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WIND ENERGY SCIENCE DISCUSSIONS

Interactive comment on "Ducted Wind Turbine Optimization and Sensitivity to Rotor Position" *by* Nojan Bagheri-Sadeghi et al.

Anonymous Referee #1

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The manuscript deals with the optimisation of the geometry of a ducted rotor, where the rotor is represented by an actuator disk and the duct by a simple single element aerofoil. An Eppler E423 aerofoil is used for the duct profile.

Parameters in the optimisation process are (see attached figure 1): - the location z of the actuator disk - the air gap Δr between actuator disk and aerofoil - the angle of attack α of the duct aerofoil

Using a numerical Fluent implementation of the geometry the parameters to be optimised are the Power coefficient CP based upon the rotor area and the power coefficient based upon the exit area CP,total. The rotor diameter and duct chord length are kept fixed in the optimisation.

The manuscript presents optimal values for both CP and CP,total together with the corresponding values of CT, α, air gap and location of actuator disk. A power coefficient CP slightly above 1 is found when optimising rotor performance, where this value reduces to around 0.85 when performance is optimised based upon exit area.

In order to arrive at optimal conditions, a non-linear quadratic optimisation method is used in two different implementations, but in both cases the authors experience difficulties. Difficulties in determination which combination of parameters are indeed optimal. These are attributed to the observation that flow separation along the duct is a highly non-linear phenomenon, and that optimal operation of a ducted wind turbine is usually close to condition where flow separation occurs.

These experienced difficulties in the optimisation procedure are well described, but it is then difficult to draw conclusions about the optimal values. The big issue is not so much the maximum attainable CP but the value of the other parameters for which the optimum achieved. It seems that both alpha and CT are still "moving around quite a lot" while CP is converging. The authors try to circumvent this problem by defining their values as being "near-optimal". But how can one declare the tabulated values to be "near-optimal" where there still might be a spread of 0.05 in CT and a spread of + 2 degrees in alpha yielding virtually the same CP values?? This is something the authors have to elaborate on further.

To the opinion of the reviewer this can be done either by demonstrating that, through one parameter variations around the identified optimal values, all gradients are negative, or by adding an uncertainty band around the secondary parameters (the "other" parameters for the identified maxima in CP and CPtotal respectively).

Finally the reviewer would like to see the authors include two more points in the concluding section:

- At first about the identified optimal values. Since the search algorithms did not nicely converge it must be stated that the values provided are approximate.

- Second the remark that the presented optima are identified for a configuration with fairly small Re numbers (i.e rotor/duct size), and that optimum values might change with increased values of Re.

Please also note the supplement to this comment:
https://www.wind-energ-sci-discuss.net/wes-2017-55/wes-2017-55-RC1-supplement.pdf

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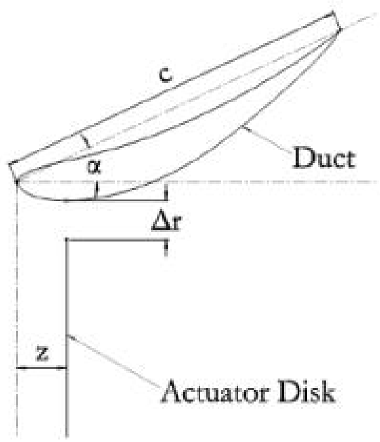

Fig. 1.