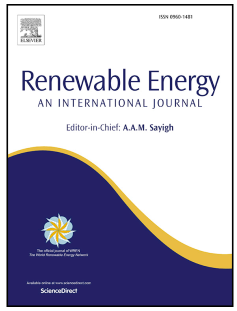
Accepted Manuscript



A new fuzzy logic proportional controller approach applied to individual pitch angle for wind turbine load mitigation

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PII: S0960-1481(17)30380-4

DOI: 10.1016/j.renene.2017.04.064

Reference: RENE 8759

To appear in: *Renewable Energy*

Received Date: 31 January 2017

Revised Date: 17 April 2017

Accepted Date: 28 April 2017

Please cite this article as: civelek Z, Lüy M, Çam Ertuğ, Mamur H, A new fuzzy logic proportional controller approach applied to individual pitch angle for wind turbine load mitigation, *Renewable Energy* (2017), doi: 10.1016/j.renene.2017.04.064.

A NEW FUZZY LOGIC PROPORTIONAL CONTROLLER APPROACH APPLIED TO INDIVIDUAL PITCH ANGLE FOR WIND TURBINE LOAD MITIGATION

ABSTRACT

In the world, efforts to increase the resource diversity in electric generation have accelerated lately. So, the great improvements have been achieved in wind turbines (WTs). The dimensions of WTs have grown for more electric generation and their energy productions have increased. Depending on these developments, it has become more important to reduce the WT load mitigation. Thus, a tendency to pass an individual pitch angle system control rather than a collective pitch angle system control employed to stable the output power of WTs over nominal wind speeds has whetted in recent studies. However, in literature, a controller proposal relating to how to incorporate the blade moments used for providing the individual pitch angle system into the output power control system has not yet been offered. Therefore, in this study, a new fuzzy logic proportional control (FL-P-C) approach has been recommended to mitigate the moment load on blades and tower to a minimum possible value while keeping the output power of WTs at a constant value. The offered FL-P-C has also been verified by MATLAB/Simulink. Through the first application of the FL-P-C on a WT, a significant improvement of 33-83% has been managed for the blade and tower moment loads. Furthermore, the grid fluctuations have been reduced because of the stabilisation of the output power of the WT. Ultimately, by the offered FL-P-C, not only the WT load mitigations and maintenance costs of WTs could be reduced, but also electric costs could be decreased owing to increasing lifetimes of WTs.

Keywords: energy, wind turbine, individual pitch control, wind turbine load mitigation, blade load mitigation.

INTRODUCTION

Nowadays, wind turbines (WTs) are become more popular with a growing interest in renewable energy resources. It is thought that this interest would be alive as environmental concerns are present and also a need for electricity increases. In parallel with technological developments and the demand for electricity, both the capacity of WTs is grown and their control methods employed are enhanced and changed.

Wind, which is energy source of WTs, suddenly varies in nature. Therefore, the sudden fluctuations are observed electric energy generation obtained from WTs **[1]**. In order to minimise the effects of the sudden fluctuations, also to increase the generated power and to stable the output power of WTs, maximum power transfer methods are applied on WTs when wind speed is lower than nominal values. On the other hand, the output power of WTs is kept at a nominal output power or the nearest to the nominal output power by means of a blade pitch angle control when wind speed is nominal values.

In literature, a number of control methods have recommended for the pitch angle control of WTs. These are control methods such as the proportional-integral (PI) control, the fuzzy logic control (FLC), the fuzzy logic proportional-integral-derivative (FL-PID) control and the artificial neural networks (ANNs) **[2-5]**. Great deals of studies have been conducted on the advantages and disadvantages of these methods **[6, 7]**. Recently, due to increases in the physical size of WTs, it is necessary to rethink the effect of the WT load mitigation. Moreover, owing to the fact that these turbines are manufactured for large powers and also allow the individual pitch angle control, the individual pitch angle control method has come to the agenda.