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Overall

- The article is very abstract and very much written as if intended for an OR audience. WES is an application-oriented journal where the domain focus of wind energy is the common denominator – thus, papers should be rooted in the realism of the domain. This should be improved substantially in the paper and several suggestions to do so are made by section.
- The introduction does not clearly state what NextPM is and how it extends the state of the art. This should be crystal clear. Flow diagrams may help. Or using a motivating real example and then comparing for that example how NextPM will work as contrasted to PMSPIC.
- The lack of wind-specific context in the entire methods portion of the paper (sections 2 and 3) is a problem – see detailed notes below
- Section 4 also is quite abstracted from reality and some of the data uses is old or model parameterization not thoroughly justified. Different turbine components are listed but there is no discussion of them (figure 1)
- Have a native English speaker edit the paper for syntax – a lot is well written but there are also many places where sentences are hard to read and I had to read them multiple times to get their intent.

Abstract

- Discussion on global warming in abstract is unnecessary – okay for introduction but abstract should be succinct and to the point, suggest eliminating entire first paragraph
- The abstract reads too much like a marketing pitch for NextPM – I suggest rewording it to put more emphasis on the scientific contribution to the state of the art

Introduction

- Lazard 2017 is a bit outdated – suggest updating reference to most recent Lazard.
- Citation on O&M costs for offshore as percent of total? There are many – see cost of wind energy review from NREL or various other sources
- The literature review is okay but there is a decent amount of literature in this space that is not addressed. Suggest the author look at the work from U. Strathclyde, ECN/TNO O&M calculator, Fraunhofer IWES, work by Dimitrov et al, and commercial capability of Peak Wind/Lautec/SeaImpact to supplement existing literature base
    - Particularly the O&M calculator from TNO provides a breakdown of planned and unplanned maintenance as well as a breakdown of failure types with a range of severity from minor repair to component replacement. It seems in the paper you are focusing on component replacement – yes? Be a bit more clear about this
    - Most maintenance models like the ones from the organizations above are time-series based which makes optimization of scheduling quite difficult – though there are efforts out there even in commercial tools
- Define what you mean by multi-component systems – it is somewhat obvious but important

- How are the models in Moghaddam and Usher nonlinear?
- It is not clear what the PMSPIC model does at all – flow diagrams would be VERY helpful to illustrate what that model does and what your model does (in order to contrast the two effectively) – already in the introduction you should be stating at a high level how the NextPM algorithm is different from and improves upon PMSPIC
- It seems like the lines 53 to 57 are a bit thrown in there.
- It would be helpful to have a bit more of the big picture to better contextualize the work. Here is a suggested path for reworking the introduction:
  - Start with the real-world issue: offshore wind O&M is costly – how costly? See NREL work for example – therefore want to reduce
  - How does O&M for offshore wind work? again, see ECN O&M calculator as a good high level overview of how offshore wind O&M works in practice
  - But, many of these models rely on time-series simulation of the failures and logistics where there are many underlying probabilistic / uncertain events both with component failures (of various types) and access issues (related to weather conditions)
  - Thus, this becomes a very challenging optimization under uncertainty problem
  - How have people tackled this before?
    - In general, operations research communities have looked at O&M optimization via several techniques
    - For wind specifically, optimization of O&M has been tackled in x,y, z ways
  - In this paper, we build on the state of the art with a new algorithm, NextPM, that does x,y,z and thus has potential for capturing a,b,c, additional realism of the offshore wind O&M optimization problem and/or improves the computational efficiency by leveraging d,e,f…
  - The paper is organized as follows…
- Appendix A and B have only the formal optimization problem formulations – is it necessary to have them as two separate appendices? Or appendices at all? Personally I prefer to see the problem formulation in situ and up front as it is the central organizing basis for an optimization study

Optimal rescheduling algorithm

- Before jumping to the description of the algorithm, consider describing it at a high-level in plan language
- FYI: A key cost of offshore wind failures is not the component costs but the downtime and associated loss of energy production. Most of the O&M models mentioned above also calculate availability which can then translate directly to revenue losses
- FYI: most models above also treat dt is a uncertain variable since it is highly weather dependent, bj and cj are also uncertain but models often treat them as deterministic – i.e. failures are probabilistic but the costs to repair them are deterministic
- Line 85 – need to explain here in plain terms what lamda is
- Again, I think a flow diagram would help here. Can you represent visually or in plan language what the optimization problem you are trying to solve is? Contextualize it

with an example using a wind turbine? And contrast it with a baseline approach? It is still unclear what is novel here.

- I am not sure why section 2 is a stand-alone section. It seems to me it is part of the methods and I recommend section 2 and 3 be merged and made subsections of an overarching methods section
- It is still not clear what NextPM is doing by the end of section 2 nor NextOM

Optimal plan for next preventive maintenance

- Overall section 3 would benefit from more contextualization from the real world offshore wind O&M problem. Nothing about section 3 seems tied specifically to the offshore wind O&M optimization problem. – can you bring in real world examples to help contextualize the approach and demonstrate its uniqueness and value from an offshore wind problem-specific perspective?
- Line 101-103 – this is important and should be discussed in the introduction. Also, it should be explained WHY this approach is being taken. It is not self-evident.
- Line 104: Explain what z and x are from a real-world perspective
- Line 110: why? Explain why this approach is being taken
- Line 142 and 152 – why is lambda introduced? Please explain more clearly
- Lines 212-215 should be brought into the introduction. It should already be clear up front how this work will extend the state of the art (though details can remain in a later section)
- Also, line 212 is the FIRST mention in all of section 2 and 3 of a wind turbine. Nothing about the work to this point is tied to the offshore wind problem specific context… this is a problem for publishing in WES and needs to be remedied before acceptance to publication (see earlier notes on same topic)

Numerical studies

- There are much more recent papers related to wind turbine failures rates and repair costs – see work from organizations mentioned above and also reporting from NREL, ORE Catapult, BVG Associates, and others
- Typical farm lifes are more like 25 to 30 or longer – lifetime from a financing perspective is often 20 but has been getting longer
- Line 224 – explain this lambda value better– at least in a footnote if not in a paragraph. What computer simulations elsewhere and why not reported???
- Line 223 and line 235 – the decision of the specification of r is not well explained
- Line 239 – d= 5, 5 what?
- Lines 240-245, for wind systems, components are designed for the full plant lifetime (in this case 20 years). Any component replacement prior to that is considered a premature failure and thus is typically in the bucket of unplanned maintenance. Condition monitoring can help detect components that will fail prematurely, which is where the approach in this paper would become relevant. But it is odd to say that PM replacement (for any major component is 43 months) this would be SUPER short from an industry perspective. Again, this entire work seems pretty unlinked to the wind specific O&M problem
- Figure 1 shows the components but neither of the two figures are really well explained. It would be good to separate these into 2 figures and clearly explain what each of them means

- Line 250- Mobilization cost of d = 10, 10 what?
- Part A and B and C headers (line 252, line 264 and line 272 respectively), make these separate lines and not in paragraph text
- Explain better what you mean by winter versus summer start – does this make sense from a real world problem perspective?
- I recommend doing Part C first – this would be the baseline (all corrective no predictive maintenance) – part A introduces some level of PM and then part B considers the seasonal effects. Then, include the percent savings in each of table 2 and 3 and reference back to the CM analysis
- Need to explain lines 286 to 289 better. How can you do a fair comparison?
- Line 304 – 5 hours to solve what? The full optimization problem?
- The overall comparison of NextPM and PMSPIC seems incomplete – are there caveats to this? What are the key assumptions you are making that might be limiting the external validity of the work?

Conclusions

- Consider revisiting the conclusions after the rest of the paper is reworked and better tied to the wind energy problem
- Do not mention preliminary results (not shown) on computational time… either show them or don't mention them – i.e. leave it as future work
- Also, what is the future work? where will this effort go? What will it take to make this actually useful for wind farm O&M planning?
- Line 316-317 again is more like a marketing pitch