

Tower Damper

Exercise to Lecture #5 Controller Design for Wind Turbines and Wind Farms

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1 Design of Tower Damper

In this exercise we design a tower damper for the NREL 5MW reference wind turbine at 20 m/s.

- Test the script [Exercise05_TowerDamperDesign.m](#). You should get a plot like Figure 1. Please take your time to understand what the script does. Use the help function for unknown commands.
- Please adjust the Pitch Controller (PC) in step 4 using the parameter `kp` and `Ti` and the definition of the PI controller in the Laplace domain. What are the damping and frequency of the poles of the rotor motion from the desired closed-loop? How do they change when coupled with the tower motion? What are the damping and frequency of the coupled tower motion?
- Please adjust heuristically the gain in step 7 for the tower damper which triples the damping of the coupled tower motion. How does the frequency of the coupled tower motion change?

2 Test of Tower Damper

In this exercise we implement a tower damper for the NREL 5MW reference wind turbine.

- Test the script [Exercise05_TowerDamperTestWindStep.m](#). You should get a plot like Figure 2. Why is it not exactly the same as in the controller design (CL without TD)?
- Please adjust `Parameter.TD.gain` in [NNREL5MWDefaultParameter_FBNREL_TowerDamper.m](#) as designed above and implement the tower damper in [NREL5MW_FBNREL_SLOW2DOF_TowerDamper.mdl](#) in the pitch controller subsystem. Following adjustment needs to be done:
 - The tower speed cannot be measured, but the acceleration. Use a simple integrator (IC 0).
 - The tower damper should be activated at 4 MW electrical power and linearly ramped up to the full gain at 5 MW. Use an interpolation block with adjusted `Parameter.TD.Power` and `Parameter.TD.Value`. Further, the power signal needs to be derived and filtered. Please use the low pass filter from the generator speed filter and parameters provided in `Parameter.LowPass2`.
- Run the simulation again and compared it to the step response from the design above (CL with TD). Is the response of the nonlinear model similar?
- Check with the script [Exercise05_TowerDamperTestTurbulentWind.m](#) the reduction in DEL for the tower base bending moment.

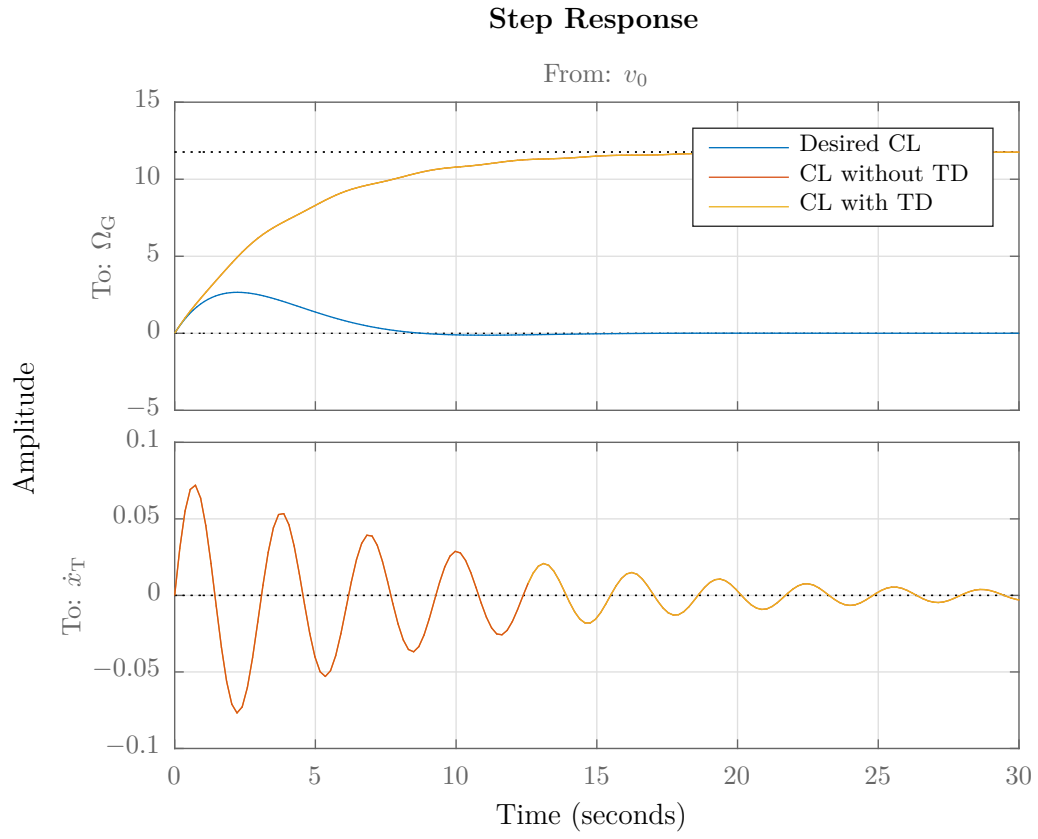


Figure 1: Start of tower damper design exercise.

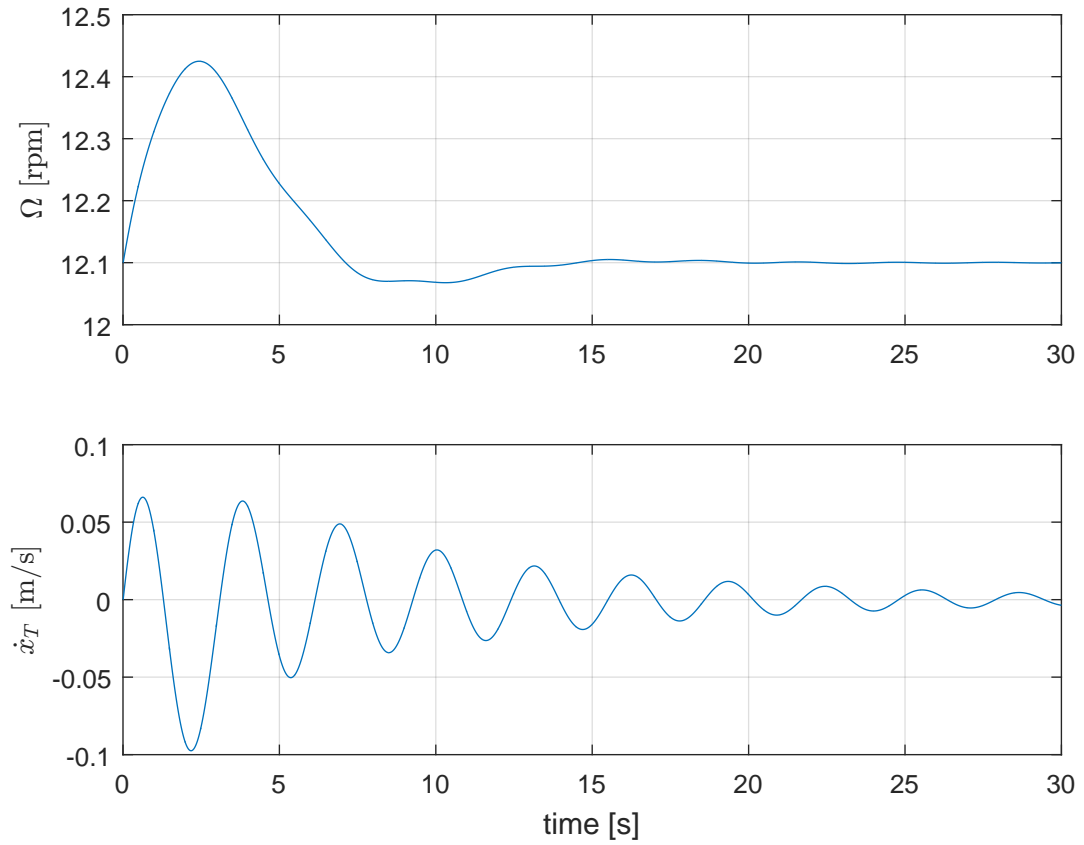


Figure 2: Start of tower damper implementation exercise.