Control of Hybrid Active Filter Without Phase Locked Loop in the Feedback et Feedforward Loops

Mohamed Abdusalam[1], Philippe Poure[2] and Shahrokh Saadate[1]

[1] Groupe de Recherche en Electrotechnique et Electronique de Nancy (GREEN), CNRS UMR 7037
[2] Laboratoire d'Instrumentation Electronique de Nancy (LIEN), EA 3440
Université Henri Poincaré, B.P.239, 54506 Vandoeuvre lès Nancy, cedex – France

Tel: ++33.3.83.68.41.31 Fax: ++33.3.83.68.41.33
E-mail: {Mohamed.Abdusalam, Shahrokh.Saadate}@green.uhp-nancy.fr, Philippe.Poure@lien.uhp-nancy.fr

This paper presents a new hybrid active filter control without Phase Locked Loop (PLL) in the feedback and feedforward loops. This filter is dedicated to suppress the harmonic currents produced by nonlinear loads. The proposed control generates the harmonic current references by only using the α-β transformation and Self Tuning Filters (STFs).

The major aims were to simplify the calculation steps in the feedback and feedforward loops and to validate by simulation the efficiency of this new control. STFs have been introduced instead of high pass and low pass filters in the feedback and feedforward loops respectively. Because of the use of the STFs, no more PLL is necessary. This method reduces the complexity of the control scheme and consequently facilitates the digital implementation of the control system. Simulation results for a non linear load consisting in a diode rectifier feeding a (R, C) parallel load demonstrate the performances of the proposed control.

Fig. 1 presents the hybrid active filter topology studied in this paper which consists in a three-phase LC filter tuned to the 7th harmonic frequency, connected in series with an active filter without any transformer. The passive filter absorbs the 7th harmonic currents generated by the load whereas the active filter improves filtering performances of the passive filter.
Fig. 2 presents the associated control scheme which combines a feedback and a feedforwad loop. The feedback control is applied to the diode rectifier input harmonic currents, whereas the feedforward loop is dedicated to the most dominant 5th harmonic current component to improve filtering characteristics of the hybrid filter.

The efficiency of the proposed control scheme has been examined by computer simulation. The THD of the non-linear load i_L is equal to 27.8 % (because of the large amount of the 5th harmonic current) while it is equal to 2.7 % for the source current i_S after filter operation. The results we obtained demonstrate the effectiveness of the new control scheme by using STFs in the feedback and feedforward loops. Furthermore, a very low THD value can be reached by using the new control scheme proposed in this paper.

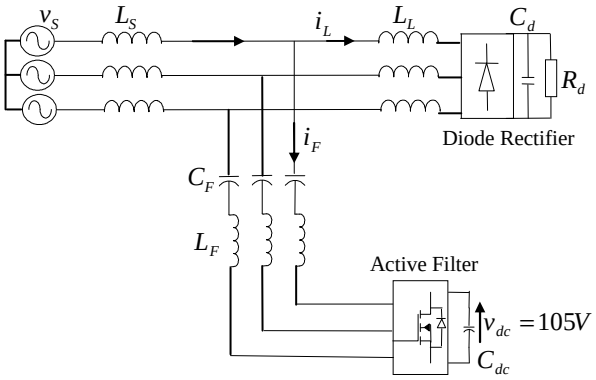

Fig. 1. Parallel hybrid active filter configuration.

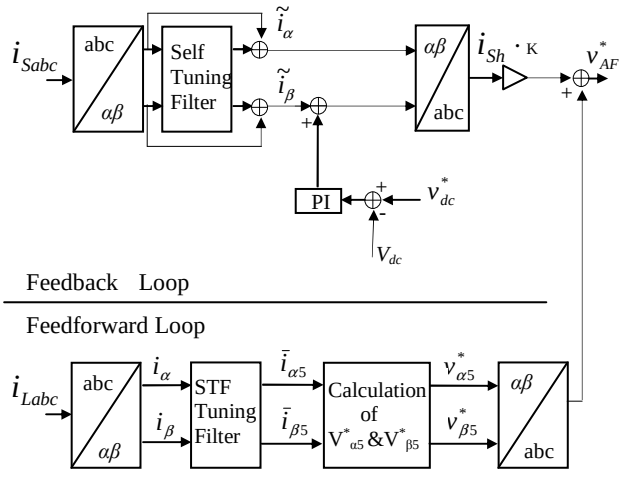

Fig. 2. Control scheme without PLL, only based on the α-β transformation and on STFs.

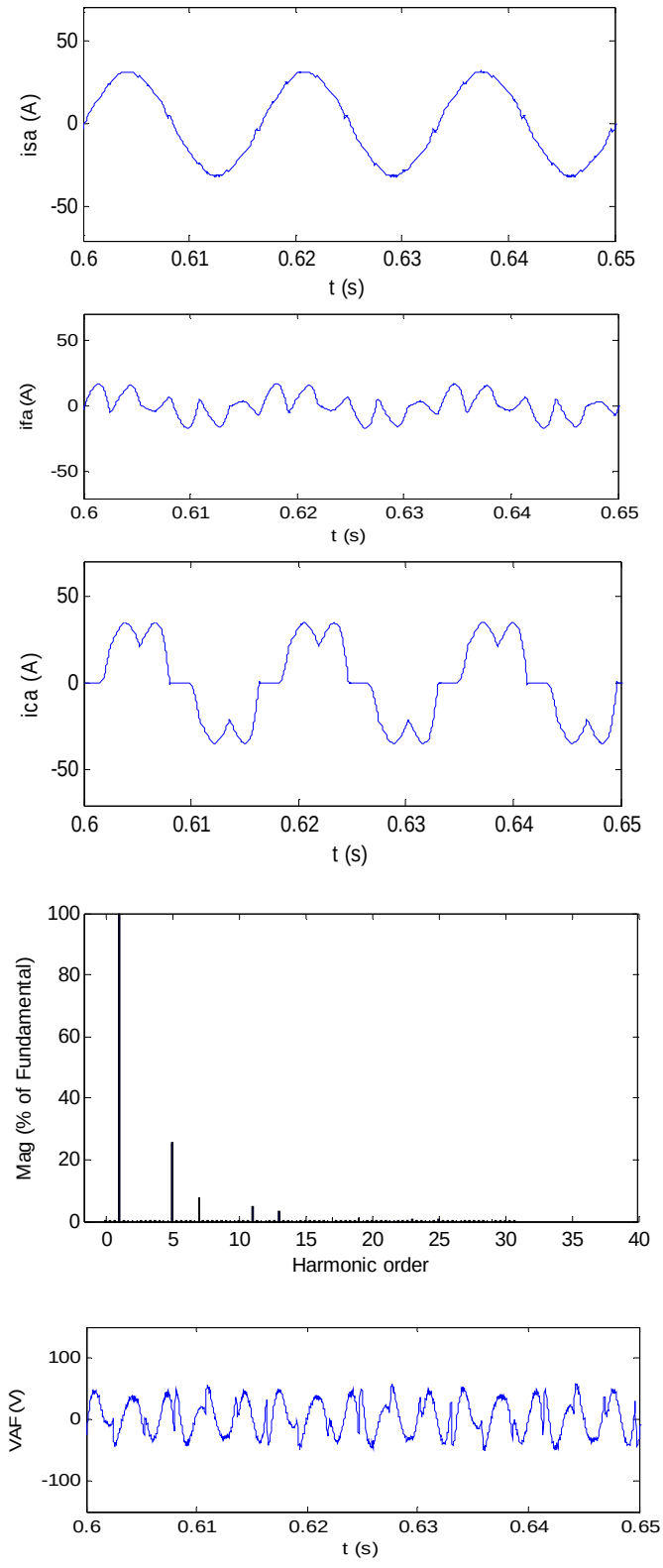

Fig. 3. Simulation results for the proposed control scheme (phase a). From top to bottom: Source current i_{Sa} (A), Filter current i_{Fa} (A), Load current i_{La} (A), and Active filter voltage V_{AF} (V).