Feasibility of up-tower repair concepts for pultruded carbon spar cap planks in wind turbine blades

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GENERAL COMMENTS:

The topic of this paper is very interesting at least for O&M engineers and managers of wind farms on- and off-shore. The manuscript is well written and its content presented in a clear and unambiguous way, more or less (see also specific comments below). However, the authors do not clearly state where the novelties of this work lie. The manuscript follows closely a patent application by the authors, published in 2024, and using even the same figures and arguments no scientific proof of concepts is provided. Section 4.2 "Support structure concepts" contains a sole presentation of brain-storming ideas without detailed calculations, implementation or experimental verification of their applicability. The attractive call for up-tower repairs mostly relies on cost reduction compared to down-tower processes. Again, there is no proof, evidence or clue on whether proposed ideas, even if pragmatic, can lead to any cost reduction for O&M budgets. In light of the above, if the manuscript is published, it is better to drastically reduce or even remove Section 4.2 by quoting the relevant patent application. Also the title has to be modified to correctly reflect the content; some ideas are cast but it is uncertain whether they are technically feasible or even advantageous cost wise.

SPECIFIC COMMENTS:

1. It is mentioned in the abstract: "…Various innovative support designs are proposed for installation…" but only a conceptual abstract sketch is shown for each idea. "Design" is more than that. Modify accordingly

2. Section 2.1, Line 41: " …The proposed repair concept …" The authors must clearly state that this type of up-tower repair in CFRP spar caps by cutting also windows in shear webs is already known and performed in the field by a few repair companies. It is not an innovative solution presented by the authors. There are no related publications because these are technical solutions and processes belonging to the commercial and not the academic universe of wind energy technology

3. Line 46: for what purpose " …Determine a rotor blade position such that the load on the weakened …" since to repair the blade it should remain horizontal, i.e. at 3 or 9 o'clock? It could be perhaps proposed to determine by aeroelastic calculations this optimal position of the damaged blade for harsh wind conditions but as for repair works, must be horizontal

4. Section 2.3, Line 92-93: "…The resulting shear force distribution was transferred from the load simulation to the FE shell model using rigid-body elements of type RBE3…" Describe this in detail; how exactly "shear force distribution" is transferred? In the entire blade model or in segments? How many RBE's are introduced? By "shear force distribution" the discrete force and moment vectors developed at the nodes of the aeroelastic beam model are meant? As vaguely described it leaves suspicions on static equivalency

5. Fig.5 is incomprehensible and text in Lines 115-118 is not helpful.

6. Section 4.2: As already argued, the information contained here can be recalled in the related patent application and since no proof of concept, whatsoever, analytical, computational, experimental is presented could be removed

7. Conclusions: The two first lines are contradicting with the content of the manuscript; the determination of optimal position of the damaged blade depending on wind conditions is irrelevant since repair is only possible when the blade is in horizontal position

TECHNICAL CORRECTIONS:

1. Line 21: reference to Fig.3 in the text precedes that to Fig.2

2. Caption of Fig.3: "…cut line B-B"; replace by A-A, "…cut line A-A"; replace by B-B

3. Line 70: Euler-Bernoulli classic beam theory is more than enough! Reference to a 3 centuries old latin source (Euler L. 1744) is an exaggeration.

4. Line 161: replace "aerial" by "areal", replace "kgm^{-2}" by "gm^{-2}"