Adaptive Backstepping Control of Lightweight Tower Wind Turbine - DTU Orbit (08/11/2017)

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This paper investigates the feasibility of operating a wind turbine with lightweight tower in the full load region exploiting an adaptive nonlinear controller that allows the turbine to dynamically lean against the wind while maintaining nominal power output. The use of lightweight structures for towers and foundations would greatly reduce the construction cost of the wind turbine, however extra features ought be included in the control system architecture to avoid tower collapse. An adaptive backstepping collective pitch controller is proposed for tower point tracking control, i.e. to modify the angular deflection of the tower with respect to the vertical axis in response to variations in wind speed. The controller is shown to guarantee asymptotic tracking of the reference trajectory. The performance of the control system is evaluated through deterministic and stochastic simulations including an extreme wind gust event, and the feasibility of stabilizing the tower position while maintaining the rated power output is shown.

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