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Interactive comment on "Basic controller tuning for large offshore wind turbines" *by* K. O. Merz

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General comments:

This paper would serve well as a tutorial. Explanations are good, and many relevant issues are covered. However it does not really advance the field: I struggle to find any new insights or ideas. There is a narrow focus on one specific turbine example, which happens to come with a very rudimentary and inadequate controller. It is unfortunate that this one example has been used so extensively in academic circles, often without questioning the basis of its controller. The paper would be greatly improved by just a few comments recognising the limitations of this particular case study. Other researchers have designed their own controllers for this turbine, and therefore have not necessarily encountered the problems which this paper dwells heavily on; and outside of academia there are very many commercial turbine designs with good, professionally-designed controllers.

Specific comments:

Model order: There is quite some emphasis on which degrees of freedom should be used, but not enough recognition that this actually depends on the specific case. When designing a controller, it is always important to analyse and understand the dynamics of the plant so that the appropriate degrees of freedom are used. A turbine with a stiff tower, for example, is very different from one with a soft tower. In general one can start with all practical degrees of freedom and then reduce them to what's needed, rather than trying to decide in advance. There are methods for this based on controllability and observability. Such formal model order reduction methods can also be used for the aerodynamic states, rather than arbitrarily picking a blade element at 75% span.

Controller structure: the problem of gain scheduling which this paper dwells on is nothing special: it is specific to the particular controller structure which was chosen. One always has to consider the controller gains in the context of the chosen controller structure. A classical PI-based wind turbine controller need not be like this example, but can also include all sorts of loop-shaping filters, auxiliary loops and other devices to tune the response. The paper should acknowledge this, and also the key goal of reducing fatigue loading which is not really captured by the simple performance metrics used.

Controller tuning and sensitivity: part of a serious controller design is to make sure it is robust, and will remain stable in all sorts of environmental conditions, not all of which can be simulated, as well as to modelling imperfections, as no simulation model can be trusted to model the system perfectly - and it's not just the model structure, but also the parameters, whose values are likely to be different in the real as-built turbine. Such robustness was clearly not considered in designing the original controller, which has probably been used far beyond its original intention. There are classical control design techniques which help to ensure robustness, reducing the chance that simply changing to a different simulation model results in instability. That would clearly be unsatisfactory, as there is no guarantee that it would be stable on the real turbine.

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