

Steady States Calculations

Exercise to Lecture #8 “Controller Design for Wind Turbines and Wind Farms”

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1 Calculation of Steady States for Baseline Torque Controller

With the script [Exercise08_StaticCalculations.m](#) and the case NREL5MW\FBNREL in [StaticCalculations_Config.m](#) (line 39) we are calculating the steady states (rotor speed, tower top displacement, pitch angle and generator torque) for the baseline torque controller. Please perform the following tasks:

- Calculate the rated wind speed within the script [HowToFindRatedWindSpeed.m](#) using `fminbnd` and `fminunc` and the function [OmegaDot.m](#). Copy the solution using into [StaticCalculations_Config.m](#).
- Adjust the calculations for the steady states calculations in [Exercise08_StaticCalculations.m](#) (Section 4.2) for the cases 'StateFeedback' and '3'.

2 Calculation of Steady States for Advanced Torque Controller

With the script [Exercise08_StaticCalculations.m](#) and the case NREL5MW\FBSWE in [StaticCalculations_Config.m](#) (line 39) we are calculating the steady states (rotor speed, tower top displacement, pitch angle and generator torque) for the advanced torque controller.

- Adjust the case NREL5MW\FBSWE in [StaticCalculations_Config.m](#) based on case NREL5MW\FBNREL. You need to set `FlagPITorqueControl` to 1 and add calculations for `Parameter.VSC.v_1to1d5`, `Parameter.VSC.v_1d5to2`, `Parameter.VSC.v_2to2d5` similar to `Parameter.VSC.v_rated`.
- Calculate the steady states for the advanced (PI) torque controller by adjusting [Exercise08_StaticCalculations.m](#) (Section 4.1) and adding the cases 1, 1.5, 2.5 in Section 4.2.
- Compare the energy gain between the advanced (PI) torque controller and the baseline torque controller and estimate the increase in AEP using a Weibull distribution for Wind turbine class I.

3 Calculation of Steady States for Baseline Controller Using FAST

Run steady state simulation for every 1 m/s using the baseline controller DLL from Exercise 4. Use a simulation length of 60s or more and average over the last 3 revolutions. Compare the steady states from FAST to the ones from SLOW. You can use the steady states for tower displacement, rotor speed and pitch angle from SLOW to initiate FAST.