Answers to reports on wes-2022-109

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Answer to anonymous referee 2

1. Lines 25 and 29. In the text we'll replace "oscillating stability" by "oscillating steady-state"
2. Line 27. We'll correct in the text
3. Line 37. We'll correct in the text
4. Line 40. We'll replace "However the platform pitch damping analysis is not investigated and the link with the compensation parameter is not given " by "(Lenfest et al., 2020) investigates the (coupled) platform pitch damping and parameter tuning with a purely numerical approach. In the present work, we propose an explicit formulation for the tuning parameter related to this damping which depends on the system properties."
5. Line 54 (and other occurrences). We'll add Fischer2013 to our bibliography. We'll cite it with Stockhouse for the previous works dealing with the platform pitch compensation
6. Line 107 and others. We'll correct in the text.
7. Line 120. We'll delete " $= k_I(\theta - \Omega_r)$". It didn't add info.
8. Line 129. We'll correct in the text.
9. Line 133. We'll correct in the text.
10. Line 142. We'll correct in the text.
11. Lines 165 - 175. We'll add this reference for the NMPZs definition and comprehension: Hoagg, Bernstein, 2007, IEEE Control Systems Magazine.
12. Line 177. We'll correct in the text.
13. Line 180. A graphic visualization of the roots of G(s) will be added. In particular, we'll show how those roots move when m_{τ_g} varies, and that will explain its utility. The stability margin will be discussed.
14. Line 185. We'll add the definition of WTG in the text.
15. Tables 1, 2, 3. We'll correct the errors in the units.
16. Tables 1, 2, 3. The values are determines arbitrarily as examples, to ensure the appearance of NMPZs. This is done in the purpose of a pedagogic example to show the effects of the NMPZs. The values are purely numerical. There are not so far from the coefficients related to the IEA15MW wind turbine because we started from those physical values and we found the right coefficients, in the order of 10% or 20%, to make the system unstable. The numerical section focuses on more realistic FOWT tests.
17. Figure 2. At lines 184 - 199, we explain intuitively how equation (25) can be interpreted and how it implies a flipped sign of the steady-state response. For more details at that subject, (Hoagg, Bernstein, 2007) is very clear. We will add this reference in our bibliography.

18. Figures 2, 3, 4. We'll add units for the y-axis (ϕ is in rad and ω is in $rad.s^{-1}$). The beta-step input is of size $0.02rad$. This precision will be added in the caption.

19. Line 206. for equation 28., we'll cite Stockhouse and Fischer.

20. Line 207-225. We'll give more details about m_{τ_g}, including its dependency on D_t. For this, the graphical representation of zeros and poles will be useful.

21. Line 215. Indeed, $d\beta_{comp} = -k_\beta\dot{\phi}$! (Of course this is just a typo error and doesn't affect the analytical results.)

22. Line 221. (Stockhouse, 2021) discusses equation (29) : the parameter m_{τ_g} introduces a possible saturation of generator torque (τ_g) control. We will rephrase this in order to make it clear.

23. sec.2.3.3. This section will be improved with the poles and zeros analysis.

24. Line 233. Gain scheduling approach defines a set of "set points". For each member of if, it provides a different set of pre-computed gain parameters. The hypothesis is that the system is linear close to the set point. Our approach make the same hypothesis. However, we don't need to pre-compute a set of gain parameters for each operational set point because the gain parameters are computed by the explicit formulas (equation 37). This explanation will be reformulated and added in the text for a clear understanding.

25. Line 238. We'll replace "negative damping" by "NMPZ phenomena (combined with the closed loop control)".

26. Non, generator torque parallel compensation is not implemented in the simulation because not necessary.

27. Line 328. Equation (51) will be separated into equation 51.a, 51.b, 51.c.

28. It would be good to have a section analyzing which NMPZ is verified and for which operating point, but I am not sure how we can obtain precise values for the partial derivatives that appear in the NMPZ conditions.

29. Line 352 and 354. For k_P and k_I, many preliminary simulations, without the floating compensation, have been performed in order to obtain a set of values which works already very well for this system, without using any k_β. Those values of ζ_{rot} and ν_{rot} gave the best results, which might also be due to our choice to switch off blade pitch saturation (choice motivated to better observe the effect of our platform pitch control strategy). We will add some details about this choice in the paper. This can be considered as a "detuning strategy". This remark is important because we actually compare our strategy to a "detuning strategy" which already avoids the negative damping effects. We'll reformulate and add this to the text. However, the focus of the paper is on the floating platform compensation. Since the platform pitch control ($\beta_comp = -k\beta\dot{\phi}$) has a damping effect on the frequencies close to the natural frequency of the platform, its tuning can reasonably be considered as independent from the tuning of the PI controller. This is why, in the paper, we didn't focus on the tuning of the PI controller, which is already well assessed in literature.

30. Section 3.3. The value of the left-hand side of the third inequality in (51) varied from case to case, but was usually between 0.055 and 0.065 (so indeed lower than 0.1). This is coherent with the fact that the system is highly under-damped.

31. Fig. 6. when the platform pitch rate is compensated, the Thrust changes because of the change in the blade pitch (induced by k_β) and the mean platform rotational position changes. In fact the system slightly shifts to another operating point.

32. Fig. 8 and 9. The main result shown here is that, while the mean values changes are very small, there are big changes in min-max and standard deviation. Figures 8 and 9 actually give more precision about this statement, since all the densities are plotted. Also DELs and extreme loads are analyzed later in the paper, on a more complete simulation.

33. Sec. 3.4. This choice is to show the as much results as possible. If necessary to be homogenized, it can be done.

34. Fig. 12. blade pitch saturation is not considered to better observe the effect of our platform pitch control strategy

35. Fig. 13. Max Rotor Speed and Max Gen Power will be added in the paper. the coupling affects rotor speed, hence, around $4m/s$ the speed is close to cut-in and the variation on the rotor speed can lead to values of power close to zero. However, it is negligible with respect to the global power production.

36. bibliography will be revised and improved