Open-loop frequency response analysis of a wind turbine using a high-order linear aeroelastic model - DTU Orbit (30/04/2019)

Wind turbine controllers are commonly designed on the basis of low-order linear models to capture the aeroelastic wind turbine response due to control actions and disturbances. This paper characterizes the aeroelastic wind turbine dynamics that influence the open-loop frequency response from generator torque and collective pitch control actions of a modern non-floating wind turbine based on a high-order linear model. The model is a linearization of a geometrically non-linear finite beam element model coupled with an unsteady blade element momentum model of aerodynamic forces including effects of shed vorticity and dynamic stall. The main findings are that the lowest collective flap modes have limited influence on the response from generator torque to generator speed, due to large aerodynamic damping. The transfer function from collective pitch to generator speed is affected by two non-minimum phase zeros below the frequency of the first drivetrain mode. To correctly predict the non-minimum phase zeros, it is essential to include lateral tower and blade flap degrees of freedom. Copyright © 2013 John Wiley & Sons, Ltd.