Model Predictive Control Of Multilevel Transformer Less Hybrid Series Active Filter For Power Quality Enhancements

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Abstract

The trends toward a future Smart Grid implementation and the ever increase of numerous nonlinear industrial, commercial and residential type of loads that are generating pollution which led to 100% of total current harmonic distortions into the grids have drastically created a concern on power quality metrics for future power systems in this Project a model predictive controlled Multilevel Transformer less Hybrid Series Active Filter (Multilevel-THSeAF) is proposed to enhance the power quality of a single-phase residential household. The proposed topology reflects new trends of consumers towards electronic polluting loads and integration of renewable sources which in fact may lead to the scope of a reliable and sustainable supply. This work contributes to improvement of power quality for a modern single-phase system and emphasis integration of a compensator with energy storage capacity to ensure a sustainable supply. A MPC regulator is implemented in the controller to prevent current harmonic distortions of various non-linear loads to flow into the utility. The main significant features of the proposed topology include the great capability to correct the power factor as well as cleaning the grid simultaneously, while protecting consumers from voltage disturbances, sags, and swells during a grid perturbation.

I. INTRODUCTION

In recent decades, cellular networks have experienced huge development that promoted it to be one of the largest industries in the world. The number of subscribers and their corresponding traffic have increased tremendously. This increase in traffic has been accompanied by a huge increase in cellular networks energy consumption and operational costs. In addition, network operators are more engaged in Corporate Social Responsibility programs with a particular focus on sustainability and environmental issues. Hence, reducing energy consumption and Carbon emissions is a strategic target for the cellular communication industry.

The information and Communication Technology (ICT) sector already represents 2% of global *CO*2 emissions, as much as air transportation. However, in contrast to air traffic, ICT energy consumption is increasing exponentially, which is unsustainable in the long run. In particular, cellular networks consume more than 0.5% of the global energy supply, a number expected to increase even further with the drastic growth of users' demands. According to Cisco Visual Networking Index, mobile data traffic is expected to grow 61% per year, so that by 2018 it will reach an11-fold increase over 2013. To satisfy users' demands, cellular network operators are deploying more base stations.

II. RELATED WORK

Marco Liserre discussed about integrating renewable energy sources into the smart power grid through industrial electronics. This paper discusses photovoltaic power, wind energy conversion, hybrid energy systems, and tidal energy conversion.

Murat Yilmaz et al reviewed the current status and implementation of battery chargers, charging power levels, and infrastructure for plug-in electric vehicles and hybrids. Charger systems are categorized into off-board and on-board types with unidirectional or bidirectional power flow

AlirezaJavadi et al investigated on power quality improvement of Smart residential buildings with Electric vehicle charging station. A multilevel Transformer less Hybrid Series Active Filter (THSeAF) is proposed to address power quality issues related to both current and voltage

Joseph M. Guerrero summarized the main problems and solutions of power quality in micro grids, distributed-energy-storage systems, and ac/dc hybrid micro grids. First, the power quality enhancement of grid-interactive micro grids is presented

Cristiano et al presented a technique based on demodulation of the power line signal and subsequent filtering for harmonics estimation.

III. EXISTING SYSTEM

A hybrid harmoniccompensation approach for non-linear loads is developed unanalyzed. This technique provides compensation for currentharmonics coming from a nonlinear load and reactive powerregulation even during grid's voltage disturbances. The methodcould be implemented on any Series Active Filter. Meanwhile the Transformer less configuration (TSeAF) is selected in these work toaddress power quality issues of a non-linear load. In the first stepthe source current distortions are extracted from the sensednonlinear load currents. Then, to improve the compensation'sbehaviour this new strategy uses voltage harmonic distortions tomake the grid current remain as clean as possible with a smallgain*G* proportional to current harmonic components. Thestrategy is evaluated on an Ideal CSC non-linear load. Then asingle-phase bridge rectifier with R–L load is taken as thenonlinear load. This strategy operates in regular conditions,while it keeps a perfectly sinusoidal current wave form duringdisturbances initiated by the grid.

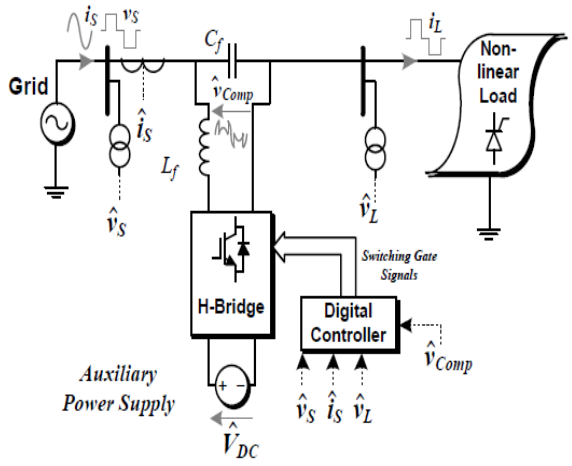

Figure: THSeAF connected to a single-phase system

The Transformer less hybrid series active filter shown in Fig.31 is used to implement the proposed control strategy. It iscreated of an H-bridge converter connected in series betweenthe grid and the load

IV. PROPOSED SYSTEM

The proposed topology reflects new trends of consumers towards electronic polluting loads and integration of renewable sources which in fact may lead to the scope of a reliable and sustainable supply. This paper contributes to improvement of power quality for a modern single-phase system and emphasis integration of a compensator with energy storage capacity to ensure a sustainable supply. A proportional resonant (P+R) regulator is implemented in the controller to prevent current harmonic distortions of various non-linear loads to flow into the utility. The main significant features of the proposed topology include the great capability to correct the power factor as well as cleaning the grid simultaneously, while protecting consumers from voltage disturbances, sags, and swells during a grid perturbation. It investigates aspects of harmonic compensation and assesses the influence of the controller's choice and time delay during a real-time implementation.

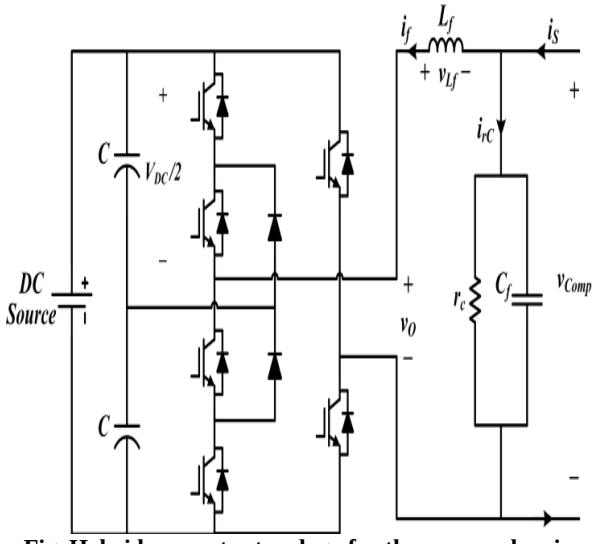

Fig. Hybrid converter topology for the proposed series compensator.

The compensator depicted is composed of a multilevel single-phase converter connected in series between the utility and the house's entrance connected terminals. The transformer less hybrid series active filter is composed of a five-level NPC converter depicted in Fig, connected in series between the utility and the entrance of the building . An auxiliary supply is connected on the dc side. To filter high frequency switching harmonics, a passive filter is used at the output of the converter. A bank of tuned passive filters ensures a low impedance path for current harmonics. In this paper the studied system is implemented for a rated power of 1 kVA. To ensure a fast transient response with sufficient stability margins over a wide range of dynamic operations, the controller is implemented on an Opal-RT/Wanda real-time simulator. For an accurate real-time measurement of electrical variables, the Opal-RT OP8665 probes are performing the measurement task. The system parameters are identified in Table I. A variable source up to 120 Vrms is connected to a 1 kVA non-linear load. The THSeAF is connected in series in

order to inject the compensating voltage. On the DC side of the compensator, an auxiliary dc-link energy storage system is installed

V. RESULTS AND DISCUSSION

Figure Simulink implementation

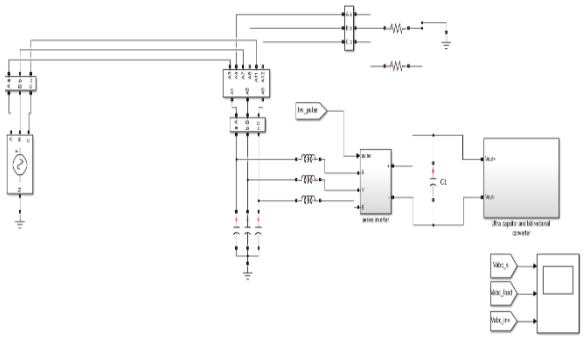

Figure converter section

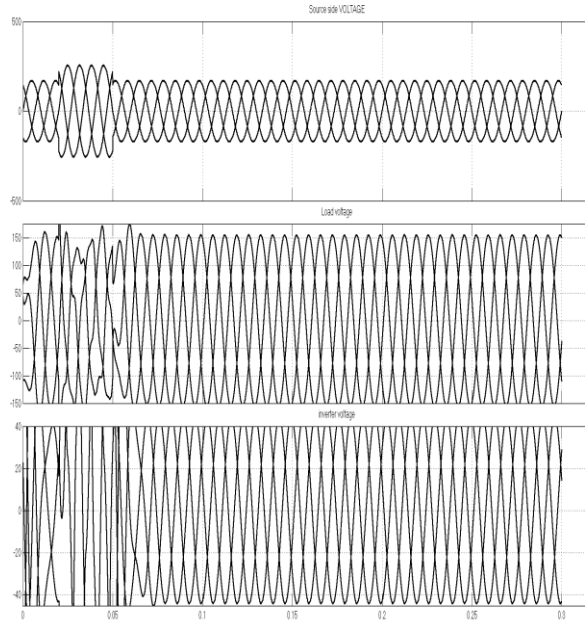

Figure Output voltage

CONCLUSION

Renewable energy sources that are proliferating very rapidly are connected to the grid via resonant filters that may also interact with the grid impedances and can cause undesired EMI and resonance phenomenon. Therefore the necessity of maintaining clean decoupled power is becoming an important issue since electric power quality is usually measured at generation, distribution and load levels. To improve power quality, a Multilevel-MPC controlled THSeAF was developed in this work based on the five-level NPC configuration. The key novelty of the proposed topology includes power quality improvement in a single residential building that may result to the enhancement of the global power system. Moreover, the configuration can regulate and improve the load voltage and when connected to a renewable auxiliary DC source, the topology is able to counteract actively to the power flow in the system similar to a UPS. Having a constant and distortion-free supply at load PCC, it was denoted that the active compensator responds well to source voltage variations.

REFERENCES

[1] M. Liserre, T. Sauter, and J. Y. Hung, "Future Energy Systems: Integrating Renewable Energy Sources into the Smart Power Grid Through Industrial Electronics," *IEEE Ind. Electron. Magazine*, vol. 4, pp. 18-37, 2010.

[2] M. Yilmaz and P. T. Krein, "Review of Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles," *IEEE Transactions on Power Electronics*, vol. 28, pp. 2151-2169, 2013.

[3] Javadi, A. Ndtoungou, H. F. Blanchette, and K. Al-Haddad, "Power Quality Device for Future Household Systems with Fast Electric Vehicle Charging Station," in *2015 IEEE Vehicle Power and Propulsion Conference (VPPC)*, Montreal, Canada, 2015, pp. 1-6.

[4] J. M. Guerrero, L. Poh Chiang, L. Tzung-Lin, and M. Chandorkar, "Advanced Control Architectures for Intelligent Microgrids, Part II: Power Quality, Energy Storage, and AC/DC Microgrids," *IEEE Trans. on Ind. Electron.*,vol. 60, pp. 1263-1270, 2013.

[5] S. Zhikang, L. Dingguo, J. Shen, T. Chunming, C. Ying, and L. An, "Series and Parallel Resonance Problem of Wideband Frequency Harmonic and Its Elimination Strategy," *IEEE Trans. on Power Electron.*,vol. 29, pp. 1941-1952, 2014.

[6] H. Akagi and K. Isozaki, "A Hybrid Active Filter for a Three-Phase 12-Pulse Diode Rectifier Used as the Front End of a Medium-Voltage Motor Drive," *IEEE Trans. on Power Electron.*, vol. 27, pp. 69-77, 2012.

[7] Javadi and K. Al-Haddad, "A Single-Phase Active Device for Power Quality Improvement of Electrified Transportation," *IEEE Transactions on Industrial Electronics*, vol. 62, pp. 3033-3041, 2015.

[8] A. G. Marques, M. V. Ribeiro, C. A. Duque, P. F. Ribeiro, and E. A. B. da Silva, "A Controlled Filtering Method for Estimating Harmonics of Off-Nominal Frequencies," *IEEE Trans. on Smart Grid*, vol. 3, pp. 38-49, 2012.

[9] K. Rahbar, X. Jie, and Z. Rui, "Real-Time Energy Storage Management for Renewable Integration in Microgrid: An Off-Line Optimization Approach," *IEEE Trans. on Smart Grid*, vol. 6, pp. 124-134, 2015.