FUZZY LOGIC WIND CONTROL STRATEGY FOR WIND POWER GENERATION SYSTEM

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To my beloved Parents and Sisters, who have Fulfilled my Heart With Love and Brightness.

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ABSTRACT

Deregulation of electric utilities has led to consideration of new distributed resources such as wind turbines. The new resources dynamics have to be studied carefully to avoid unpredictable outputs and unknown interferences as well as to make sure that consistent and efficient power is supplied according to the load requirements. The objective of this work is to make a contribution to the ongoing wind turbine research in the areas of modeling, control and implementation of wind turbines as renewable source in electric power systems. A model of complete open-loop wind turbine was developed, and it was used as a basis for the design of a controller for the wind turbine. The wind turbine transfer function was derived and its performance was studied using the MATLAB Program. After simulation the wind turbine model two controller were implemented on the system to control the power output of the wind turbine. A PI controller and a Fuzzy Logic controller. The performances of two controller were compared and the result was shown the advantages of using Fuzzy logic controller for the wind turbine. The ability of Fuzzy logic controllers for facing with nonlinearity make them a powerfull tool for controlling such systems

ABSTRAK

Ketidakupayaan peralatan elektrik membawa kepada pengagihan sumber yang baru seperti turbin angin. Sumber dinamik yang baru perlu dipelajari dengan baik untuk mengelakkan keluaran di luar jangkaan dan inteferan yang tidak diketahui untuk memastikan kuasa konsisten dan efisyen yang dibekalkan mengikut keperluan beban. Objektif projek ini adalah untuk mengambil bahagian kepada pelaksaaan penyelidikan turbin angin dari segi pemodelan, kawalan, dan perlaksanaan turbin angin untuk sumber yang baru dalam sistem elektrik kuasa. Model turbin angin bagi *open-loop* telah dibangunkan, dan telah digunakan sebagai rekabentuk asas dalam kawalan turbin angin. Fungsi pengubah turbin angin telah dikembangkan dan dilaksana mengunakan perisian Matlab. Selepas membuat simulasi trubin angin, dua kawalan telah dilaksanakan dalam sistem untuk mengawal keluaran kuasa bagi turbin angin. Kawalan *PI* dan kawalan *Fuzzy Logic*. Pelaksanaan dua kawalan telah dibandingkan dan keputusan menunjukkan kelebihan menggunakan kawalan *Fuzzy logic* bagi turbin angin. Keupayaan kawalan *Fuzzy logic* untuk berdepan dengan ketidaklinearan telah menjadikannya peralatan yang hebat untuk mengawal sesuatu sistem.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The use of wind power is one of the cheapest methods of reducing CO2 emissions in electricity production. In the long run, ecologically energy supply can only be guaranteed by integration of renewable resources. The worldwide potential of wind power means that its contribution to electricity production can be of significant proportions. Wind turbines produce electricity by using the natural power of the wind. The wind is a clean and sustainable energy source. It does not create pollution and it will never run out. Wind turbine generator system provides an environmentally friendly, competitive and socially beneficial means of electricity generation.

1.2 Problem Statement

The most special feature about wind turbines is the fact that, unlike other power generation systems, the power inflow rate is not controllable [1]. In most generation systems, the fuel flow rate, or the amount of energy, applied to the generator controls the output voltage and frequency. The fact that one has no control over the energy source input, the unpredictability of wind and the varying power demand are more than enough to justify the

need for a control system. This will regulate the parameters of the wind energy conversion system that need to be controlled for matched operation of the wind turbine.

With changing the wind speeds the amount of power produced by a wind turbine change if the pitch angle is constant. An active pitch control system is needed to realize a long lifetime of turbine and produce high quality power or increase energy capture. In wind power generation system (WPGS) with much uncertainty and serious nonlinearity, precise mathematical model based traditional PID controller cannot meet the requirements of pitch control [9]. Figure 1.1 shows a block diagram of a wind energy conversation system with controller for blade pitch angle.

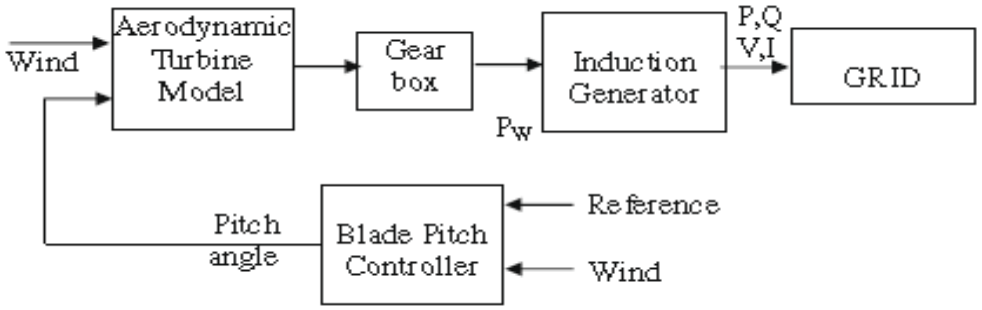

Figure 1.1: Block diagram of a WECS configuration

1.3 Objectives

(i) To design a Fuzzy logic controller for pitch control strategy in a WPGS.

(ii) To find the advantages of Fuzzy controller comparing with traditional PI controllers.

(iii) To compare the performances of PI and Fuzzy controllers and find the appropriate one.

1.4 Significance of the Research

Wind energy is seriously growing in response to environmental problems of traditional energy sources and turbines technological improvements [1]. The part of this kind of energy is each day more important in windy regions. Thus, the wind turbine power quality impact on the power grid increases. However, wind energy costs is still too high to compete with traditional sources on less windy sites. More careful design techniques must be introduced into wind turbines control to ameliorate these problems. This control must be done taking into account the whole wind turbine behaviour. This design can reduce the cost of producing energy by wind turbines more and more. Figure 1.2 shows a block diagram of a wind energy conversation system with a Fuzzy Logic controller for blade pitch angle.

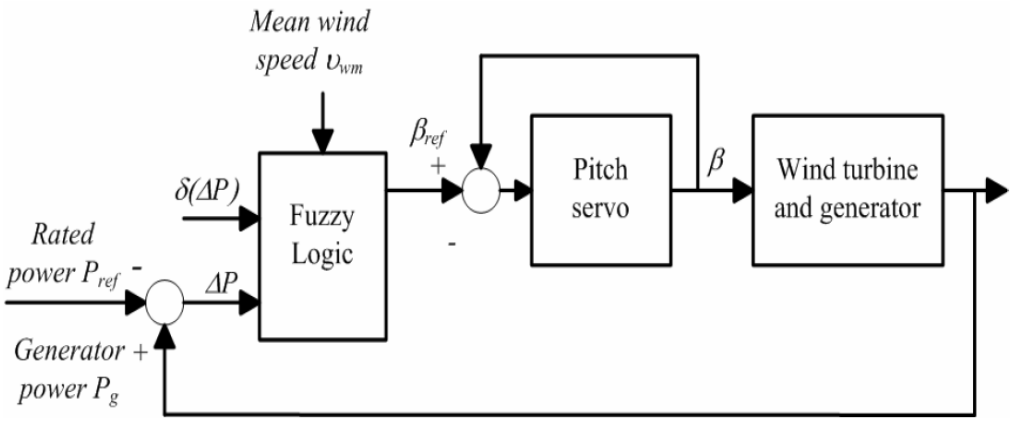

Figure 1.2: Fuzzy logic control strategy

1.5 Scope of the Research

For this work at the following steps should be done

(i) Mathematical model of WPGS should be achieved.

(ii) By result of mathematical model appropriate PI and Fuzzy controllers can be found and designed.

(iii) After it Simulation the systems and controllers in Matlab simulink will be possible.

(iv) Comparing the performances and making conclusion are the last part of this project.

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