Response to reviewers

Title: Design and Simulation of a Continuously Variable Hydraulic Power-Split Drivetrain for Wind Turbines

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The authors thank the reviewers and the editor for their constructive comments. All revisions have been incorporated into the manuscript. The corresponding changes are described and explained in detail below.

Line No. coloring: Preprint: light grey; Revision #1: blue; Revision #2: red

Comments of referee #2 and their respective answers are listed below:

1. "Line 35 (25): This sounds like the fully hydrostatic drivetrains were the first attempts to decouple rotor and generator, however their is a limited decoupling of the speeds in asynchronous machines that has been used in early commercial wind turbines. Maybe add the word "fully" or "over the full range of rotor speeds" to make this a bit clearer."

   We added "over the full range of rotor speeds" as suggested (line 25, revision #2)

   First attempts to decouple rotational speed of the rotor and the generator over the full range of rotor speeds were made by introducing fully hydrostatic drivetrains.

2. "You say the generator power exceeding the rotor power at 5.5 m / s is ~~not~~ *(?)* discussed in section 5.1, but I did not find any such discussion. Could you point it out to me, maybe I am not clever enough to find it."

   We discuss the hydraulic power exceeding rotor power shortly in section 4.1 and in more detail in section 5.1 in lines 362 – 376 (revision #2). What you see in Figure 3 is not the generator power exceeding rotor power, but the demanded hydraulic power which would be necessary to enable TSR-optimal rotor conditions. Generator power would be negative in this scenario, if TSR-optimal operation is enforced. If not, a non-optimal rotor speed would be the result, and the generator power could not exceed rotor power which would likely be even lower then. In Section 5.1 the intersection between demanded hydraulic power and rotor power lies at even higher wind speeds of around 7 m/s due to the hydraulic efficiency. We added "demanded" hydraulic power to the caption of Fig. 3 to make it a bit clearer what we mean there.

   Line 362-376, Section 5.1:

   With generator-side power take-off, efficiencies are generally higher due to constant, high pump speeds at the generator shaft. However, pump input power and demanded motor power rise above rotor power at low wind speeds, as described in section 4.1. This leads to unrealistic conditions and it is unclear how the drivetrain would behave in this area.

Looking at the fixed torque ratio at the planetary stage (Eq. (4)), the maximum torque at the pump is given by the transmission ratio of the planetary stage and is significantly lower than the demanded torque at the ring gear. With this low torque and the needed high rotation speeds at the generator it is not possible to achieve the necessary power at the pump without the generator acting as a motor and adding power. When there is not enough torque applied at the ring gear, the system will reach a state of equilibrium with the rotation speeds and the rotor speed will differ significantly from the optimal TSR-speed. This leads to the assumption, that generator-side power-split is unsuitable for low wind speeds and therefore in general not practically applicable for the investigated arrangement. Thus it will be excluded from further investigations in this work. In Fig. 13 b) the intersection point of pump power and rotor power marks the start of the permissible operating range. Increasing partial load efficiencies would shift the intersection point of pump and rotor power towards lower wind speeds and therefore allow operation in that range of wind speeds. A possible solution could be lowering the generator speed and the transmission ratio of the last stage or interchange the positions of the motor and generator to get a different power flow.

3. "In the author's response there is a remark about the possibility of spur gears as the second stage. I am still very much in doubt of this being applicable to multi-MW turbines, but the response says this is in line 138 and I could not find the respective part of the text again. Could you help me out? Also, I cannot help your argument in the response. I am in agreement with a configuration with to planetary stages and a third spur gear stage, but you seem to be arguing to replace the second planetary stage or medium speed stage by spur gears, which doesn't seem to make sense."

   Line 138 was the line to which your first comment referred in the first preprint draft. Line 188 was the new line, indicated in light blue in the author comments document.

   But we understand the confusion and see misunderstandable wording in line 188. We're suggesting two planetary stages plus spur gear, and you are completely right, the first and second high torque stages would have to be planetary stages and then the last HSS Stage could potentially be omitted. Then the second planetary stage would become the summation stage.
   We clarified the section and changed the "second" to "third" (line 187, new document):

   Since the selected transmission ratios of the individual stages are deliberately conservative, the additional spur gear could potentially replace the third planetary stage entirely, provided that the transmission ratios of the remaining stages are increased accordingly. In this configuration, the second planetary stage must be designed as the summation stage. With that, material and mass could be reduced.