

Title: Disturbance Accommodation Control of Wind Turbines Based on Sliding Mode Approach

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This paper presents a novel robust sliding mode controller design for wind turbines based on output feedback and disturbance rejection schemes. Considered horizontal axis wind turbine has 5MW capacity with variable speed. For this purpose, first, using rotor speed, system states are estimated while wind is considered as an exogenous state. Then, robust disturbance accommodation controller (DAC) based on sliding mode (SM) is developed. Finally, the efficiency of the proposed DAC-SM approach is compared with existing DAC method. As the results verify, DAC-SM scheme provides satisfactory performance against uncertainties.

Wind energy is an important type of renewable energy which involves operation of the wind turbines. Wind turbine control is an important research topic. Due to nonlinear and complex nature of turbines, they always have uncertainties in the model parameters or dynamics. Many studies on wind turbine control for partial or full load regions of operations are done. The main objective is to optimize energy achieved at speeds less than nominal speed of the wind.

Measuring the rotor speed and considering the wind as one of the states, all states are estimated, but the effects of uncertainties are not investigated. Using this approach, satisfactory performance has been achieved based on disturbance accommodation control (DAC) to estimate wind speed compared to PI controllers. On the other hand, design and implementation of controllers which taking into accounts uncertainties and stormy winds become essential. Since increasing rotor speed results in bigger generator speed and also power productivity of wind turbine, thus, increasing the power generation of the turbine more than its capacity will cause irreparable damages.

At the nominal wind speed, the purpose of wind turbines is to regulate power while the realization of this issue in face of uncertainties is very important. Therefore, improvement of the results obtained from DAC methods seems essential. The contribution of this paper is to combine DAC method with sliding mode approach, for the first time, in order to include uncertainties in the nonlinear controller design for wind turbines. In this regard, using simple and efficient model of the wind turbine, the state variables are estimated while rotor speed is considered as output. Then, invoking robust sliding mode, the rotor speed can be kept constant in stormy winds as much as possible.

This paper develops controller design for wind turbines based on disturbance accommodation controller and robust sliding mode. Due to high nominal wind speed as well as applying complicated wind profile, proposed controller provide satisfactory performance. Actually, combining adaptive sliding mode control with disturbance rejection method, we can attain 50% error reduction compared to the DAC method.

Biography

Azita Sharifi Faskhodi has completed his MSc at the age of 30 years from Qazvin Islamic Azad University. She invented first indoor greenhouse in the undergraduate in Iran with her partner Mr.ghamari.she is manager marketing of automation devices. Also She has participated in more than 10 robotics competitions.

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Category: (Oral presentation/ Poster presentation): Poster