Author Response to Referees

Thank you for your helpful reviews. We believe we have addressed all of the comments sufficiently. You will find our detailed responses to all comments, including changes made to the manuscript, in the following sections.

Note: numbered comments and quotations are from the referees, indented bullets contain the author responses.

Response to Referee 1

"In this manuscript, eight different optimization algorithms are used to optimize the layout of wind farms with concave boundaries and discrete regions. The main comments are as follows:"

1. "The running time and corresponding hardware facilities of each algorithm are suggested to provide."
    - The runtime and hardware information is provided in the text, but was intentionally not presented in aggregate form because the widely varying hardware used for each algorithm makes a run-time comparison misleading at best, not to mention the differences due to programming language. Instead of comparing run time, we have compared function call metrics. The information in the function call metrics is arguably more useful than the run-time because the function calls are less dependent on what hardware and language were used.
2. "The single wind turbine wake model and wake superposition model should be given."
    - Good suggestion. We have included the wake and wake superposition models in the manuscript.
    - See lines 176-190 in the revised manuscript.
3. "The effect and efficiency of various optimization algorithms need to be analyzed quantitatively, refers to the recent publication: (Yang, Q., Li, H., Li, T., & Zhou, X. (2021). Wind farm layout optimization for levelized cost of energy minimization with combined analytical wake model and hybrid optimization strategy. Energy Conversion and Management, 248, 114778.)"
    - It is not clear from the provided citation what efficiency is referred to. We have provided quantitative comparisons between algorithms in terms of function calls, objective results (AEP), and wake-loss. This information provides significant insight into the efficiency of each algorithm (function calls) and efficiency of the resulting layouts (wake loss). The effect of each is algorithm is addressed quantitatively through providing the objective results (AEP).

Response to Referee 2

General Comments

"This paper compared the performance of 8 optimization methods for wind farm layout optimization, using a case from the IEA Wind Task 37 with 81 turbines spread in 5 disconnected regions. In general, all methods showed similar performance. The results seem quite interesting and should be valuable for the wind farm optimization field."

Detailed Comments

"There are some places that the reviewer thinks could be improved, which are listed as follows":

1. "Minimal distance requirement seems to be a constraint considered, according the descriptions of different methods, but is not mentioned or introduced in the problem formulation description."
    - This is a good point. We have referenced another document providing more details on the case study formulation, but agree that providing the constraints explicitly is useful. We have added the objective function, which includes the spacing constraint referred to in the comment
        - See lines 195 to 198 in the revised manuscript.
        - See equation 5 in the revised manuscript.
2. "Wake loss (L_w) is defined in Eq. (2) by multiplying 100 to the percentage loss, but in other places, it is always referred to as percentage (%). I can't seem what is the point of multiplying 100 here."
    - This is a good point. We added the 100 because of presenting wake loss as a percent later on, but you are right that it is not necessary. We have removed the multiple of 100 from equation (6).
        - see line 210 in the revised manuscript.
3. "According to Fig. 2, it seems that the same Weibull distribution is assumed for all wind direction bins, but this usually is unrealistic, since wind coming from different direction usually have different strength. For a more realistic modelling of wind condition, you could use a joint distribution of wind speed and wind direction, which allows different Weibull distributions in different wind direction sectors, such as the one proposed in: https://doi.org/10.3390/en8043075"
    - Thank you for pointing this out. We did use a different wind speed distribution in each direction. We have edited the manuscript to clarify this point.
        - See line 203 in the revised manuscript.
        - See the caption to figure (2) in the revised manuscript
4. "The concave hull is defined with coordinates in lines 243-244. It is better to show it in figure, also there are no numerical axis shown in all the layout/wind farm plots, thus, it is impossible to figure out where is the

concave hull located."

- Good point. We have added a figure with the concave hull.
  - See figure (4) in the revised manuscript
- Note that the boundary points and turbine locations are all provided in the supplemental data repository.

5. "The local search method in the DEBO algorithm is actually very similar to the Random Search (RS) algorithm as proposed in: https://doi.org/10.1016/j.renene.2015.01.005 for wind farm layout optimization, as they both move only one randomly chosen turbine in each iteration. Although DEBO uses discretized grids and RS operates on continuous design space, the basic principle is similar, thus, the reviewer think it may make sense to mention the RS algorithm, and discuss a bit on the similarity and differences."
   - Thank you for providing the reference. We have added an explanation of the comparison between the two algorithms in the description of the local search part of the DEBO method
     - See lines 316 to 328 in the revised manuscript.
6. "d_x and d_y in Eqs. (7-8) are not introduced or explained anywhere."
   - Variables (d_x, d_y) were defined line 330 in the submitted manuscript, we have added more description of these variables to make sure they don't go unnoticed.
     - See lines 337 to 338 in the revised manuscript.
7. "In several methods, two stage approaches are applied. It would be nice to present how much improvements can be attribute to different stages. The other aspect is the initial layout, some use randomly generated ones, some use the provided one, some use manually generated good ones. Instead of only compare to the reference layout, i.e., the provided layout, comparison to the used specific initial layout may also be added. So we can have a better idea on how much improvement has been achieved by the algorithm starting from the initial layout."
   - This information would certainly be interesting. We chose not to provide it because it was only available for some of the algorithms and in different forms for those that did provide the information. Some of the starting layouts used are available in the supplemental data repository for those interested in a deeper dive.
8. "Description of the DPA method can be improved, currently, there are purely text and missing some details. But more importantly, the reviewer can't understand step 4 as stated in lines 627-628, i.e., "using the wind resource information, order the list from highest wind speed to lowest." If it is onshore wind farm with non-uniform wind resource distribution, such as on complex terrain, I can understand, but for offshore site with uniform wind resource, how do we do this? In this case, every location will have the same ambient inflow wind speed. Better explaination of the algorithm will be need if the readers are to understand the procedure."
   - In the DPA algorithm, ordering by wind speed is irrelevant in the case of a uniform wind speed distribution. We have added clarification to

this effect.
  - see lines 649 to 653 in the revised manuscript.

9. "No-free-lunch theorem is mentioned in the discussion section, see line 867-868. I will think the original source of the theorem should also be cited here, i.e.: https://doi.org/10.1109/4235.585893"
   - Good point. We have included the reference.
   - See lines 892 to 895 in the revised manuscript.