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Comparative Study of Different Methods of Active Power Compensation

*L. Benyettou, *T. Benslimane, **O. Abdelkhalek

[*] Laboratory of Electrical Engineering, University of M'sila, Algeria
[**] Department of Electrical Engineering, University of Béchar, Algeria
BP-166 University of M'Sila, M'Sila 28000, Algeria
(benyettou.loutfi_lge@yahoo.fr)

Abstract

Shunt Active Filter generates the reference current that must be provided by the power filter to compensate harmonic currents demanded by the load. This paper presents different types of methods for real time regeneration of compensating current for harmonic mitigation. Several methods including instantaneous real and reactive power theory have been proposed for extracting the harmonic content. This paper presents a different modification based on the same principle and compares its performances with sinusoidal source and balanced load condition. The Modified SRF method called, in this paper, Filtered Modified Reference Frame Method, because it uses filters and is based on the modified reference frame method. The performance of Shunt Active Power Filter in terms of THD (Total Harmonic distortion) of voltage and current is achieved with in the IEEE 519 Standard. The comparison of all methods is based on the theoretical analysis and simulation results obtained with MATLAB/SIMULINK.

Keywords

Parallel active filter, Extraction methods of harmonics, MVF, Control PWM, Control hysteresis.

1. Introduction

In recent years, the expansion of employment in the industry of non-linear-based power electronic loads has led to increasing problems with interference or distortion harmonics of power systems. This affects all industrial sectors (using dimmers, rectifiers, inverters, ...), tertiary (computer or office lighting, commercial, ...) and domestic (televisions, home consumer devices, ...).

Harmonic distortion is generated by non-linear loads connected to the network and absorbs non-sinusoidal currents. These harmonic currents will in turn generate harmonic voltages at different points of the network connection. For other electrical equipment connected at these points, the harmonic pollution has adverse effects. These effects may be cited the deformation of the grid voltage at the connection point when the energy distributor is required to provide clean power. This pollution can also lead to overheating of the cables and electrical equipment or even stopped suddenly rotating machines, even the total destruction of all equipment. Therefore, suppliers of electrical energy are therefore obliged to impose standards and protect themselves against these disturbances. Standards on harmonics have been proposed by the International Electrotechnical Commission IEC61000, recommendations and IEEE Std. 519-1992 [1,2,3]. To cope with the phenomenon of harmonic disturbances, several solutions have been proposed. These solutions are based on diode rectifiers single and three phases to special structures, PWM rectifiers, passive filters and active filters. Traditional methods for reducing harmonics involve the use of passive filters trapping harmonic currents-based LC circuits calculated in line with harmonic filtering rows. They can also be used to compensate the reactive power. However, the passive filter some problems: a lack of adaptability to variations in the impedance of the network load and possible resonance with the impedance of the network and in some unfavorable cases where the resonance is excited, it can a driving voltage and a higher harmonic current in significant harmonic filter capacity and the network. Thus, this solution has a major drawback that can be intolerable in these particular [1,3] circumstances. Another solution is to implement an active filter in order to avoid the drawbacks of passive filters. Many solutions for active remediation of electrical networks filters have been proposed in the literature. Those that best meet the active parallel-series (also known as Unified Power Quality Conditioner - UPQC). In the case where the source currents are non-linear, parallel active power filter (Shunt Active Power Filter - SAPF) is considered the best solution to reduce harmonic currents in applications of low to medium power. The active filter is more advantageous where rapid response is required in the presence of dynamic loads. In addition, it represents a powerful tool for versatile packaging because it is also able to compensate reactive power and the unbalanced load. The active principle of the parallel filter is to generate harmonic currents in phase opposition to those existing on the network. The current absorbed by the pollutant loads is non- sinusoidal, while the current generated by the parallel active filter is such that the current network is sinusoidal. To comply with standards imposed stringent quality electric providers and industrial consumers and to stem the increasing problems of disturbances on power systems, active filters must adapt and meet these requirements and thus optimize their topologies and control techniques. For this purpose, several researches continue to be published on the parallel active filter, considering three main areas. The first is to estimate the offset current, the second is to evaluate alternative topologies, and the third area deals with control strategies that generate the control signals for the power switches. Our work is a comparative study under the same operating conditions between two control methods proposed for the identification of reference currents disrupting a nonlinear load FAP.

2. Parallel Structure of an Active Filter

The general structure of a three-phase voltage type FAP is presented by Figure 1 where we distinguish the inverter and the filter output power as well as the different blocks of the party control systems part. The power section usually consists of a voltage inverter-based power switches whose states of the inverter switches are controlled by the hysteresis controller, or PWM, a circuit energy storage (often capacitive) and an output filter of the first order to mitigate the components due to the switching of the inverter and has connect the crossover to the power grid. [4] The control-command portion is composed of a first step whose role is to identify the harmonic filter whose quality largely depends on the identification of the harmonics reference method, and a second step that performs the regulating the DC voltage. A third and final step generates the inverter control. This study is limited to cases where the source voltage is sinusoidal, and where the current drawn by the load is tainted with harmonic components. Under these conditions, the total harmonic distortion THD is well suited to describe the degree of harmonic pollution on the grid.

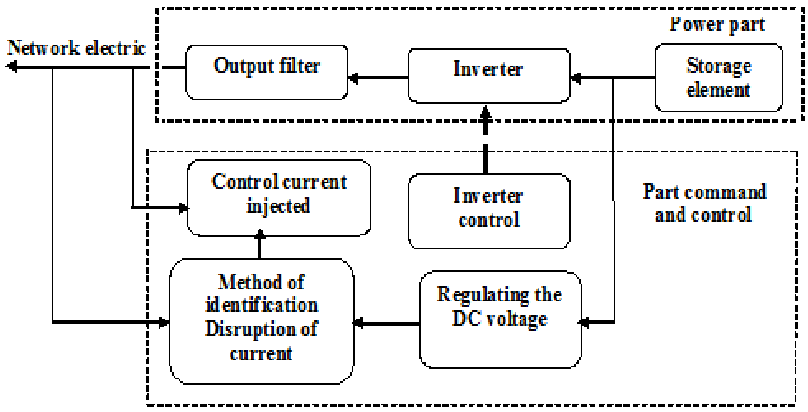

Fig. 1. General Structure of a FAP Voltage Structure

3. Calculation of Current Harmonics

The current consumption of the pollutant load is composed of a fundamental and harmonics. The active filter is used to generate the harmonic currents of the same magnitude but in phase opposition with those existing in the feed. To do this, we must identify the harmonic currents of the load. Several methods exist for identifying [5]:

The first is based on the spectral analysis of pollutant stream.

The second uses a band pass filter for filtering the fundamental. The third uses the concepts of instantaneous real power and imagination. The latter is most commonly used in most crossovers because it achieves the best agreement between the static and dynamic performance.

3.1. Method of Instantaneous Active and Reactive Power

The method of instantaneous active and reactive power (commonly denoted pq method) operates the Concordia transformation of voltages and line currents [6] to calculate the instantaneous active and reactive powers. The fundamental component is converted into a DC component and the harmonic components in the AC components. By removing the DC component of the instantaneous active power (corresponding to the fundamental component of the current of the load) using a simple low-pass filter (FPB), the harmonic components can be identified. The principle of this conventional method is now briefly described. Are respectively the voltages from the point of connect (Pcc), freedom from zero (connected to a pollutant load) and the three load currents, denoted v_{s1}, v_{s2}, v_{s3} and i_{c1}, i_{c2}, i_{c3}. The transformation can reduce this Concordia a balanced two-phase system in which the axes are quadratic phase system:

$$\begin{bmatrix} v_{s\alpha} \\ v_{s\beta} \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix} \cdot \begin{bmatrix} v_{s1} \\ v_{s2} \\ v_{s3} \end{bmatrix} \tag{1}$$

$$\begin{bmatrix} i_{c\alpha} \\ i_{c\beta} \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix} \cdot \begin{bmatrix} i_{c1} \\ i_{c2} \\ i_{c3} \end{bmatrix} \tag{2}$$

Neglecting the voltage harmonics, the actual power p_c and imaginary power q_c are expressed by:

$$\begin{bmatrix} p_c \\ q_c \end{bmatrix} = \begin{bmatrix} v_{s\alpha} & v_{s\beta} \\ -v_{s\beta} & v_{s\alpha} \end{bmatrix} . \begin{bmatrix} i_{c\alpha} \\ i_{c\beta} \end{bmatrix} \quad (3)$$

Components of real power and instantaneous imaginary expressed as the sum of a DC component and an AC component:

$$\begin{bmatrix} p_c \\ q_c \end{bmatrix} = \begin{bmatrix} \overline{p}_c + \widetilde{p}_c \\ \overline{q}_c + \widetilde{q}_c \end{bmatrix} \quad (4)$$

with:

- $\overline{p}_c$: The continuous power associated to the fundamental active component of the current and voltage;

- $\overline{q}_c$: The continuous power associated to the fundamental component of the reactive current and voltage;

- $\widetilde{p}_c$ et $\widetilde{q}_c$: Alternative power corresponding to the sum of the interference components of the current and voltage.

To isolate the conventional active and reactive power, it is necessary to know accurately the frequency pulsations instantaneous power formed from equation (4). It should be noted that now considers that the studied system is composed of three son that prevents zero sequence components are circulating. After identifying the pulse instantaneous power, the power filter charged isolate conventional active and reactive power can be sized. A circuit comprising a low pass filter with a subtract or can be used, as presented in figure (2).

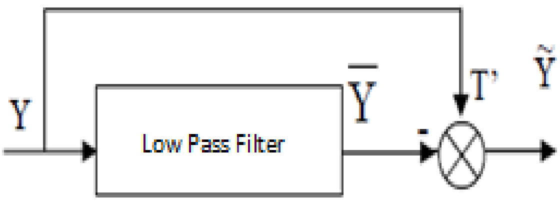

Fig. 2. Diagram Showing the Principle of Separation of Powers

The order of this low-pass filter defines the dynamics and effectiveness of the identification method. In this paper, a low-pass second order filter is selected for the extraction of harmonics. The cut off frequency fc=25Hz is chosen so that the filter can block any disturbing component of instantaneous power.

From equation (3), we can find current component:

$$\begin{bmatrix} i_{c\alpha} \\ i_{c\beta} \end{bmatrix} = \begin{bmatrix} v_{s\alpha} & v_{s\beta} \\ -v_{s\beta} & v_{s\alpha} \end{bmatrix}^{-1} \cdot \begin{bmatrix} p_c \\ q_c \end{bmatrix} = \frac{1}{v_{s\alpha}^2 + v_{s\beta}^2} \begin{bmatrix} v_{s\alpha} & -v_{s\beta} \\ v_{s\beta} & v_{s\alpha} \end{bmatrix} \cdot \begin{bmatrix} p_c \\ q_c \end{bmatrix} \quad (5)$$

By introducing (4) in (5), the currents in the axes (α, β) becomes:

$$\begin{bmatrix} i_{c\alpha} \\ i_{c\beta} \end{bmatrix} = \frac{1}{v_{s\alpha}^2 + v_{s\beta}^2} \begin{bmatrix} v_{s\alpha} & -v_{s\beta} \\ v_{s\beta} & v_{s\alpha} \end{bmatrix} \cdot \begin{bmatrix} \bar{p}_c \\ \bar{q}_c \end{bmatrix} + \frac{1}{v_{s\alpha}^2 + v_{s\beta}^2} \begin{bmatrix} v_{s\alpha} & -v_{s\beta} \\ v_{s\beta} & v_{s\alpha} \end{bmatrix} \cdot \begin{bmatrix} \tilde{p}_c \\ \tilde{q}_c \end{bmatrix} \quad (6)$$

Depending on the function that we want to give to the FAP, we can simultaneously compensate the current harmonics and reactive power or only one. Table (1) summarizes the possible modes of compensation [7], [8]. If we want for example to compensate current harmonics and reactive power simultaneously, then we eliminate the DC component of p_c using a simple LPF. In this case and after adding to the AC component of the instantaneous active power, active power p_{dc} for regulation of the DC voltage v_{dc}.

Tab. 1. Methods of Controlling the Compensation Instantaneous Power

Type of compensation	Control parameters	
Compensation of current harmonics	$p_f^{ref} = p_c + p_{dc}$	$q_f^{ref} = \tilde{q}_c$
Compensation of reactive energy	$p_f^{ref} = 0 + p_{dc}$	$q_f^{ref} = \bar{q}_c$
Compensation of current harmonics and reactive power	$p_f^{ref} = \tilde{p}_c + p_{dc}$	$q_f^{ref} = q_c$

The reference currents, denoted $i_{f\alpha}^{ref}$ et $i_{f\beta}^{ref}$, are expressed along the axes (α, β) by:

Finally, it is easy to obtain the reference currents according to the axes abc by the transformation:

$$\begin{bmatrix} i_{f1}^{ref} \\ i_{f2}^{ref} \\ i_{f3}^{ref} \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & 0 \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{1}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix} \cdot \begin{bmatrix} i_{f\alpha}^{ref} \\ i_{f\beta}^{ref} \end{bmatrix} \quad (7)$$

3.2. Principle of Multi-Variable Filter MVF

Mr. Benhabib suggested in his thesis [1] a new filter called MVF extraction, for extracting the fundamental component of electrical signals (voltage or current) directly along the axes (α-β). The transfer function of this filter is:

$$H(s) = \frac{\hat{v}_{\alpha\beta}(s)}{v_{\alpha\beta}(s)} = K\frac{(s+K)+j\omega_c}{(s+K)^2+\omega_c^2} \tag{8}$$

(ω_c) represents the fundamental pulsation (fc = 50 Hz),(K) a positive constant, (v)electrical input voltage MVF and $(\hat{v})$ is the voltage corresponding to (v)output MVF .the fundamental component of the electrical signal (voltage or current) can be extracted directly by the axes (α-β),without phase change or amplitude. from equation (8), we obtain the following two expressions.

$$\hat{v}_\alpha(s) = \frac{(s+K)K}{(s+K)^2+\omega_c^2}v_\alpha(s) \quad - \frac{k\omega_c}{(s+K)^2+\omega_c^2}v_\beta(s) \tag{9}$$

$$\hat{v}_\beta(s) = \frac{(s+K)K}{(s+K)^2+\omega_c^2}v_\beta(s) \quad + \frac{k\omega_c}{(s+K)^2+\omega_c^2}v_\alpha(s) \tag{10}$$

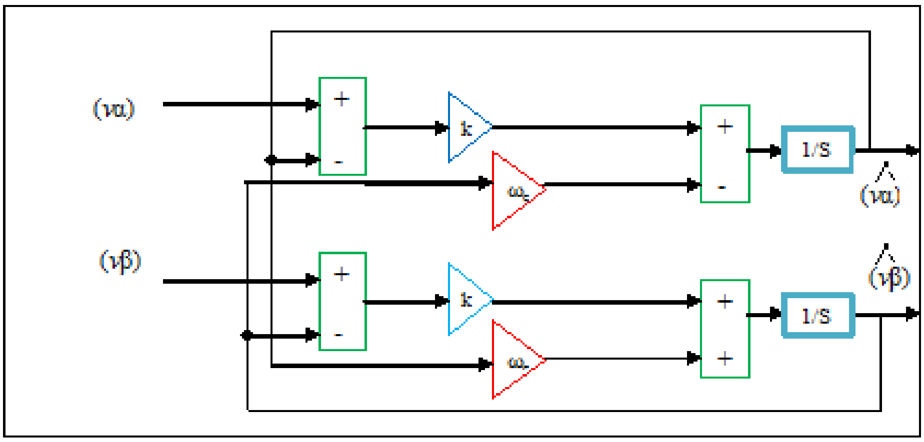

Fig. 3. Block Diagram MVF

MVF used at the two-phase voltages, can effectively filter the harmonic components of the power supply voltages. Thus, its implementation can improve the performance of the filter.

3.3. Method Called the Reference Related to Synchronization

This method, introduced by [4], [10], the processing also operates Concordia but applied only to the line currents of the load i_{c1}, i_{c2} and i_{c3}. Then, a second processing is performed to switch the line currents in dq, which transforms the fundamental component of current in a DC component and harmonic current components in the AC components. This allows us to eliminate using a simple low pass filter, the DC component of the current. The major advantage of this method compared to previous lies in the fact that any tensions harmonics have no more influence on the identified current and therefore the filter will be better. Its principle is set out below. Are the line currents of a three-phase system without zero sequence? The transformation can reduce this Concordia phase system to a two-phase equilibrium system, as above by the following relationship:

$$\begin{bmatrix} i_{c\alpha} \\ i_{c\beta} \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix} \cdot \begin{bmatrix} i_{c1} \\ i_{c2} \\ i_{c3} \end{bmatrix} \quad (11)$$

By generating signals with a P.L.L $\cos(\hat{\theta})$ and $\sin(\hat{\theta})$ derived from the fundamental tension"" network, we obtain the expression of the currents in the dq system [4]:

$$\begin{bmatrix} i_{cd} \\ i_{cq} \end{bmatrix} = \begin{bmatrix} \sin(\hat{\theta}) & -\cos(\hat{\theta}) \\ \cos(\hat{\theta}) & \sin(\hat{\theta}) \end{bmatrix}^{-1} \cdot \begin{bmatrix} i_{c\alpha} \\ i_{c\beta} \end{bmatrix} \quad (12)$$

These components may then be expressed as the sum of a DC component and an AC component:

$$\begin{bmatrix} i_{cd} \\ i_{cq} \end{bmatrix} = \begin{bmatrix} \bar{i}_{cd} + \tilde{i}_{cd} \\ \bar{i}_{cd} + \tilde{i}_{cd} \end{bmatrix} \quad (13)$$

with:

$\bar{i}_{cd}$ and $\bar{i}_{cq}$: The DC components of i_{cd} and i_{cq},

$\tilde{i}_{cd}$ and $\tilde{i}_{cq}$: ac components of i_{cd} and i_{cq}

Equation (12), we can deduce the components of current α-β :

$$\begin{bmatrix} i_{c\alpha} \\ i_{c\beta} \end{bmatrix} = \begin{bmatrix} \sin(\hat{\theta}) & \cos(\hat{\theta}) \\ -\cos(\hat{\theta}) & \sin(\hat{\theta}) \end{bmatrix}^{-1} \cdot \begin{bmatrix} i_{cd} \\ i_{cq} \end{bmatrix} = \begin{bmatrix} \sin(\hat{\theta}) & \cos(\hat{\theta}) \\ -\cos(\hat{\theta}) & \sin(\hat{\theta}) \end{bmatrix} \cdot \begin{bmatrix} i_{cd} \\ i_{cq} \end{bmatrix} \tag{14}$$

Soint:

$$\begin{bmatrix} i_{c\alpha} \\ i_{c\beta} \end{bmatrix} = \begin{bmatrix} \sin(\hat{\theta}) & \cos(\hat{\theta}) \\ -\cos(\hat{\theta}) & \sin(\hat{\theta}) \end{bmatrix} \cdot \begin{bmatrix} \bar{i}_{cd} \\ \bar{i}_{cq} \end{bmatrix} + \begin{bmatrix} \sin(\hat{\theta}) & \cos(\hat{\theta}) \\ -\cos(\hat{\theta}) & \sin(\hat{\theta}) \end{bmatrix} \cdot \begin{bmatrix} \tilde{i}_{cd} \\ \tilde{i}_{cq} \end{bmatrix} \tag{15}$$

Next we give the function active power filter [4], we can also compensate with this command is the current harmonics and reactive energy or only one of the two. Table (2) summarizes the modes of compensation possible.

Tab. 2. Methods Compensation Control Repository Binds to Synchronously

Type of compensation	Control parameters	
Compensation of current harmonics	$i_{fd}^{ref} = \tilde{i}_{cd} + i_{dc}$	$i_{fq}^{ref} = \tilde{i}_{cq}$
Compensation of reactive energy	$i_{fd}^{ref} = 0 + i_{dc}$	$i_{fq}^{ref} = \bar{i}_{cq}$
Compensation of current harmonics and reactive power	$i_{fd}^{ref} = \tilde{i}_{cd} + i_{dc}$	$i_{fq}^{ref} = i_{cq}$

The reference currents are expressed by:

$$\begin{bmatrix} i_{f\alpha}^{ref} \\ i_{f\beta}^{ref} \end{bmatrix} = \begin{bmatrix} \sin(\hat{\theta}) & \cos(\hat{\theta}) \\ -\cos(\hat{\theta}) & \sin(\hat{\theta}) \end{bmatrix} \cdot \begin{bmatrix} i_{fd}^{ref} \\ i_{fq}^{ref} \end{bmatrix} \tag{16}$$

After the choice of control parameters, the inverse transformation can be traced back to the Concordia reference currents:

$$\begin{bmatrix} i_{f1}^{ref} \\ i_{f2}^{ref} \\ i_{f3}^{ref} \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & 0 \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{1}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix} \cdot \begin{bmatrix} i_{f\alpha}^{ref} \\ i_{f\beta}^{ref} \end{bmatrix} \tag{17}$$

3.4. Overall Rate of Harmonic Distortion

The overall distortion (Total Harmonic Distortion: THD) is a parameter that defines the overall deformation of the alternating quantity [8]:

$$THD(\%) = (\sqrt{\sum_{h=2}^{\infty} I_h^2 / I_1}) \times 100 \tag{18}$$

with: I_h :harmonic component of order h and I_1 : the fundamental component.

4. Current Control by Hysteresis

The method is based on the comparison of the difference Ɛ between the current reference and the measured currents with a fixed band. Each violation of this band gives a switching command switches to 4.

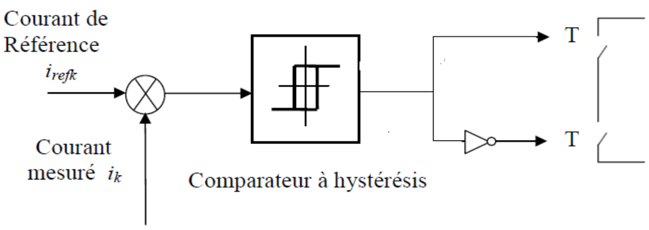

Fig. 4. Principle of Current Control by Hysteresis

5. Current Control by PWM

The PWM control principle is described in Figure 5. In this case, the difference between the current reference if and the actual current ifref is applied to the input of a controller. The output signal of the controller, called modulator, is then compared with a triangular wave of fixed frequency (carrier) to determine the order of switching of the switches. The frequency of the triangular carrier therefore sets the switching frequency of the power semiconductors [9].

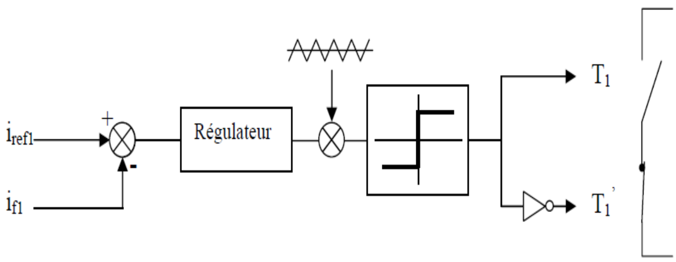

Fig. 5. Principle of Command Current by PWM

6. Simulation of Results

The simulation of the direct control in the phase marker based on the method binds to the repository synchronization or the theory of instantaneous power (pq with MVF) was conducted with the following parameters:

- The load current is increased 50% to t = 0,3 s
- The value of the DC voltage is equal to 600V
- The hysteresis band attached to 3A, for control by hysteresis
- The switching frequency is set at 13.5 KHz. for PWM control.
- Drop filter low pass second order cutoff frequency equal to 25Hz.
- The parameter K of MVF was chosen equal to 80.

Table (3) includes all network settings and pollutant loads used in the simulation.

Tab. 3. Simulation Settings

Parameters of the Source	
Rcc	1.59.10-6 Ω
Lcc	45.56.10-6H
Parameters of the Active filter	
Rf	0.43.10-3 Ω
Lf	9.10-5H
Parameters of the polluting load	
Rch	0.79Ω
Rl	2.73.10-3Ω
Lch	2.6.10-6 H
Ll	23.19.10-6 H

6.1. Results of Simulation of the Overall Network Load Before the non-Linear Filter

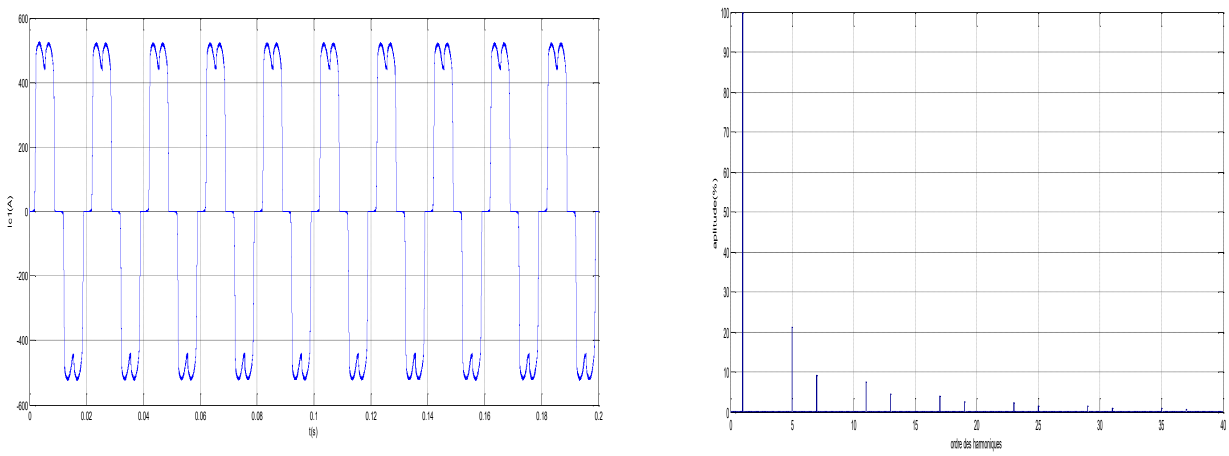

Fig. 6. The Line Currents of Each Phase and Their Frequency Spectra

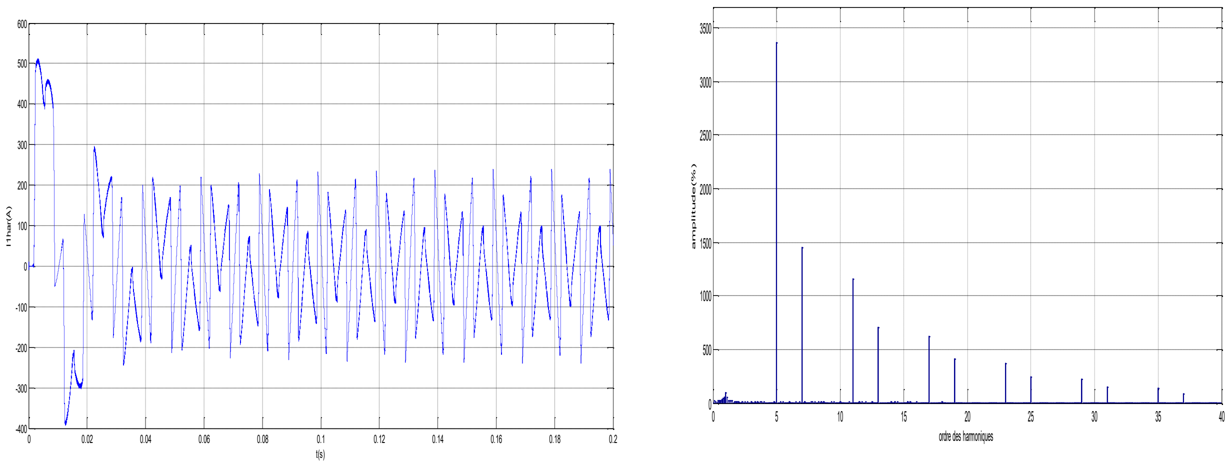

Fig. 7. The Reference Harmonic Currents and Their Spectra

6.2 Direct Control Method Based on the Instantaneous Power with MVF

a. Hysteresis control strategy using the instantaneous power method

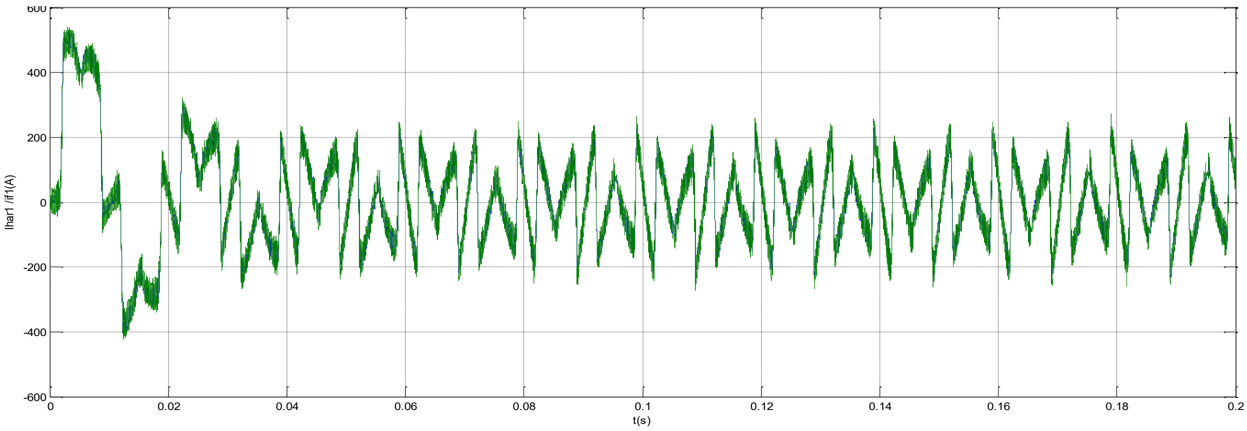

Fig.8. Reference and Injected Currents of the First Phase for the Hysteresis Control

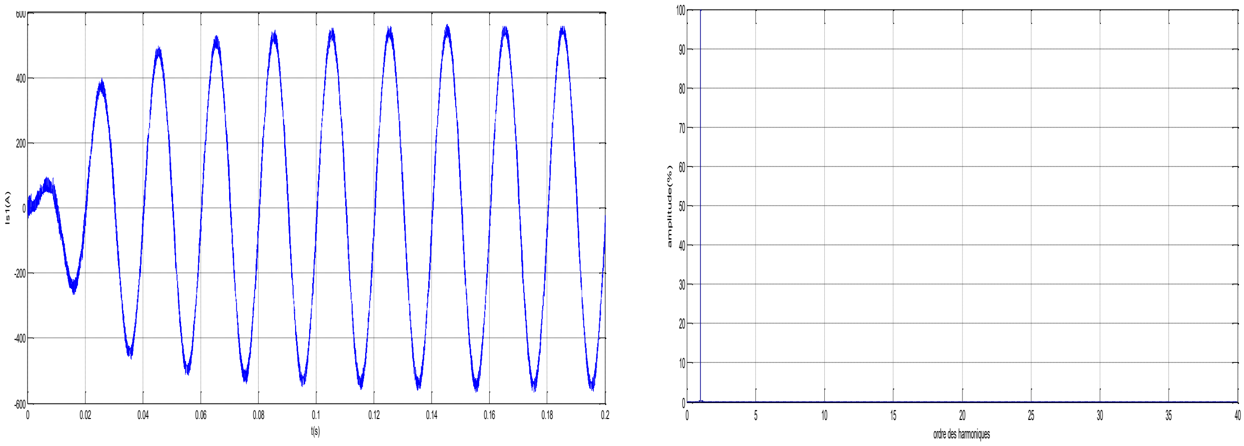

Fig. 9. Source Currents after Filtering and Their Frequency Spectra for the Hysteresis Control

b. MLI Control Strategy Using the Instantaneous Power Method

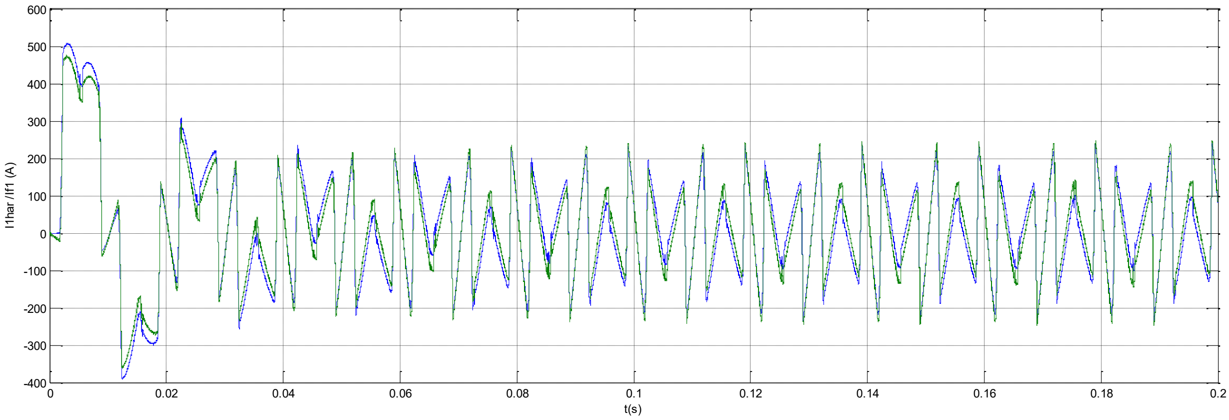

Fig.10. Reference and Injected Currents of the First Phase for the MLI Control

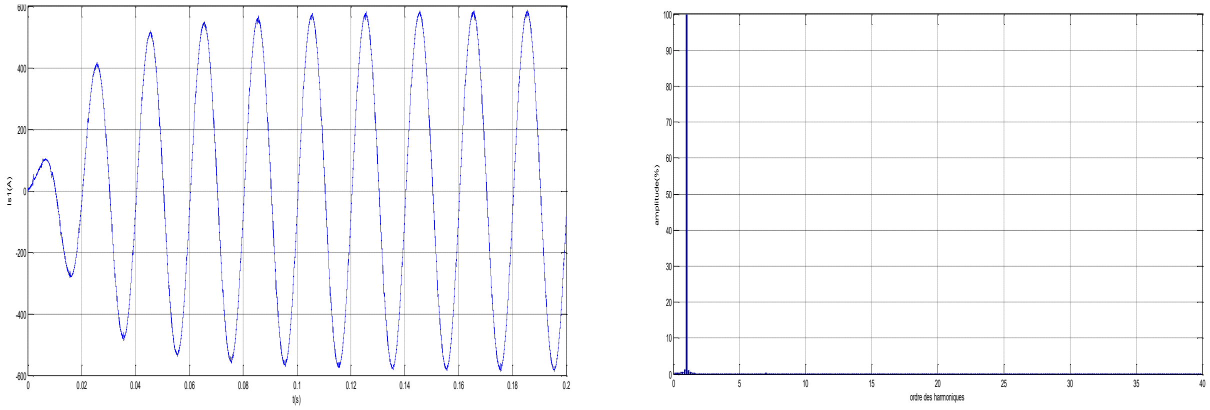

Fig.11. Source Currents after Filtering and Their Frequency Spectra for the MLI Control

c. Vector MLI control strategy using the instantaneous power method

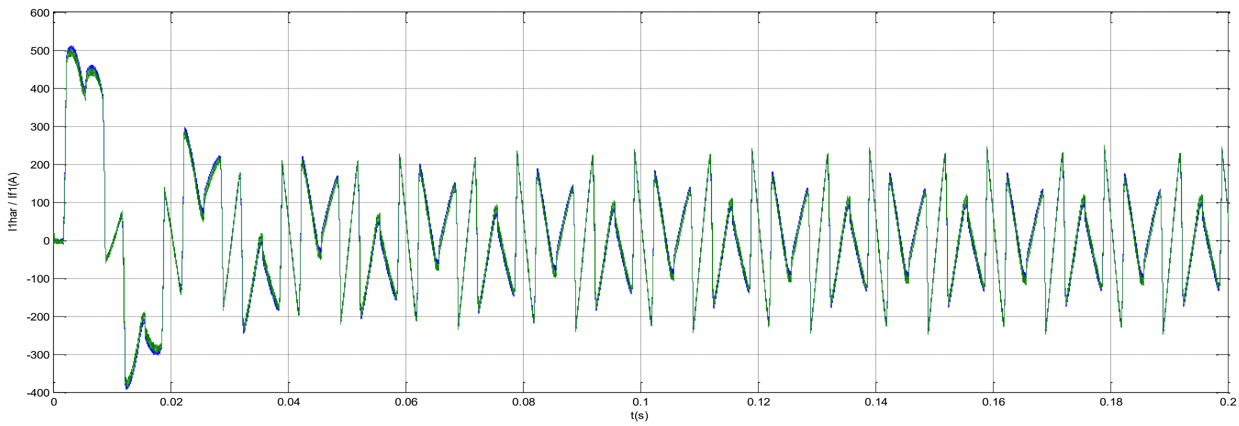

Fig. 12. Reference and injected Currents of the First Phase for the Vector MLI Control

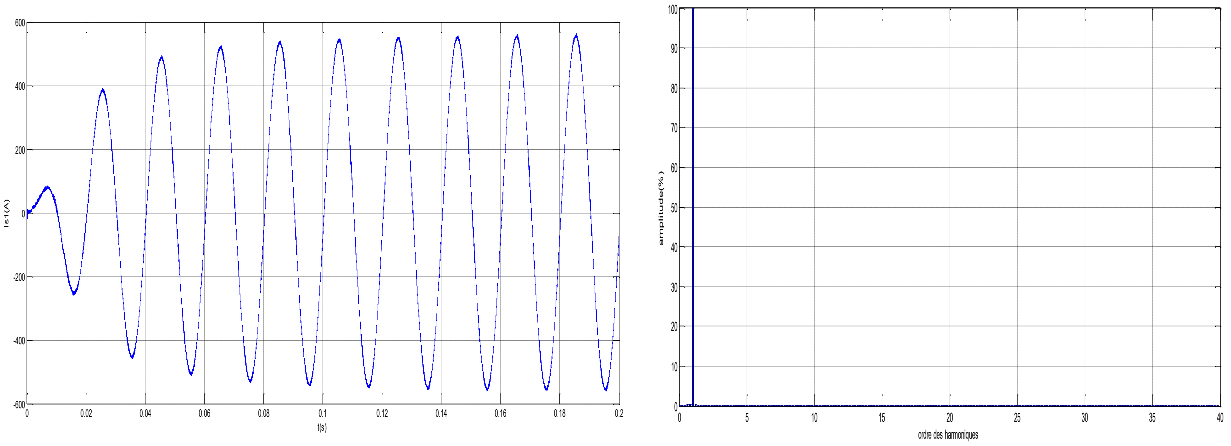

Fig.13. Source Currents after Filtering and Their Frequency Spectra for the Vector MLI Control

6.3 Direct Control Method Based on the Synchronous Reference Frame SFR

a. Hysteresis control strategy using the method (SRF)

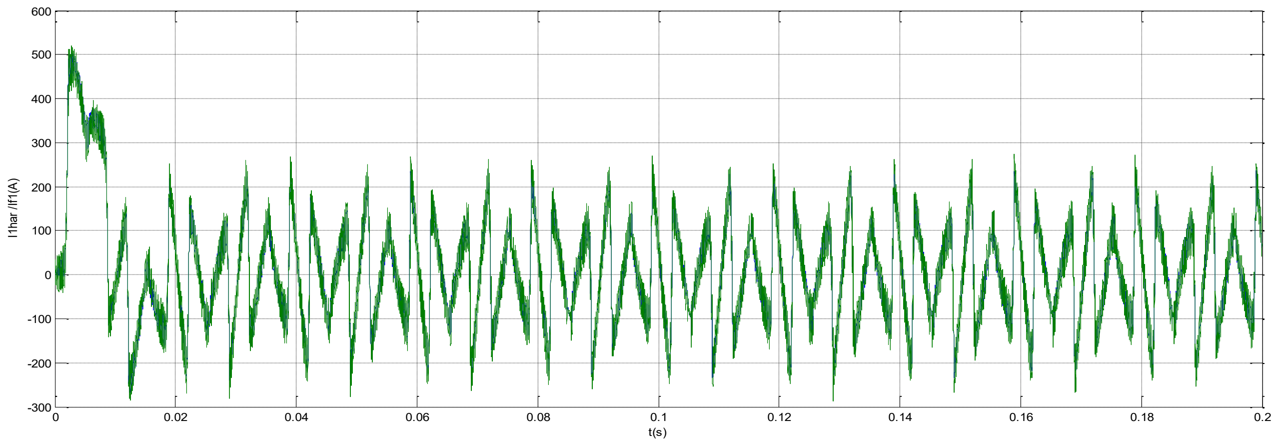

Fig.14. Reference and Injected Currents of the First Phase for the Hysteresis Control

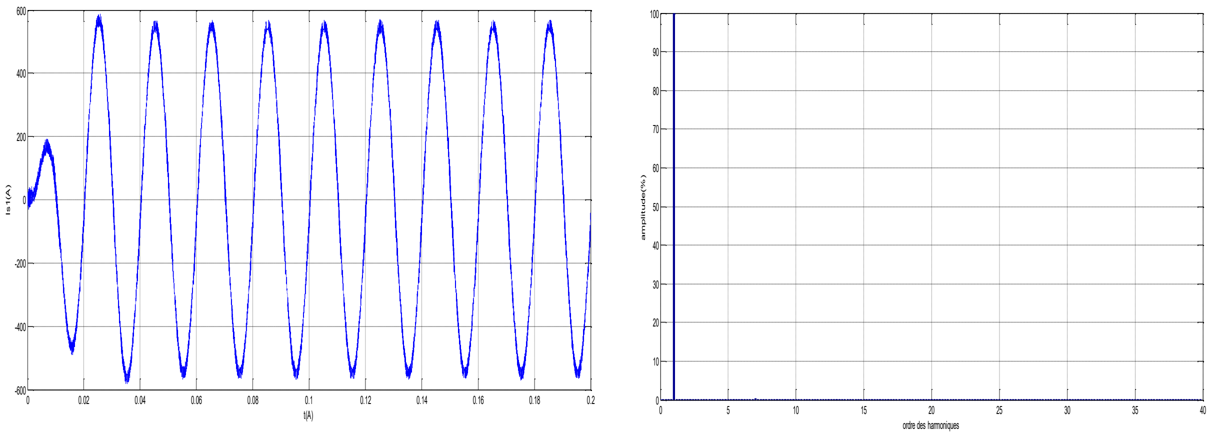

Fig. 15. Source Currents after Filtering and Their Frequency Spectra for the Hysteresis Control

b. MLI control strategy using the method (SRF)

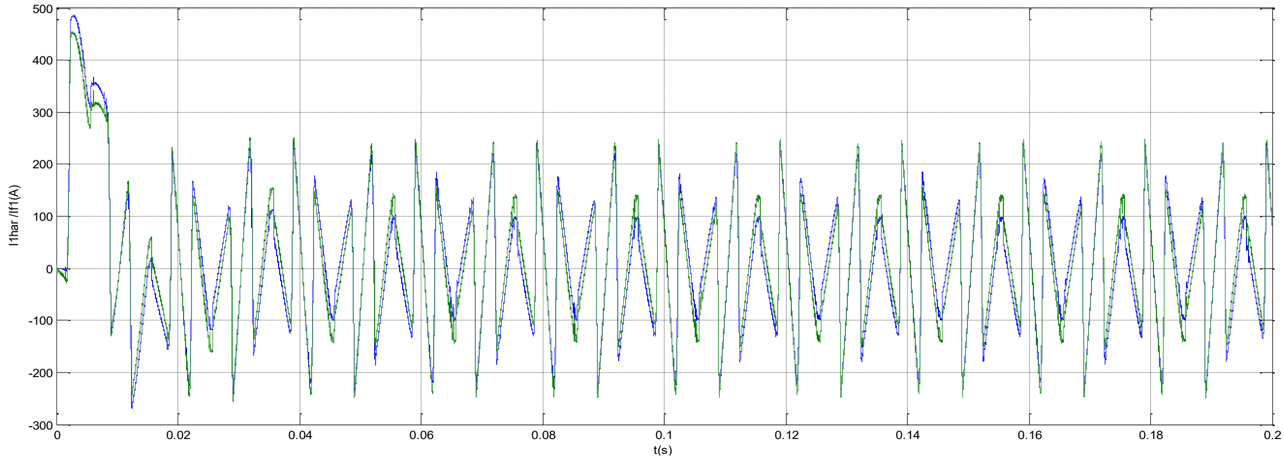

Fig. 16. Reference and Injected Currents of the First Phase for the MLI Control

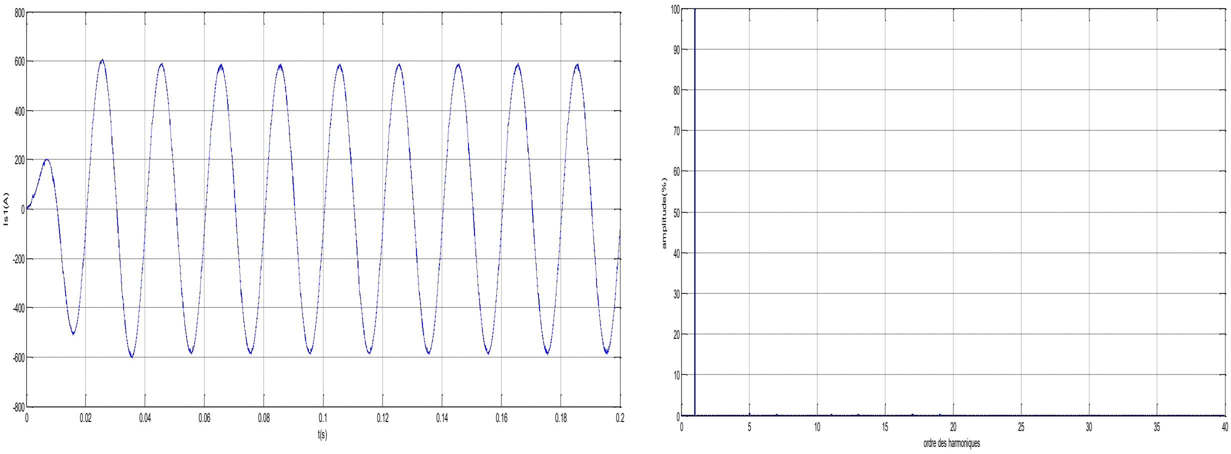

Fig. 17. Source Currents after Filtering and Their Frequency Spectra for the MLI Control

c. Vector MLI control strategy using the method (SRF)

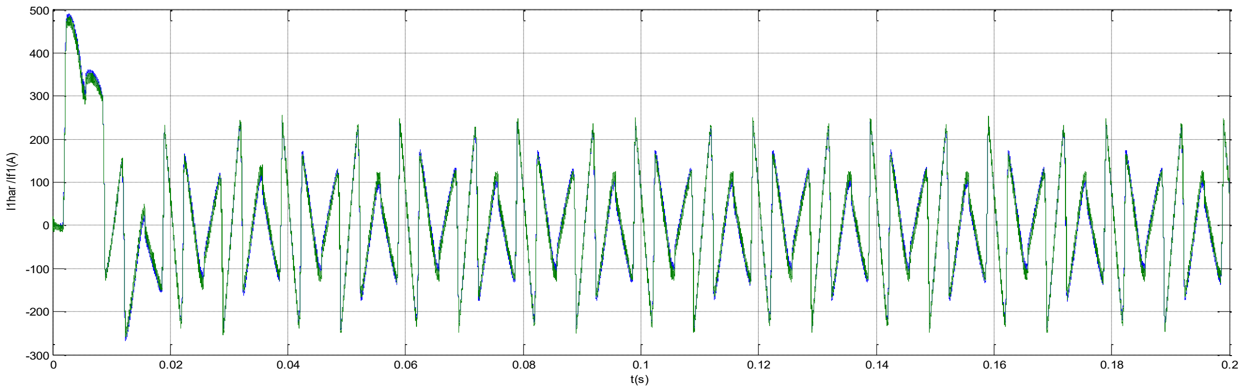

Fig. 18. Reference and Injected Currents of the First Phase for the Vector MLI Control

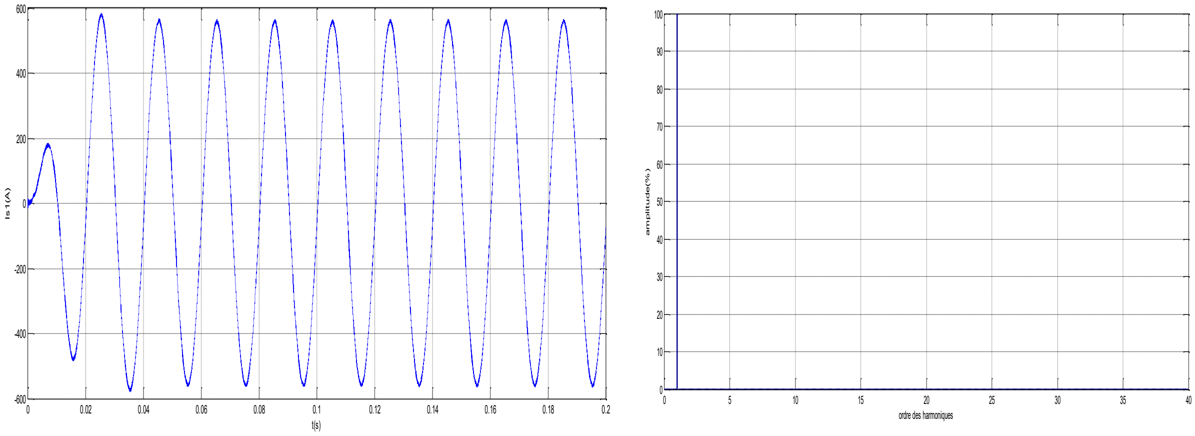

Fig. 19. Source Currents after Filtering and Their Frequency Spectra for the Vector MLI Control

7. Results Interpretation

7.1 Interpretation of Results for the Instantaneous Power Method

Figures (6) illustrate the line currents and their frequency spectrum, it is noted in the latter that the line currents have a rectangular shape this is due to the non-linear load and their frequency spectrum of the line currents Presents the presence of several harmonics tell that are THDI = 25.75%

The figures (7) show that the frequency spectrum of the identified currents coincides with the Spectrum of line currents except for the presence of a fundamental component in the latter.

The figures (8), (10) and (12) show respectively the reference current and injected for the first phase for the hysteresis control, MLI and Vector MLI, which means that if our inverter can inject a current following its reference, we will have a current of sinusoidal source.

Figures (9) show the source currents after filtering and their frequency spectra for hysteresis control, there is an improvement in the quality of the currents and reduction of the THD = 1.76%.

The figures (11) show the source currents after filtering and their frequency spectra for the MLI control, one notices an improvement of the quality of the currents and reduction of the THD = 1.25%.

Figures (15) show the source currents after filtering and their frequency spectra for Vector MLI control, there is an improvement in the quality of the currents and reduction of the THD = 0.85%.

7.2 Interpretation of Results for the Method (SRF)

The figures (14), (16) and (18) respectively show the reference current and are injected for the first phase by the hysteresis control, MLI and Vector MLI, which means that if our inverter, can inject a current following its reference, of sinusoidal source.

The figures (15) show the source currents after filtering and their frequency spectra for the hysteresis control, there is an improvement in the quality of the currents and a reduction of the THD = 1.65%

The figures (17) show the source currents after filtering and their frequency spectra for the MLI control, there is an improvement in the quality of the currents and reduction of the

THD = 1.01%.

Figures (19) show the source currents after filtering and their frequency spectra for Vector MLI control, there is an improvement in the quality of the currents and reduction of the THD = 0.78%

Conclusion

From the results obtained by the simulation made under the same operating conditions of the FAP next two proposed methods, the component method reference related to the timing with MVF and method of instantaneous active and reactive power with MVF detected disruptive current successful they effectively reduced the THDi after compensation, we found that the FAP Vector MLI control method gave satisfactory results and slightly better than the hysteresis and PWM method.

The results obtained with the two commands show that the implementation of the active filter can significantly reduce the harmonic content of the current source, which results in decreased after filtering THD well below 5%.

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