Variable speed control for Vertical Axis Wind Turbine

A robust variable speed control for vertical axis wind turbine applications is implemented. It is a PI rotor speed controller based on an induction generator model operated at variable frequency. The generator dynamics are approximated by a first order differential equation with a prescribed slip. In order to allow variability in the rotor speed an inverter is assumed which changes the nominal generator speed. Below rated power the optimum tip speed ratio is tracked, while above the power is constrained to rated. The wind speed which is needed in the control is considered as a known signal and used after a first order low pass filtering with a certain time-constant. The controller has been developed and coded by Torben Larsen and it is compiled as an external DLL file. The simulations are done in the HAWC2 aero-servo-elastic code using a 3-bladed H-type VAWT which has been built within the Inflow project. The investigation of the VAWT performance under different control parameters such as the PI gains has been performed by Christos Galinos. Deterministic and turbulent wind speed steps of 2 m/s from 6 m/s to 24 m/s and back to 12 m/s are applied. The controller gives smooth transient response on rotor speed and the produced power with a small overshoot in the power when the rated wind speed is reached for a wide range of PI gains for both the deterministic and the turbulent wind field. Lastly, it is not affected from the inherent variation in blade loading of VAWTs for each rotor revolution due to a low pass filter in the measured electrical power.