A FUZZY BASED POWER COMPENSATION ELECTRIC AND EFFECTIVE WAY TO OVERCOME ENERGY QUALITY PROBLEMS

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ABSTRACT: Electronic sources (ES), as an effective way to overcome energy quality problems caused by wind and photovoltaic (PV) weaknesses, have little power, are adaptable to the place, and have an advantage in low effort. The controller presented in this article with the internal and external power analysis of ES-2, distributing power and acceptance by introducing the integrated link interface (SOGI-PLL) and the second required fictitious axis emulator. (FAE) In summary The control calculation is constructed with constant voltage and current figures and the model of equation ES-2 is established in the partial rotation of the pivot dq. At that time, a closed environment was prepared, especially for the solid state control system. The ES power circuit, the current circuit, and the power circuit were designed. Of the three, adjusted performance (PR) was accepted. ES guarantees the maximum power of the ES-2 power supply. Considering all electronic circuits, PI controllers are normally used for current circuits and forced circuits. Finally, the ability to control the power of isolation is recognized by total reproduction. And search results.

Keywords: – Electric spring (ES), photovoltaic (PV) power, fictitious axis emulator (FAE), proportional resonance (PR).

INTRODUCTION

In order to alleviate such problems, many solutions have been put forward. Currently, the mainstream solutions include reactive power compensation [2], energy storage device [3], direct load control [4] and price incentive [5]. However, these solutions have some limitations. For instance, the equipment for reactive power compensation typically utilizes centralized control so that it may not adapt to the distributed development trend of future power grid. By now, energy storage devices still cost too much, which precludes their massive usage. Direct load control and price incentive use hysteretic control mode, which is not a good choice for localization. A new compelling way to solve the power quality issues caused by the uncertainty of photovoltaic (PV) and wind power is represented by ES [6]. It creatively applies the concept of mechanical spring to the power system. The basic idea is to classify the loads of a power system into two categories, one is the critical load (CL) that requires higher power quality, such as information center and hospital, the other one is the non-critical load (NCL) that tolerates a certain degree of voltage variation, such as water heater and lighting. By adjusting the magnitude and phase of the output voltage of ES, the active and reactive power absorbed by the ES system is controlled.

Specifically, the active power consumed by the NCL is modified while keeping the active power consumed by the CL unaltered in order to improve the power quality for it. The ES topology has developed for three generations, namely ES-1 [6], ES-2 [7], [8] and ES-3 [9]. In particular, ES-2 replaces the capacitor in the DC side of ES-1 with a voltage source and/or a battery pack, giving ES the capability of regulating both active and reactive power. Compared with the previous two generations, the NCL in ES-3 is not seen visually. The research on ESs is mainly focused on modelling of their dynamics [10], analysis of their application [11], and development of an effective control strategy for them [12]–[16]. In [7], a general study was conducted on the control of ES with active and reactive power compensations at steady state. In [10], the dynamic modelling of ES-1 was formulated, considering only the reactive power compensation. In [11], it is proved that ES can reduce the capacity of energy storage devices in future distributed grid. In [12], Wang et al. proposed the so-called δ control strategy for ES with a proportional resonant (PR) controller for the outer voltage loop and a proportional (P) controller for the inner current loop. In [13], the radial-chordal decomposition (RCD) control was devised, with the radial and chordal components of ES voltage controlling the power angle and voltage amplitude of smart load (SL) respectively. In [14], an input current control scheme is designed for ES focusing on power factor correction. However, it is hard to set the reference of the outer voltage loop. In [15], the collaborative control when power grid with multiple ESs embedded was analyzed. But it's not related to power decoupling. In [16], multifunctional DC electric springs for improving voltage quality of DC grids was discussed.

WORKING PRINCIPLE OF MOSFET

The aim of the MOSFET is to be able to control the voltage and current flow between the source and drain. It works almost as a switch. The working of MOSFET depends upon the MOS capacitor. The MOS capacitor is the main part of MOSFET. The semiconductor surface at the below oxide layer which is located between source and drain terminal. It can be inverted from p-type to n-type by applying a positive or negative gate voltages respectively. When we apply the positive gate voltage the holes present under the oxide layer with a repulsive force and holes are pushed downward with the substrate.

The depletion region populated by the bound negative charges which are associated with the acceptor atoms. The electrons reach channel is formed. The positive voltage also attracts electrons from the n+ source and drain regions into the channel. Now, if a voltage is applied between the drain and source, the current flows freely between the source and drain and the gate voltage controls the electrons in the channel. Instead of positive voltage if we apply negative voltage, a hole channel will be formed under the oxide layer.

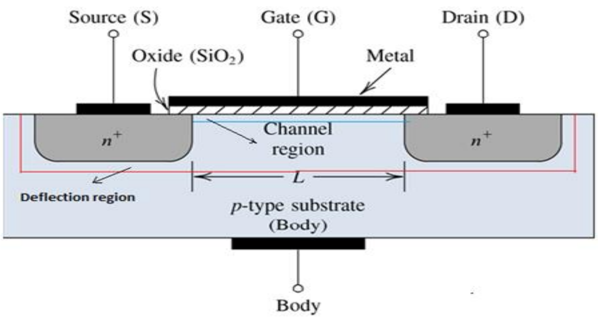


Fig: 2.3 MOSFET Block Diagram

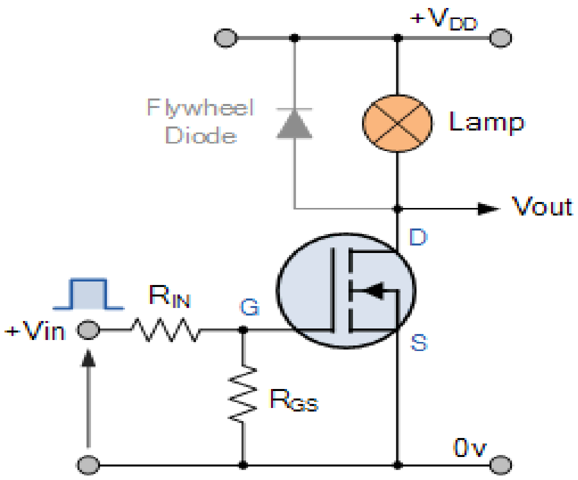


Fig: 2.4 Mosfet switch

In this circuit arrangement an enhanced mode and N-channel MOSFET is being used to switch a sample lamp ON and OFF. The positive gate voltage is applied to the base of the transistor and the lamp is ON (V_{GS} =+v) or at zero voltage level the device turns off (V_{GS}=0). If the resistive load of the lamp was to be replaced by an inductive load and connected to the relay or diode which is protect to the load. In the above circuit, it is a very simple circuit for switching a resistive load such as lamp or LED. But when using MOSFET to switch either inductive load or capacitive load protection is required to contain the MOSFET device. We are not giving the protection the MOSFET device is damage. For the MOSFET to operate as an analog switching device, it needs to be switched between its cutoff region where V_{GS}=0 and saturation region where V_{GS} =+v.

ADVANTAGES:

MOSFET has four terminals e.g. Gate, Source, Drain and Substrate. There are two types of MOSFET viz. n-channel MOSFET and p-channel MOSFET. Moreover there are two categories in each of these types. As a result, MOSFET operates in any of the following modes. They can be operated in either enhancement mode or depletion mode:

i) They have much higher input impedance compare to JFET.

ii) They have high drain resistance due to lower resistance of channel.

iii) They are easy to manufacture.

iv) They support high speed of operation compare to JFETs.

Finally, we will conclude that, the transistor requires current whereas MOSFET require voltage. The driving requirement for the MOSFET is much better, much simpler as compared to a BJT.

PROPOSED ELECTRIC SPRING

Space vector control is an effective method for the analysis and design of the active and reactive power decoupling techniques in three-phase grid-tie-inverters. Recently, this method has been extended to single-phase systems [17]. Since only one control variable is available in a single-phase system, a fictitious variable is needed to complete the space vector-based control schemes. To solve this issue, a variety of virtual signal generation algorithms have been proposed [18]–[20]. Unfortunately, these algorithms will introduce additional time delay, which may result in a slower or even oscillatory dynamic response of the control systems. In [21], a fictitious-axis emulator was introduced to prevent the inconvenience above. However, a detailed analysis of how to apply such an algorithm to the power control of ES-2 is still not reported. Further to the previous discussion, a control strategy setting active power and CL voltage as control objectives is needed for an intensive usage of ES-2 in applications such as households microgrids. Although a simple active and reactive power control was proposed in [22], it is still not satisfactory; for instance, it lacks of a system modelling suitable for the assessment of control parameters. What's more, it is not a complete decoupled power control.

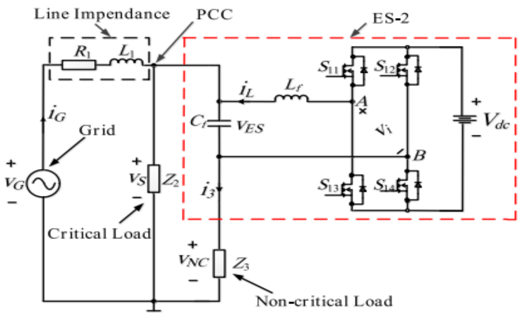
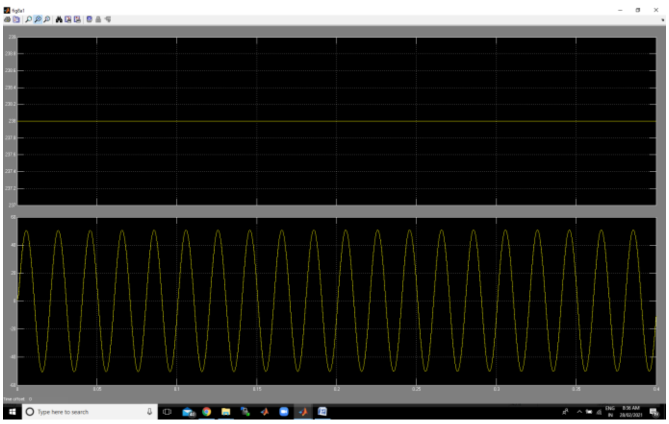
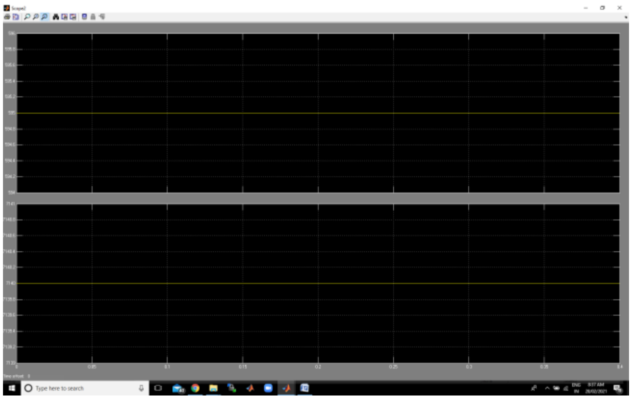


FIGURE 1. **Typical application diagram of single-phase ES-2.**

Aiming at achieving a decoupled power control with in-depth analysis for ES-2 used in households applications, this paper improves dynamic responses significantly compared with the existing control proposed in [22] by adding an inner current loop and a decoupling network, in which second order generalized integrator (SOGI) algorithm and fictitiousaxis emulator (FAE) were introduced to construct the virtual orthogonal voltage and current signals.

SIMULINK RESULT





CONCLUSION

In this paper, a new type of decoupled power control is proposed for ES-2 in the applications such households microgrids. Compared to existing power control for ES-2, system modeling with more analysis for parameters tuning and more functions are added. For instance, decoupling network is added as well as the inner current loop, which can achieve power decoupling and higher dynamic responses. Besides, more in-depth analysis including detailed system modeling and parameter tuning are provided. A simple discussion about the ability of active and reactive regulation of ES-2 is provided. In order to establish the mathematical model of ES-2 in dq axis synchronous rotating reference frame, SOGI algorithm and FAE were introduced to construct the virtual orthogonal voltage and current signals. Then, the detailed power decoupling control method was well illustrated. The PCC voltage was selected as the reference vector, helping decompose the injected current into active and reactive components, by controlling which the independent power control can be achieved only using PI controllers. Besides, an additional ES voltage loop was introduced to promise the premise tracking of the ES voltage. Finally, the effectiveness of the proposed decoupled power control is verified by both simulation and experimental results.

REFERENCES

[1] H. Hu, P. Pan, Y. Song, and Z. He, ‘‘A novel controlled frequency band impedance measurement approach for single-phase railway traction power system,’’ IEEE Trans. Ind. Electron., vol. 67, no. 1, pp. 244–253, Jan. 2020.

[2] L. Wang, C.-S. Lam, and M.-C. Wong, ‘‘Hybrid structure of static var compensator and hybrid active power filter (SVC//HAPF) for mediumvoltage heavy loads compensation,’’ IEEE Trans. Ind. Electron., vol. 65, no. 6, pp. 4432–4442, Jun. 2018.

[3] Q. Xu, J. Xiao, X. Hu, P. Wang, and M. Y. Lee, ‘‘A decentralized power management strategy for hybrid energy storage system with autonomous bus voltage restoration and state-of-charge recovery,’’ IEEE Trans. Ind. Electron., vol. 64, no. 9, pp. 7098–7108, Sep. 2017.

[4] M. Shad, A. Momeni, R. Errouissi, C. P. Diduch, M. E. Kaye, and L. Chang, ‘‘Identification and estimation for electric water heaters in direct load control programs,’’ IEEE Trans. Smart Grid, vol. 8, no. 2, pp. 947–955, Nov. 2017.

[5] T. Namerikawa, N. Okubo, R. Sato, Y. Okawa, and M. Ono, ‘‘Realtime pricing mechanism for electricity market with built-in incentive for participation,’’ IEEE Trans. Smart Grid, vol. 6, no. 6, pp. 2714–2724, Nov. 2015.

[6] S. Y. Hui, C. K. Lee, and F. F. Wu, ‘‘Electric Springs—A new smart grid technology,’’ IEEE Trans. Smart Grid, vol. 3, no. 3, pp. 1552–1561, Sep. 2012.

[7] S.-C. Tan, C. K. Lee, and S. Y. Hui, ‘‘General steady-state analysis and control principle of electric springs with active and reactive power compensations,’’ IEEE Trans. Power Electron., vol. 28, no. 8, pp. 3958–3969, Aug. 2013.

[8] S. Yan, C.-K. Lee, T. Yang, K.-T. Mok, S.-C. Tan, B. Chaudhuri, and S. Y. R. Hui, ‘‘Extending the operating range of electric spring using backto-back converter: Hardware implementation and control,’’ IEEE Trans. Power Electron., vol. 32, no. 7, pp. 5171–5179, Jul. 2017.

[9] C. K. Lee and S. Y. R. Hui, ‘‘Input AC voltage control bi-directional power converters,’’ U.S. Patent 13 907 350, May 31, 2013. [10] N. R. Chaudhuri, C. K. Lee, B. Chaudhuri, and S. Y. R. Hui, ‘‘Dynamic modeling of electric springs,’’ IEEE Trans. Smart Grid, vol. 5, no. 5, pp. 2450–2458, Sep. 2014.