**General overview:**

This is the review for the submitted manuscript “Static Closed-Loop Wake Steering and Induction Control in Floating Wind Farms for Load-Constrained Power Optimization”. The paper implements four wind-farm control strategies: greedy control, induction, wake steering and hybrid and evaluates the results on wind-farm power and loads for a floating farm of four turbines using FAST.Farm.

The main concern that I have with the manuscript, is that the validation is done using FAST.Farm. This is a mid-fidelity dynamic wake meandering model that isn’t validated under the conditions used for control, as mentioned by the authors themselves. And as a result it is not really clear whether the main findings (induction control seems most promising and strong dependency on operating regime) are physical or due to model errors. Especially since it goes in contrast with existing high-fidelity simulation results and experimental data, where induction control tends to underperform. Further analysis of the simulation results is also rather descriptive, without a lot of physical explanation or reasoning.

The different control approaches have already been studied for fixed-bottom turbines, so perhaps some more insight/focus could be put on the difference between fixed and floating farm control.

The writing style and grammar are good, although there is a lot of repetition in the text which should be removed to make the manuscript more concise.

I would therefore advise revisions are needed before proceeding further.

**Specific comments:**

- FAST.Farm as validation

As mentioned above this is my main issue with the current methodology. The FAST.Farm code is another model, which has not been validated for de-rated or yaw-misaligned turbines, which is precisely what is used in this manuscript. The authors mention future work being further validation of FAST.Farm under these conditions, but in my opinion that should be done before or alongside a study like this.
Especially considering the peculiar results such as the large power gain from induction control that is not found in literature using experimental data or high-fidelity simulations. F.e. (Heck et al., 2024) showed that the de-rating led to a reduced near wake deficit, but that the wake recovery was slower due to the reduced wake mixing behind the de-rated turbine. One potential cause for the large induction gain could be that the FAST.Farm model only accounts for this first effect and not the second.

I recommend a high-fidelity model like LES is used to validate the FAST.Farm under these conditions by testing a few of the studied cases, f.e. static 8m/s wind speed, -5deg WD and all four control setpoints. You could use an open-loop optimization for simplicity and compare with FAST.Farm open loop. This should still be computationally reasonable since the farm is rather small. Afterwards you can also compare the FAST.Farm open loop vs closed loop optimization, which I suspect to be very similar since only wind speed is varied.

- Yaw direction change between WD -5 and -10deg

Figure 5, shows that the optimal nacelle yaw angles swap direction between the -5 and -10 WD inflow conditions (from + to – sign). But looking at figure 1, I would expect the wakes to always be steered under the downstream turbines by yawing the upstream turbines counter clockwise (CCW). It would however make sense if, the WD angles or turbine lateral spacings were mirrored. Is my interpretation or the figure itself wrong, please elaborate? And also indicate in the manuscript whether yawing is positive in the CCW or CW direction.

- Ct and Cp dependency on yaw

The typical cosine models that determine the dependency of Cp on yaw are based on empirical fits that only works at a single induction set point (e.g. Betz optimum). It's also not really clear what coefficient to use for Ct, even after fitting Cp.

Thus when combining induction and wake steering control, I recommend to either use a yawed induction model (Heck et al. 2023; Burton et al. 2021) or by modelling it directly  using BEM. You already ran a series of OPENFast cases to find Ct and Cp as a function of de-rating regime and tilt, so I suggest (using a coarser resolution and) adding yaw and interpolating where necessary.

- Wake model fitting

Using 24 (3x8) wake model fitting parameters is a lot. I am kind of surprised you need that many, especially for the different inflow directions that 'only' differ 5 degrees.

The downside is a risk of overfitting to the specific FAST.Farm model, which isn't necessarily better than the data that was used to fit the coefficients in the original literature. E.g. can you explain the physical reasoning behind a negative wake expansion parameter ka that you get for all three cases? Another downside is that it also limits real world applicability, since there you might not have the required data.

I recommend to restructure this section 2.5.2 and all the calibration explanation to an appendix. At the moment certain parameters like G are explained in eq 4 and others are glossed over. I would also like to see the match between the fitted/unfitted FLORIS model and FAST.Farm (and ideally a high-fidelty model). And give a brief, but complete overview of the different submodels used in FLORIS, e.g. wake deflection model from Bastankhah 2016, which superposition method, TI dependent expansion from Niayifar 2016… You already refer to Bastankhah, but it's not clear whether the deflection or deficit model is used.

- Farm-level rotor-thrust constraint

Could you elaborate on why a farm-level rotor-thrust constraint was chosen instead of an individual constraint or unconstrained optimization? Especially since later the loads are studied for individual/most loaded turbines, so then the farm-level constraint doesn't necessarily help.

In Figure 8, is my understanding correct that the increased loads under wake steering come from the increased velocity at downstream turbines, increasing their thrust. Which is then greater than the effect of the reduced thrust of upstream turbines due to yaw-misalignment (cosine factor)?

And are the induction and hybrid control cases constrained to the 0.9 farm-level thrust constraint, or is it often non-binding? It would be interesting to see the FLORIS data as well.

- Effect of floating farm

A lot of work has already been done in wind-farm control for classical fixed-bottom turbines, so I would elaborate on the distinct differences and interactions that come with floating farms. Studying the fairlead tension is a good start!
In Figure B2 the first turbine's (which has no wake effects) induction and hybrid control tower-based DEL is significantly different in the -5deg case from the 0 and -10 deg cases, is this perhaps due to some sort of platform and turbine induction resonancy effect? Are these effects elsewhere at play, and how do they effect optimal control?

It would also be interesting to look at the effect of varying ambient TI's, since it has a significant influence on both induction and wake steering control.

- Less repetition

The text is a bit long. I recommend:

- Limiting the explanation on known techniques (such as Serial Refine)
- Avoiding double definitions (e.g. de-rating levels repeated multiple times, although it's still not clear what the actual range defines, d=0 is non de-rated, d=10 is what precisely).
- Not describing all the tabulated data again in the text (focus on analysis, correlations, physical reasoning).

**Technical corrections:**

- Figure 2: u is used for both the control vector and the speed magnitude which is rather confusing
- Indicate whether yaw + sign is counter clockwise or clockwise
- Figure 3 has different MAE values (0.074, 0.089) compared to the text (0.065, 0.076), line 407,409
- Describe which values are used for $p_p$ and $p_P$ factors
    - Also their naming is confusing, they are different right? (Power vs thrust dependency on yaw).

    - But ideally you replace them anyway
    - Also leave out tilt cosine correction, since it’s incorporated in OPENFast calculated Ct
- I wouldn’t use gamma as a symbol for both yaw and thrust constraint (even with thrust subscript)
- Mix of ms^-1 and m/s notation
- WD abbreviation is written in italic instead of normal, since it’s in the math equation, you can use \text{}

**References:**


Heck et al.: Modelling the induction, thrust and power of a yaw-misaligned actuator disk, J. Fluid Mech., 2023

Heck et al. : Investigation of far-wake models coupled with yaw-induction control for power optimization, Journal of Physics: Conference Series, 2024.

Burton, T et al.: Wind Energy Handbook, 3rd ed: The aerodynamics of a wind turbine in steady yaw, 2021. Chapter 4.2.2 Glauert’s momentum theory for the yawed rotor