for pitching airfoils. When transferred to vibrating rotor blades besides effective AoA changes there are also effective inflow velocity changes. It would be interesting for the reader to know how the model can be transferred to the case of a rotating and vibrating blade. 3) Independent studies (see references below) indicate that the shedding frequency at 90 deg AoA is about 0.10-0.13Hz and not 0.20Hz which is representative of cylinders. On the other hand as the AoA decreases (still within deep stall but lower AoAs, eg. 30 deg) the frequency increases towards 0.2Hz. Perhaps this is an explanation why the agreement is better in the 2D cases while the model considerably over-predicts the shedding frequencies of the parked blade. References: Skrzypiński W, Gaunaa M, Sørensen N, Zahle F, Heinz J. Vortex induced vibrations of a DU96-W-180 airfoil at 90 deg angle of attack. Wind Energy 2014; 17: 1495–1514. DOI: 10.1002/we.1647 Zou, F., Riziotis, V.A., Voutsinas, S.G, Wang, J., "Analysis of vortex and stall induced vibrations at standstill conditions using a free wake aerodynamic code," J Wind Energy, 2015, Vol. 18, Issue 12, pp 2145-2169. Additional minor comments that should be discussed by the authors as well as grammar/syntax corrections can be found in the accompanying pdf.

Please also note the supplement to this comment:
https://www.wind-energ-sci-discuss.net/wes-2019-87/wes-2019-87-RC1-supplement.pdf

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