A Shunt Active Power Filter's Pi and Fuzzy DPC Control Comparison

Feriel Abdelmalek[1*], Hamza Afghoul[2], Fateh Krim[1], Djallal Eddine Zabia[3] ,
Taha Lamdjed Belahcene[3], Salah Anis Krim[2]

[1]LEPCI Laboratory, Department of Electronics, University of Ferhat Abbas Setif-1,Setif, Algeria
[2] LEPCI Laboratory, Department of Electrotechnics, University of Ferhat Abbas Setif-1,Setif, Algeria
[3]LI3CUB Laboratory, Department of Electrical Engineering,University of Mohamed Khider, Biskra, Algeria
*Corresponding author's e-mail: feriel.abdelmalek@univ-setif.dz

ABSTRACT

In this paper, an improved form of direct power control (DPC) for a shunt active power filter (SAPF) system is presented. The optimization is achieved by applying a fuzzy logic strategy to the DC link voltage control strategy. The three main objectives are to ensure reactive and harmonic compensation in the power grid, to achieve the lowest possible DC voltage error during the transient state, and to eliminate or significantly reduce the influence of unwanted harmonics. The static and dynamic behaviors of DPC and F-DPC are presented. The results of F-DPC simulation are compared with those of conventional DPC. Due to the high level of power quality improvement, F-DPC can become an interesting alternative over traditional DPC technique for SAPF.

Keywords: SAPF, DPC, F-DPC.

1 System Description

Figure 1 depicts the basic idea of the power system. A three-phase network makes up the first of the system's three main building blocks [1]. A three-phase rectifier and an RL load connected to the power source make up the second non-linear load [2]. The third type is an active power filter, which is a draw level inverter made up of the proposed DPC of an SAPF. Finally, the DC vector voltage is managed by the PI-controller or the fuzzy-controller [3].

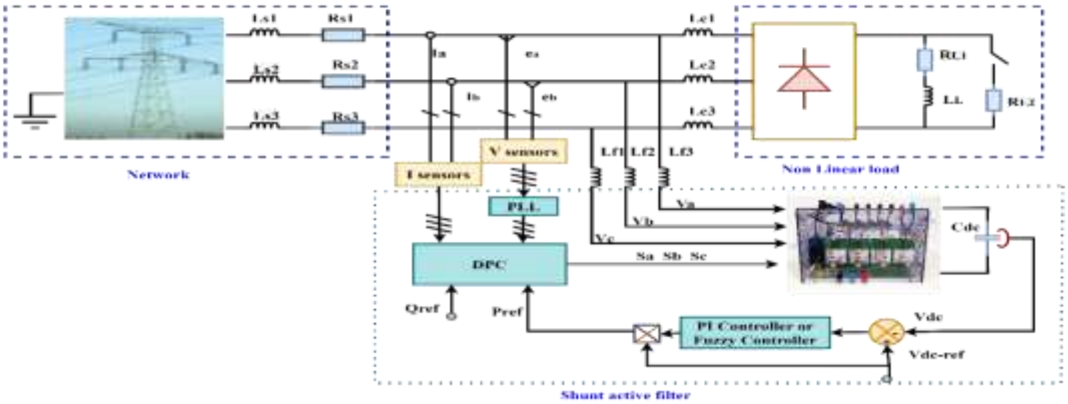

Figure 1: *Block diagram of the studied configuration*

2 Simulation and performance comparison

The entire system shown in Fig.1 has been simulated in the MATLAB/Simulink environment in order to assess the performance and robustness of the suggested control strategies. The graphics below show the main results of the simulations that were used to create this study. In figures 2-3, we examine the behavior of the filter in a transient state after receiving the results in a steady state. Since both PI and fuzzy controllers are responsible for the response quality of the system in the dynamic state, two performance indicators are used in this study. System response time is the first, and varies depending on the type of controller used. After changing the load at time t2 = 0.2 sec, the same process is followed. We notice that the response time

DOI: 10.21467/abstracts.163 ISBN: 978-81-965621-5-1 (eBook)

of the fuzzy controller is faster than that of the PI controller. The same behavior is shown by the second parameter, specifically the first override D (%), which is expressed in percentages (decreases). Table 1 compares the techniques in detail.

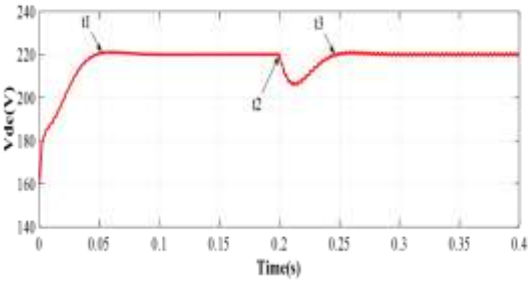

Figure 2: *Conventional DPC: Capacitor voltage*

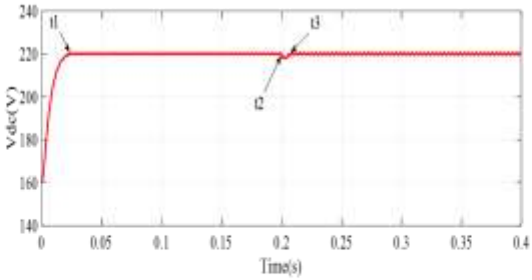

Figure 3: *F-DPC: Capacitor voltage*

Table 1: *Comparison of various approaches*.

Controllers	THD Values	Transient state	
		Response time	Voltage error
without compensation	26.72%	/	/
DPC with PI controller	0.87 %	0.05s	0.01V
DPC with fuzzy controller	3.37 %	0.025s	0V

3 Conclusion

The DPC algorithm is very popular because of PI control technology's ease of use and respectable performance. When the operating conditions of the power system change, this controller may not achieve the required performance. As a result, this paper suggests a fuzzy logic-based control strategy. We observe that under transient conditions, the filter quality is primarily dependent on the DC feed-in input inverter regulation index because it enables reactive power compensation to raise the unit's power factor. The stability and filtering capacity of the harmonic mitigation system are increased by the results obtained using fuzzy, which generally showed a significant decrease in voltage error and response time compared to PI.

How to Cite

F. Abdelmalek, H. Afghoul, F. Krim, D. E. Zabia, T. L. Belahcene, S. A. Krim, “A Shunt Active Power Filter's Pi and Fuzzy DPC Control Comparison”, *AIJR Abstracts*, pp. 80–81, Feb. 2024.

References

[1] H. Afghoul, et al, "Implementation of fractional-order integral-plus-proportional controller to enhance the power quality of an electrical grid," Electric Power Components and Systems, 2016. 44(9): p. 1018-1028.

[2] H. Afghoul, and F. Krim," Comparison between PI and fuzzy DPC control of a shunt active power filter," in 2012 IEEE International Energy Conference and Exhibition (ENERGYCON). 2012. IEEE.

[3] H. Afghoul, et al, "Robust switched fractional controller for performance improvement of single phase active power filter under unbalanced condition," Frontiers in Energy, 2016. 10(2): p. 203-212.

ISBN: 978-81-965621-5-1

Series: AIJR Abstracts

DOI: 10.21467/abstracts.163