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HYBRID PI-FUZZY CONTROLLER FOR PERFORMANCE IMPROVEMENT IN A DC GRID-BASED WIND POWER GENERATION SYSTEM IN A MICROGRID

Dr. G Venu Madhav[1], Kothuri Ramakrishna[2],
[1]Professor, Department of EEE,
Anurag Group of Institutions,
Hyderabad, India [2]Associate Professor,
B.V.Raju Institution of Technology,
Narsapur Medak(Dist),Telangana, India

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Abstract

With the advent of Renewable Energy sources DC Grid control plays a vital role. In this paper we are implementing the design of a dc grid which is depend upon the wind power generation system in the poultry farm. Therefore the control scheme which is utilized for separate controller for the inverter when the grid is connected and the islanded operation have been proposed. A model predictive control algorithm which is used for the better transient performance with respect to the change in the operation condition which is proposed for the inverter operation. Hybrid PI-Fuzzy controller is denoted as human decision making mechanism which provided the operation for the electronic system with the expert decision. Hybrid PI-Fuzzy logic controller is introduced for the fluctuations of the micro grid which are controlled with the constant regulation of power. And a separate controller have been developed for the wind turbine which is used for maintain the power to mitigate the variation error. Therefore we are comparing the controller with the Hybrid PI-Fuzzy controller. Therefore to determine the capability of the proposed micro grid which is connected and islanded from the distributed grid which is obtained by discussed.

***Key Words*:**Energy management, Hybrid PI-Fuzzy controller, Wind power generation, dc grid, model predictive control.

1 Introduction

According to the recent analysis of the energy storage devices, and increase within the form of dc loads and therefore the penetration of dc distributed energy resources (DERs) like solar photovoltaics and fuel cells. Several analysis works on dc micro grids are conducted to facilitate the combination of varied DERs and energy storage systems. A dc micro grid based mostly power station design during which every wind energy conversion with matrix convertor, a elevated frequency electrical device and a single-phase ac/dc convertor is proposed. However, the proposed design will increase the system quality as 3 stages of conversion are needed. In [7], a dc micro grid based mostly power station design within which the WTs are clustered into teams of four with every cluster connected to a device is planned. However, with the proposed design, the failure of 1 device can lead to all four WTs of an equivalent group to be out of service. The analysis works conducted are focused on the event of various distributed management ways to coordinate the

A control theme that uses separate controllers for the inverters throughout grid-connected and islanded operations is planned. Though there are plenty of analysis works being conducted on the event of primary management ways for metric weight unit units, there are several areas that need any improvement and analysis attention. The in operation conditions once the micro grid operates within the grid-connected or islanded mode of operation moreover as its capability to handle constraints, a model-based model predictive control (MPC) design is planned during this paper for controlling the inverters. Because the micro grid is needed to work stably in several operative conditions, the preparation of MPC for the management of the inverters offers higher transient response with relevance the changes within the operative conditions and ensures a additional robust micro grid operation. There are some analysis works on the implementation of MPC for the control of inverters. An investigation on the utility of the MPC within the control of parallel-connected inverters is conducted.

2 OBJECTIVE

According to the proposed system which performance the flexible operation of multiple parallel which is connected to the wind generation by neglecting the required voltage and frequency synchronization. Therefore according to the model predictive control algorithm for the better transient response with respect to the change in the operation condition this is proposed to control the inverter operation. Therefore according to the dc grid which is depend upon the distribution network where the wind generation is the output ac in the poultry form which are rectified. Then merit which are present in this proposed in system is that DC Grid Side voltage is controlled in the parallel operation of various wind generation without any synchronize voltage, phase and frequency which allow the wind generation to be turn ON and OFF without any causing in disruptions.

3 PROPOSED SYSTEM

Therefore in this project a dc micro grid which is depend upon the wind plant design where it consists of the matrix converter, a signal phase ac/dc converter and a high frequency transformer which have been proposed. The proposed design show that it will increases the complexity of the system such as three stages of conversion which required. Moreover the dc micro grid which is based on the wind farm design in which consist of the wind turbine are clustered in the four groups with the group which are linked to the converter have been proposed. The proposed design contents that the failure of converter which results in the wind turbine of the same group which have the outer service.

A. System Description

The Block Diagram of the proposed model is shown below the.

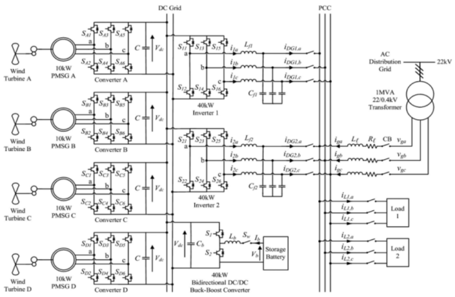

Fig. 1. Overall configuration of the proposed dc grid based wind power generation system in a microgrid.

B. AC/DC Converter

The Figure. 2 Publicizes the Comparison of power circuit of a PMSG which is connected with an air conditioner/dc voltage source converter. The PMSG is displayed as an adjusted three-stage air conditioning voltage source esa, esb, esc with arrangement protection Rs and inductance Ls

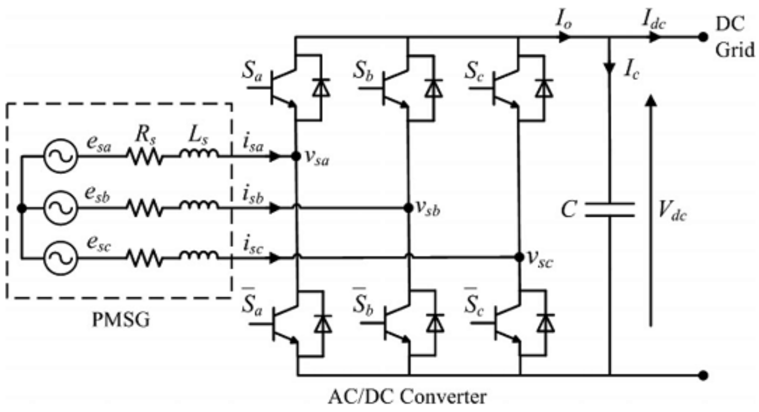

Fig. 2. Power circuit of a PMSG linked to an ac/dc voltage source converter.

C. DC/AC Inverter Modeling

The single phase DC/AC Inverter modeling is shown in Fig. 3.

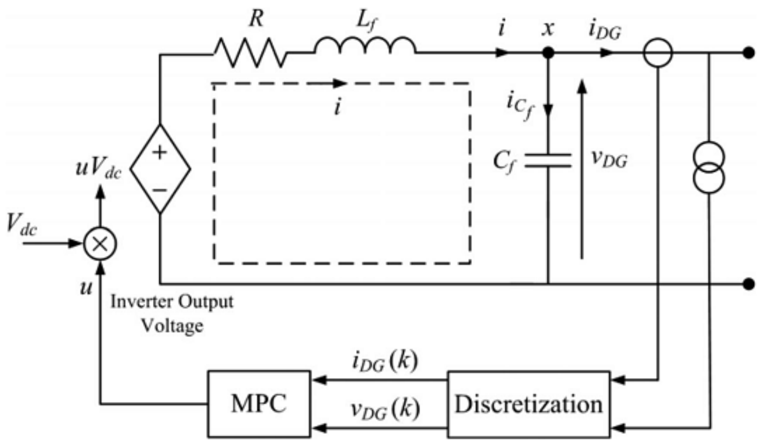

Fig. 3. Single-phase representation of the three-phase dc/ac inverter.

4 CONTROL DESIGN

A. Control Design for the AC/DC Converter

The control signals for AC/DC Converter are harnessed with the help of synchronous reference frame theory. And it is shown below.

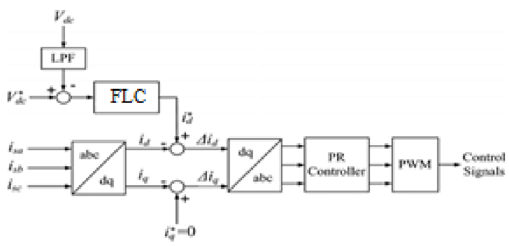

Fig. 4. Proposed controller for the ac/dc converter.

5 Hybrid PI-Fuzzy Logic Controller

Hybrid PI-Fuzzy Logic controller is the parallel combination of Both PI Controller and Fuzzy Controller.

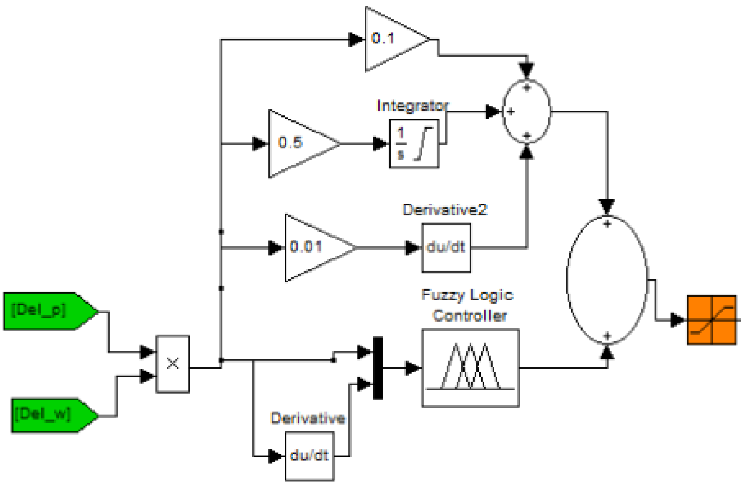

Fig: 5 Hybrid PI-Fuzzy Controller.

6 SIMULATION RESULT

The Proposed model is simulated in MATLAB/Simulink. The corresponding parameters are given in Table I.

TABLE I: PARAMETERS OF THE PROPOSED SYSTEM

Parameter	Value
Distribution grid voltage	$v_g = 230$ V (phase)
DC grid voltage	$V_{dc} = 500$ V
PMSG stator impedance	$R_s = 0.2\ \Omega$, $L_s = 2.4$ mH
Distribution line impedance	$R_\ell = 7.5$ mΩ, $L_\ell = 25.7\ \mu$H
Inverter LC filter	$L_f = 1.2$ mH, $C_f = 20\ \mu$F
Converter capacitor	$C = 300\ \mu$F
Converter and inverter loss resistance	$R = 1$ mΩ
Load 1 rating	$P_{L1} = 35$ kW, $Q_{L1} = 8$ kVAr
Load 2 rating	$P_{L2} = 25$ kW, $Q_{L2} = 4$ kVAr

Case1 Failure of One Inverter During Grid-Connected Operation

In this case inverter 1 is turned off the simulation results are shown below.

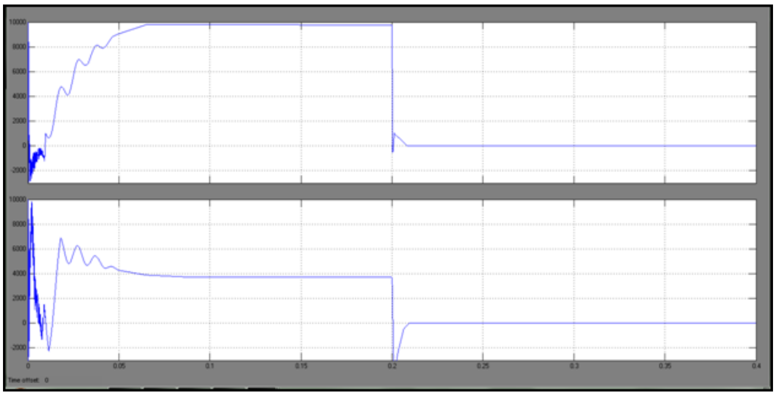

Fig. 6. Real (top) and reactive (base) control conveyed by inverter 1.

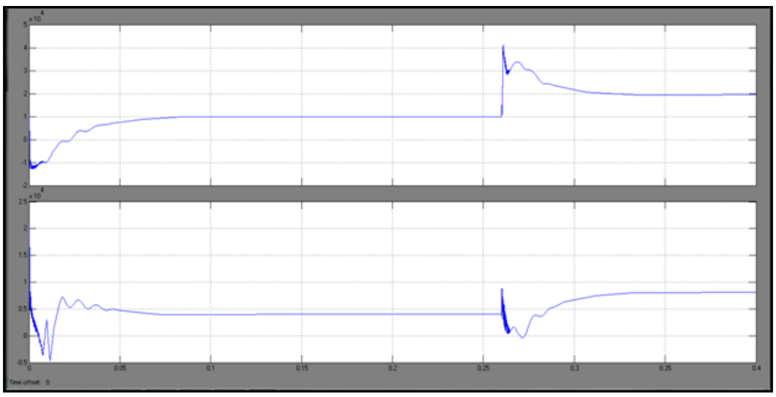

Fig. 7. Real (top) and reactive (base) control conveyed by inverter 2

According to the Figs. 6 and 7 show the waveforms of the certifiable and responsive power passed on. The remaining authentic and responsive power that is asked for by the stacks is given by the cross section which is showed up in Fig. 8.

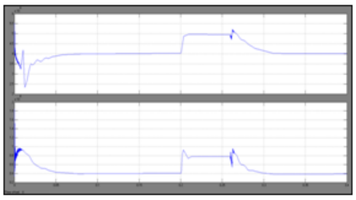

Fig. 8. Real (top) and reactive (base) control conveyed by the matrix.

The dynamic and receptive power gave to the heap which is around 60 kW and 12 kVAr as showed up in the power waveforms of Fig. 9.

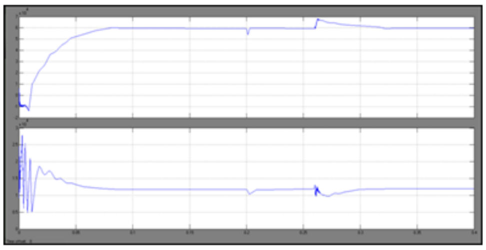

Fig. 9. Real (top) and reactive (base) power consumed by the loads.

The DC frame work voltage is shown in Fig. 10.

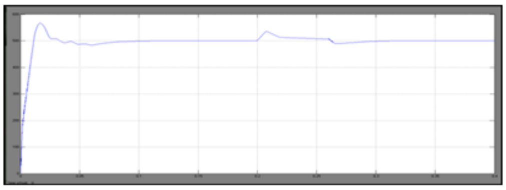

Fig. 10. DC framework voltage.

Case2: Connection of AC/DC Converter During Grid-Connected Operation

As appeared in Figs. 14 and 15, every inverter conveys genuine and responsive energy of 7 kW and 4 kVAr to the heaps individually

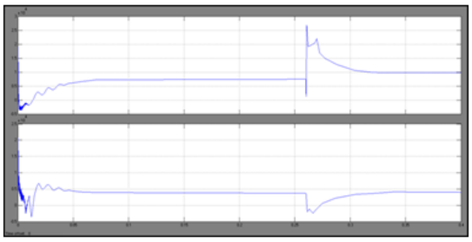

Fig. 11. Real (top) and reactive (base) control conveyed by inverter 1.

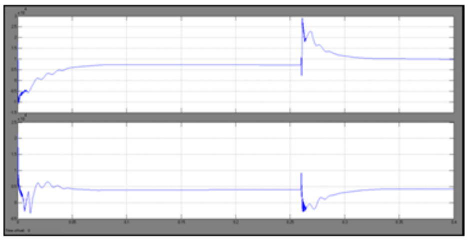

Fig. 12. Real (top) and reactive (base) control conveyed by inverter 2.

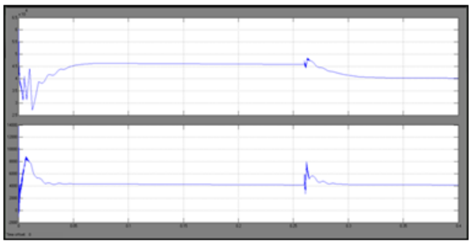

Fig. 13. Real (top) and reactive (base) control conveyed by the framework.

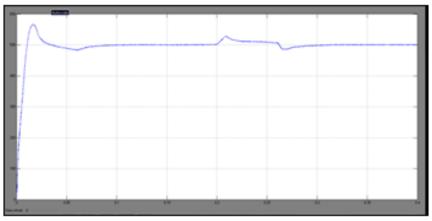

Fig. 14. DC matrix voltage.

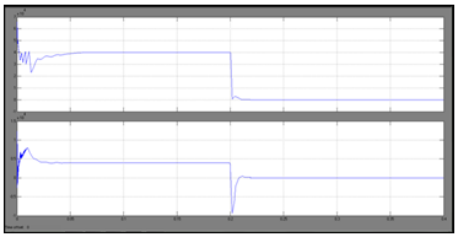

Fig. 15. Real (top) and reactive (bottom) power delivered by the grid.

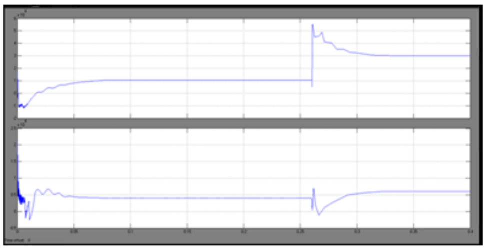

Fig. 16. Real (top) and reactive (bottom) power delivered by inverter 1.

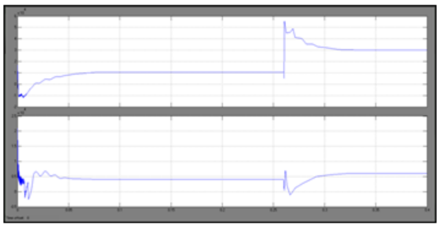

Fig. 17. Real (top) and reactive (bottom) power delivered by inverter 2.

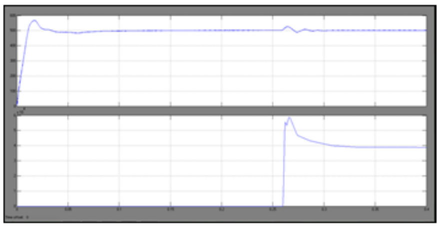

Fig. 18. DC grid voltage and Real power delivered by SB.

C. Test Case 3: Islanded Operation

The case 3 is Islanded operation is shown below.

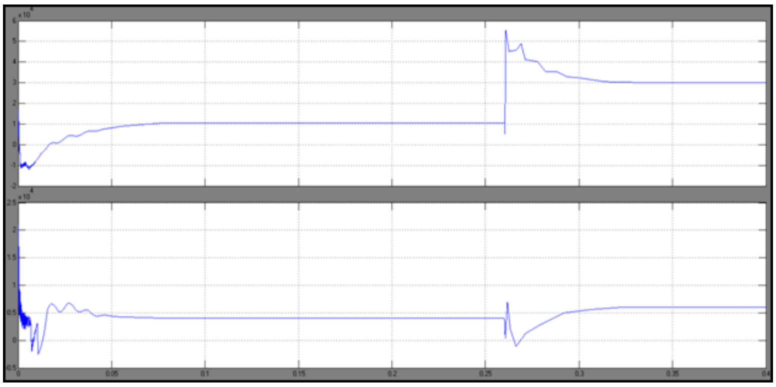

Fig. 19. Real (top) and reactive (bottom) power delivered by inverter 1.

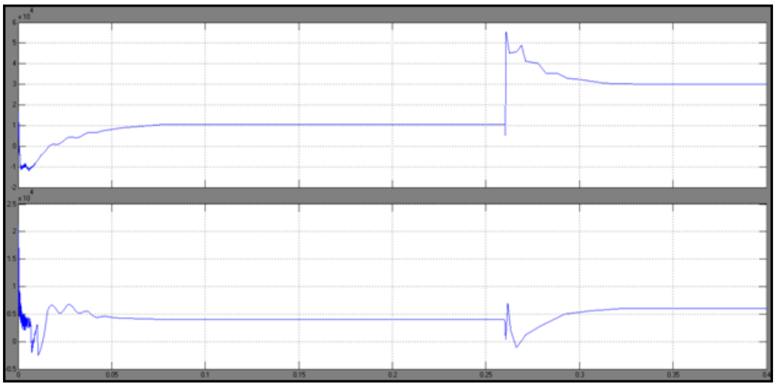

Fig.20. Real (top) and reactive (bottom) power delivered by inverter 2.

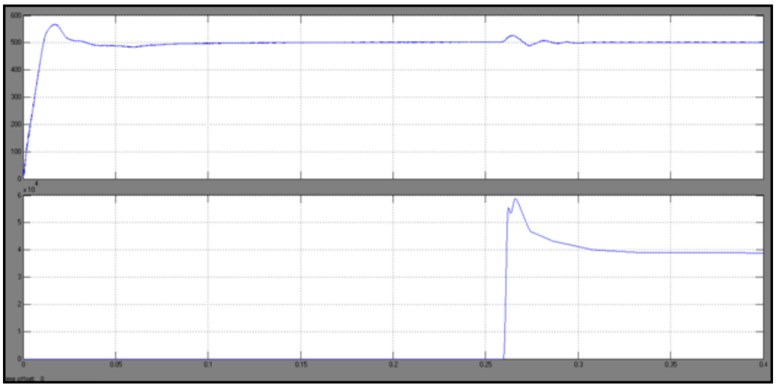

Fig. 21. Real power delivered by SB and DC grid voltage.

7 CONCLUSION

In this paper Hybrid PI-Fuzzy logic controller is introduced for the fluctuations of the micro grid which are controlled with the constant regulation of power. And a separate controller have been developed for the wind turbine which is used for maintain the power to mitigate the variation error. Therefore we are comparing the controller with the Hybrid PI-Fuzzy controller. Therefore MATLAB/Simulation results determine the capability of the proposed micro grid which is connected and islanded from the distributed grid.

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