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A Novel Control Strategy for a Grid Connected Converter under Dynamic Fault Conditions

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Abstract— **In this paper, the control strategy for the Converter used in utility distribution systems is investigate, and a three-phase grid-connected converters are widely used in renewable and electric power system applications. Traditionally, grid-connected converters are controlled with standard decoupled d-q vector control mechanisms. However, recent studies indicate that such mechanisms show limitations in their applicability to dynamic system. Based on power balancing principle and feed forward decoupling control, this novel Direct Output voltage (DOV) control strategy cannot only reduce the active and reactive current control loops of a conventional double-loop control strategy but also achieve the decoupling control to regulate dc-link voltage and maintain the voltages at the point of common coupling (PCC). PI controllers are separately employed to maintain the voltages at the PCC and to simultaneously regulate dc-link voltage. *(Abstract)***

Keywords- PI Controller, D-Q axis parameter, grid connected converter, decouple vector control.

I. INTRODUCTION

Recently, with the growth of nonlinear loads in industrial manufactures, the electric power quality has become more and more important. As one of the most common issues about the electric power quality, voltage fluctuations influence domestic lighting and sensitive apparatus in transmission and distribution systems [1]. As a key component for the implementation of a flexible ac transmission system, the main function of a Converter is to regulate the voltages at the point of common coupling (PCC) in transmission. The Converter is a shunt connected voltage source converter using self-commutating device and can be effectively used for reactive power control. In renewable and electric power system applications, a three-phase grid- connected dc/ac voltage-source pulse-width-modulated (PWM) converter is usually employed to interface between the dc and ac systems. Fig. 1 demonstrates the grid-connected dc/ac converter. Conventionally, this type of converter is controlled using the standard decoupled d-q vector control approach [2] – [3].

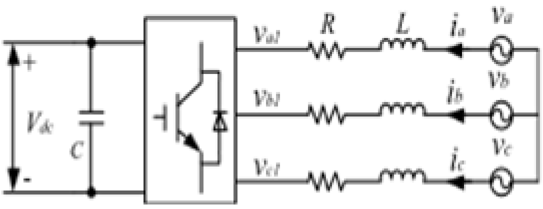

Fig. 1.Grid Connected Converter

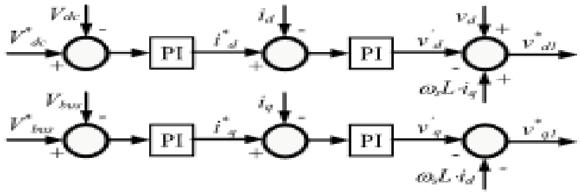

Fig.2 .Standard Vector Control Strategy

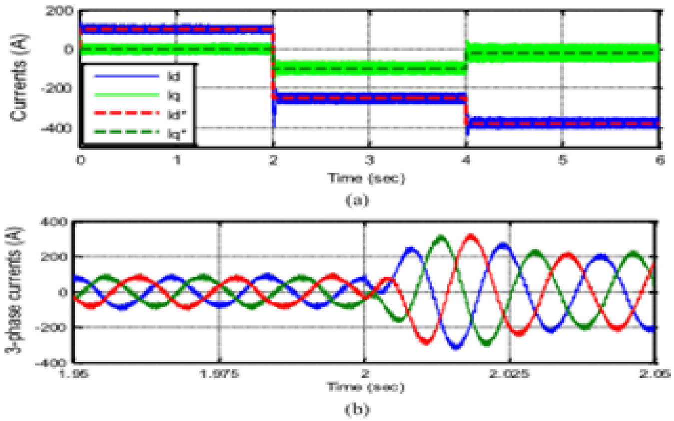

Fig.3 Performance of conventional standard vector controller [Ts =0.1 ms (a) dq current (b) three-phase current.

Direct Power Control:- The basic idea of the DPC approach, proposed by Noguchi [4], is the direct control of active and reactive power. In DPC, the inner current control loops and the PWM modula- tor are not required because the converter switching states are selected by a switching table based on the instantaneous errors between the commanded and the estimated values of active and reactive powers (Fig. 5).

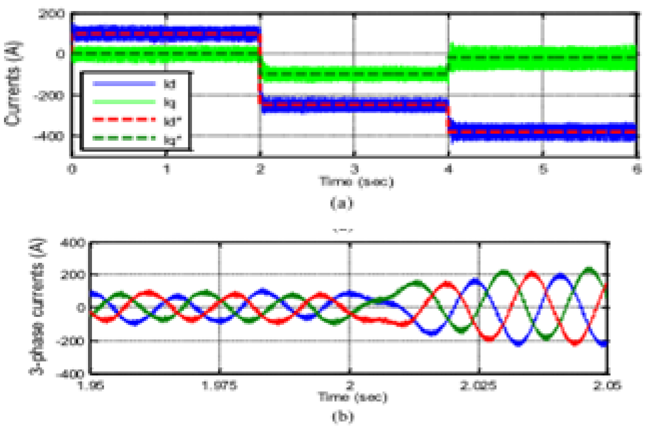

Fig. 4 Performance of DCC vector controller [Ts = 0.1 ms (a) dq current (b) three-phase current.

However, a major challenge of the direct-current-based vector control mechanism is that no well- established systematical approach to tuning the PI controller gains exists, so that optimal DCC is hard to obtain. Other con- trol methods have also been developed recently.

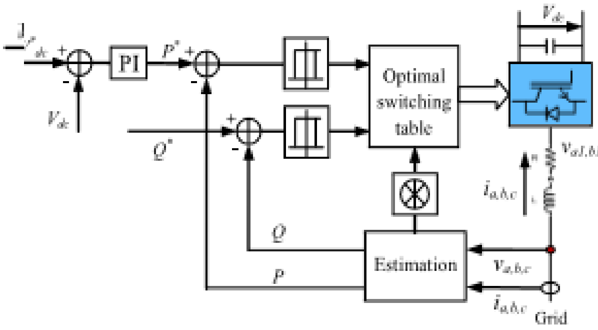

Fig.5. Direct current Vector Control

Fuzzy for PI Controller:-As is known to everyone, the traditional PI controller is widely used in industrial applications for its simplicity and reliability. However, in practice, a traditional PI controller with constant parameters may not be robust enough due to the variations of design parameters. To improve the static and dynamic performances of the STATCOM with this improved DOV control strategy, two fuzzy PI controllers have been adopted to separately regulate the dc-link voltage and maintain the voltages at the PCC.A fuzzy adjustor is used to adjust the parameters of proportional gain KP and integral gain KI based on the error e and the change of error Δe [12]

$$KP = K*P + \Delta KP$$

$$KI = K*I + \Delta KI$$

Where K∗ P and K∗ I are the reference values of fuzzy-PI-based controllers.

In this paper, K∗ P and K∗ I are calculated offline based on the Ziegler–Nichols method. The error e and the change of error Δe are used as numerical variables from the real system.

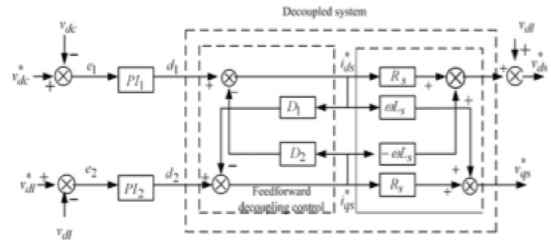

Fig.6 the DOV control strategy with a feedforward decoupler.

.To convert these numerical variables into linguistic variables, the following seven fuzzy sets are chosen: negative big (NB), negative medium (NM), negative small (NS), zero (ZE), positive small (PS), positive medium (PM), and positive big (PB).

II. SYSTEM OBJECTIVE

The main objective of this work is to design a selectively coordinated electrical power system using Mi Power, “A Power System Analysis and Simulation Software.

III. PROPOSED WORK

By connecting the compensating devices at different-different distances, we will analyse the result and find the best one which would be more suitable for system.By changing the demand or load, we will see the status of waveform of voltage and current.

The model consists of

- Three phase source
- PI Controller
- D-Q Axis and a-b-c model
- Voltage measurement block
- Current measurement block
- Active and reactive power compensation.
- Grid connected converter
- Circuit breaker to generate fault for analysis

SYSTEM ARCHITECTURE

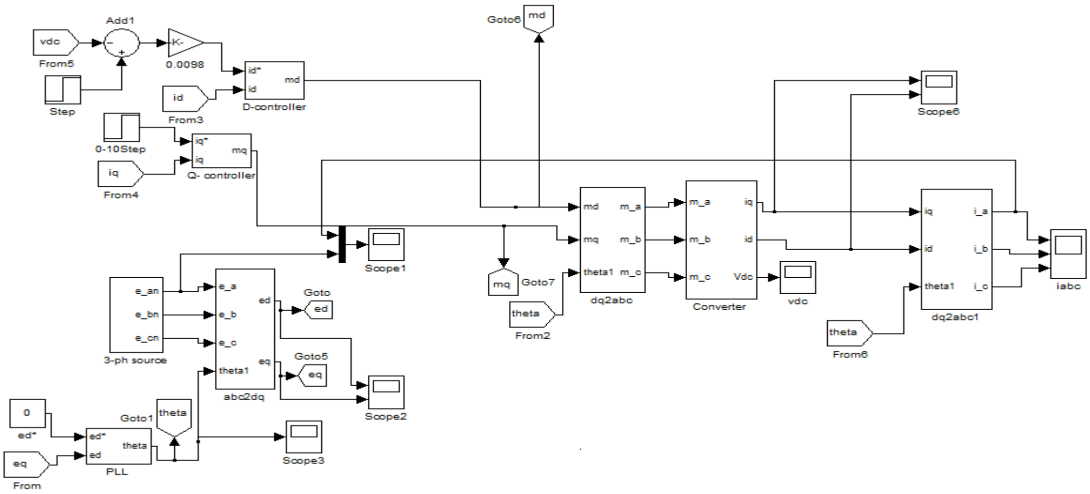

Fig 7. va1,b1,c1 stands for the GCC output voltage in the three-phase ac system and the corresponding voltages in dq-reference frame are vd1 and vq1. va,b,c is the three-phase PCC voltage and the corresponding voltage in dq-reference frame are vd and vq. ia,b,c stands for the three-phase current flowing from PCC to GCC and the corresponding currents in dq-reference frame are id and iq

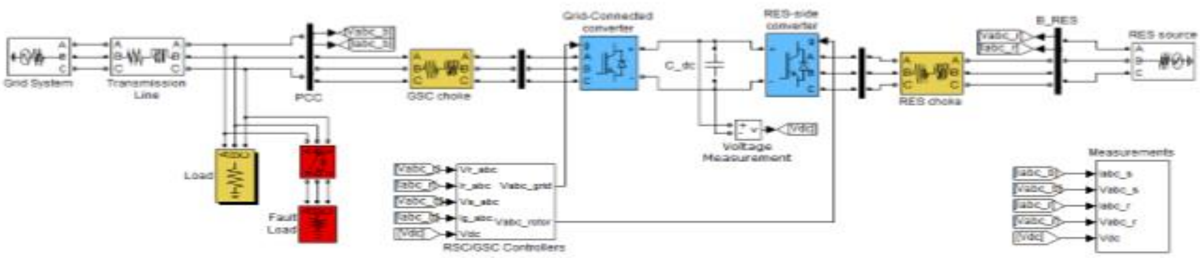

Fig. 8 Proposed model for project

IV. FUTURE SCOPE

Three phase grid-connected converters are widely used in renewable and electric power system applications. A dc/dc/ac converter for solar, battery and fuel cell application. A Dc/ac converter for STATCOM applications. An ac/dc/ac for wind power and HVDC application. Controlling a turbo generator and tracking control with time delay.

Performing auto landing and control of an aircraft .It will be applicable to improve reliability of system and reduced cost of maintenance of equipments. It is applicable in future extension and designing a new power system damaging to equipments and personnel by faults will be minimized. For future work, we plan to purchase equipment and develop hardware experiment system.

V. EXPECTED RESULT

Grid-connected Rectifier/Inverter under Disturbance, Dynamic and Power Converter Switching Conditions which should be:

The fuzzy controller can track the reference d- and q-axis currents effectively even for highly random fluctuating reference currents minimize. The damage/error signal due to the fault, Fuzzy for control approach produces the faster response time, low Overshoot and Maintaining the high power

VI. CONCLUSION

Three-phase grid-connected Converter are used widely in renewable, micro grid and electric power system applications. This paper analyzes the limitations associated with conventional vector control methods for the grid- connected converters. Then, a neural-network based vector control method was developed. The paper described how the vector controller was developed based on a

Dynamic-programming technique and trained via a back propagation through time algorithm. The performance evaluation demonstrates that the neural controller can track the reference d-axis and q-axis currents effectively even for highly random punctuating reference currents. Compared to standard vector control methods and direct- current vector control techniques, the neural vector control approach produces the fastest response time, low overshoot, and, in general, the best performance. To improve Fuzzy and stability under disturbance conditions, we used additional strategies. These include adding integrals of error signals to the network inputs and introducing grid disturbance voltage to the outputs of a well-trained network rather than to the inputs of the network. We have proved that these strategies are effective. In both power converters switching environments and nested- loop control conditions, the neural network vector controller demonstrates strong capability in tracking reference command while maintaining a high power quality. Under a fault in the grid system, the neural controller exhibits a strong short-circuits ride-through capability.

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