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University of Bahrain
College of Engineering
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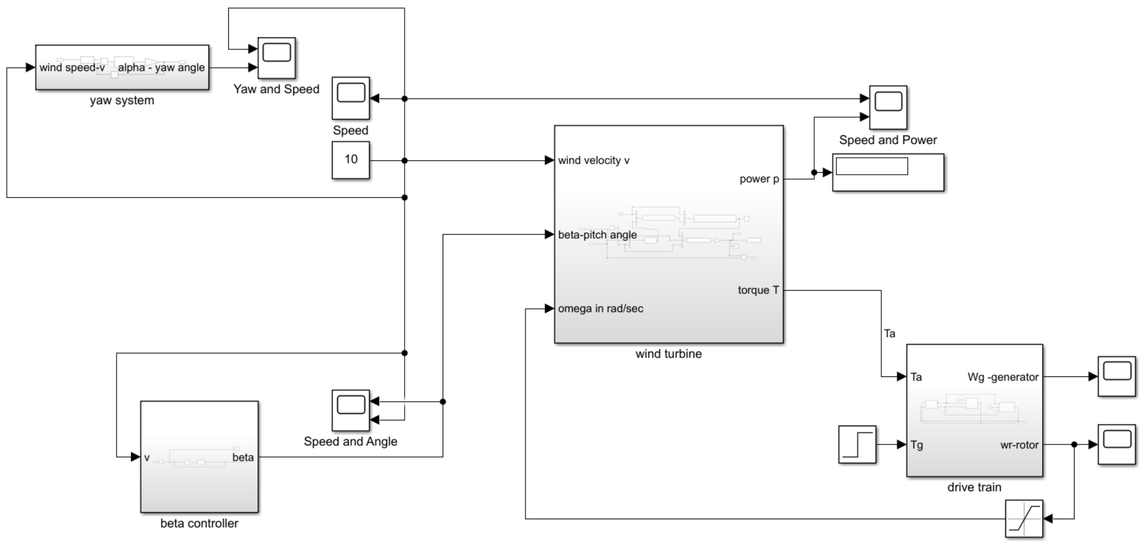
Wind Turbine Control to Maintain Desired Constant Output

Abstract

Studying the behavior of turbines during their operation is very important in the design stage of wind farms to reduce risks and losses. The most common method of adjusting the aerodynamic torque of a wind turbine when the wind speed is higher than the rated speed is to control the pitch angle. This project compares adjusting the pitch angle in wind turbines between Fuzzy PID and PID. Where Fuzzy PID is not better than PID in terms of the study state behavior of the system to maintain the efficiency of the turbine, but the flaw in PID controller is that it takes more time, and it has oscillations. The system is simulated in MATLAB/SIMULINK software.

Design and Implementation

Due to the complex turbine system, many models of sub-systems that are related to each other have been created. A pitch angle-controlled wind turbine includes the drive train and the pitch controller subsystem. MATLAB/Simulink has been used for this.



Conclusion

In this project, the wind model, drive train, and controller are simulated using mathematical models. The Fuzzy-PID is not better than PID to maintain the efficiency of the turbine, the PID controller takes more time, but it gives more power. It is possible to develop this project by building a yaw direction controller model into an integrated model. In future projects to improve dynamic behavior, we recommend the use of controllers that do not depend on the model type.

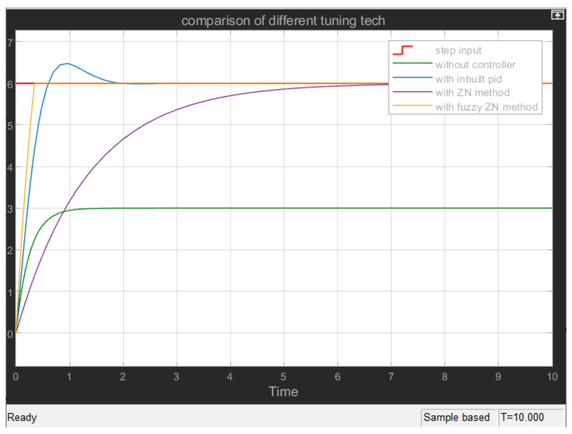
Objective and Motivation

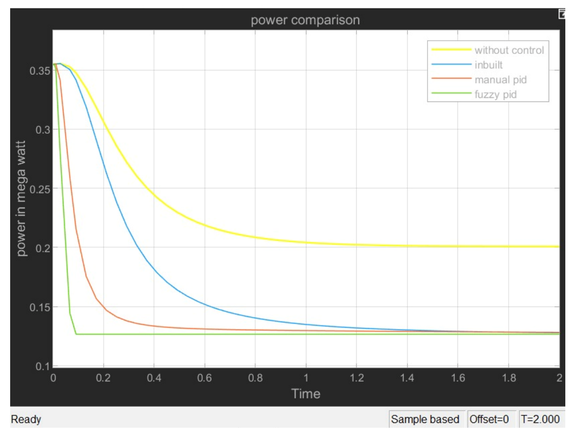
The main objective of this research is to discuss and design a model wind turbine control unit to reduce the wind loads and other loads on the blades and achieve a desired constant output power to maintain the turbine and increase its efficiency. This is by developing an available wind turbine model, simulating it using MATLAB/SIMULINK software under different wind speeds to predict the best blade angle, and developing it with PID and Fuzzy PID controllers and tuning. The effectiveness of the system can be demonstrated by analyzing the mechanical behavior of the turbine model with and without different control systems and comparing them.

The motive of this research is to implement a strategy to control the angle of the pitch to reduce the aerodynamic loads and other loads at the tip of the blade. It makes it easier for researchers to conduct their preliminary studies with this model, and engineers and countries working in this field will benefit from it and come out with a greater profit.

Results

In order to reach the desired angle, the Fuzzy PID is the best response among the other controllers, as the settling time is very fast and has no overshoot, while the PID controller has an overshot and its settling time is slower. But when we raise the step input, the study state behavior of Fuzzy PID is not better compared to PID, even if the PID controller takes time and has oscillation. While in order to reach the raised power, it takes longer time for winds without the controller to reach the raised power, as for the PID controllers and especially the Fuzzy PID controllers, it only takes some time, so it is more efficient. This is true for different wind speeds.





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