**IJCTA**, 9(2) 2016, pp. 1015-1021


# Design of Multilevel Convertor for Renewable Energy Applications Using Fuzzy Logic Controller

**R. Sai Ranjith[1], M. Gopinath[2] and M. Venktesh Kumar[3]**

**ABSTRACT**

Multi level voltage source converters happen to be emerging as a fresh and an innovative variety in power converter alternatives for high-power level applications. The multilevel voltage source conversion programs commonly consists a set of stairs of voltage wave from a number of degrees of capacitor concentration .The primary limitations of the multi-level convertors is volt quality unbalance between different amounts. The methods that are to balance the voltage between different amounts normally involve voltage clamping or capacitor charge control. There are several methods to maintain voltage balance in multilevel convertors. Without taking into consideration the standard magnetic coupling conversion programs, this paper presents recently developed multilevel ac electricity source converters by Cascading of converters with separate power sources.

The operating principle, features, constraints, and potential applications of this conversion program will be discussed in this paper.

***Keywords:*** Multi-level convertor, pulse width modulation, Fuzzy logic controller;

## I. INTRODUCTION

Among all energy which is present in the world the electrical energy is much needed and much used by the man kind. This energy should by supply without having much wastage. Therefore large scale inter connected power system which consists generation and transmission is intended to make more reliable. By usage of multi-level convertors the power quality can be maintained.

In recent times the “multilevel converter” has attracted huge hobby the force business. The general structural scheme of the multi-level convertor is to blend a sinusoidal voltage from a few levels of voltages pulses, commonly acquired from capacitor voltage source. The supposed “multilevel” begins from three levels. A three-level converter, otherwise called an “unbiased clasped” converter, comprises of more than one capacitor voltages in arrangement and utilizations the middle tap as an impartial . Every stage leg of the each three-level converter has two sets of exchanging gadgets in this arrangement. Focal point of every pair is clipped to the nonpartisan passing through clasping diodes[1-5].

The attractive transformer coupled multi beat voltage source converter has been a surely understood strategy and has been actualized in 18-and 48pulse converters for battery vitality stockpiling and static condenser (STATCON) applications, individually. Conventional attractive coupled multi pulse converters normally combine the staircase voltage wave by shifting transformer turns proportion with muddled crisscross associations. Issues of the attractive transformer coupling technique are massive, overwhelming, and lossy. The capacitor voltage combination strategy is accordingly liked to the attractive coupling technique. There are three reported capacitor voltage amalgamation based multilevel converters: I.diode-brace, II. flying-capacitors, and III. fell inverters with isolated dc sources. This paper will depict working standards of the

Assistant Professor[1], U. G. Students[2,3], Saveetha University, Thandalam, Chennai.

capacitor voltage combination multilevel converter In view of fell inverters with independent dc sources. This paper examines about the elements and requirements, the application territories of these multilevel converters will be tended to .Multi- level convertors plays a vital role in emerging world to improve the power quality these convertors are being used for the renewablbe energy applications.

## II. MULTILEVEL CONVERTER USING CASCADING OF INVERTERS WITH SEPARATE DC SOURCE

### A. Principle

A by and large new converter structure, fell inverters with discrete dc sources (SDC's) is introduced here. This new converter can keep up a vital separation from extra fastening diodes or voltage changing capacitors. Fig. 2(a) clarifies the basic structure of the fell inverters with SDC's, showed up in a lone stage setup.[6][7] Each SDC is associated with a lone stage full-interface inverter. The aeration and cooling system terminal voltages of different level inverters are related in game plan. The stage yield voltage is incorporated by the aggregate of four inverter yields, van=v1+v2+v3+v4 to make three level yields, +vdc,O, and - v&. This is made possible of interfacing the sources sequentially to the aeration and cooling system side by method for the four portal turn-off contraptions. Each level of the full-associate converter contains four switches, SI, S2, S3,what's more, S4. Using the top level as the outline, turning on S1 and S4 yields 211 = +V&. Turing on SZ and S3 yields v1 = - I&.

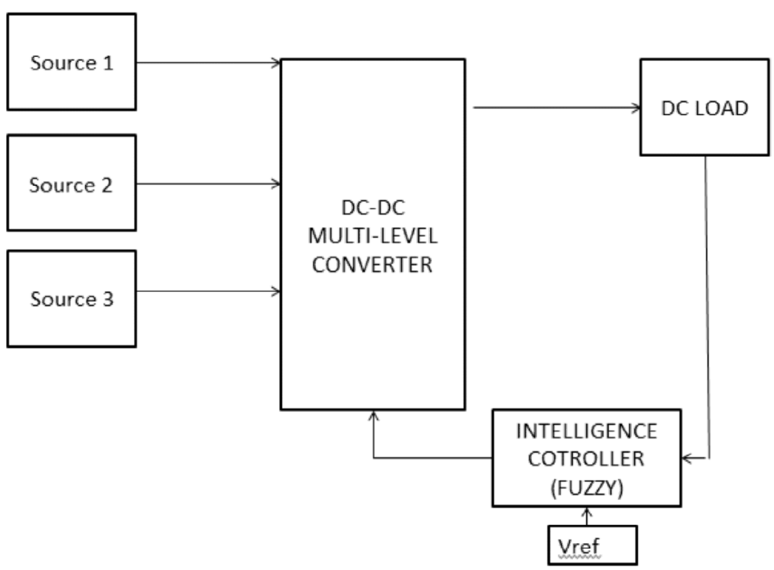


**Figure 2: Block Diagram of Multi-level convertor**

Killing all switch yields u1 = 0. Additionally, the air conditioner yield voltage at every level can be acquired in the same method. Minimum symphonious mutilation can be gotten by controlling the coordinating focuses at different inverter levels. With the stage current, i,, driving or slacking the stage voltage v,, by 90°, the ordinary charge to each dc capacitor is proportionate to zero more than one line cycle, Along these lines, all capacitor voltages can be balanced.[9][10] To consent to the significance of the already said diode-secure and flying-capacitor multilevel converters, the "level" in a fell inverters based converter is described by m = 2s + 1, where m is the yield stage voltage level, and s is the amount of dc sources. For example, a 9-level fell inverters based converter will have four SDC's and four full traverses. For a three-stage system, the yield voltages of the three fell inverters can be related in either Y-or A.

### (B) Features

For genuine force changes, (air conditioning to dc and vice versa), the fell inverter is to isolate dc sources. The model of independent dc sources is appropriate for different renewable vitality sources, for example, energy component, photovoltaic, and biomass, and so on. Interfacing isolated dc sources in between the two converters in a consecutive manner is unrealistic in light of the fact that a short out will be acquainted when two back to back with converters are not exchanging synchronously. In outline, focal points and disservices of fell inverter based multilevel voltage source converter can be recorded from underneath.

### Advantages

* It requires minimal number of parts among every multilevel convertor to match the same number of voltage levels.
* Modularized circuit design and bundling is conceivable on the grounds that every level has the same structure, and there are no additional bracing diodes or voltage adjusting capacitors.
* Delicate exchanging can be utilized as a part of this structure to maintain a strategic distance from massive and loss consisting resistor-capacitor-diode snubbers

### Disadvantages

* Needs separate dc hotspots for genuine force transformations, and in this manner its applications are to some degree restricted.

## III. FUZZY LOGIC CONTROLLER

### 1. Design of Fuzzy Logic Controller

The Fuzzy logic controller is wise controller which is utilized to control framework utilizing the fresh values. For the most part the Fuzzy logic controller comprises of three stages. Fuzzyfication ,defuzzification and enrollment capacity.

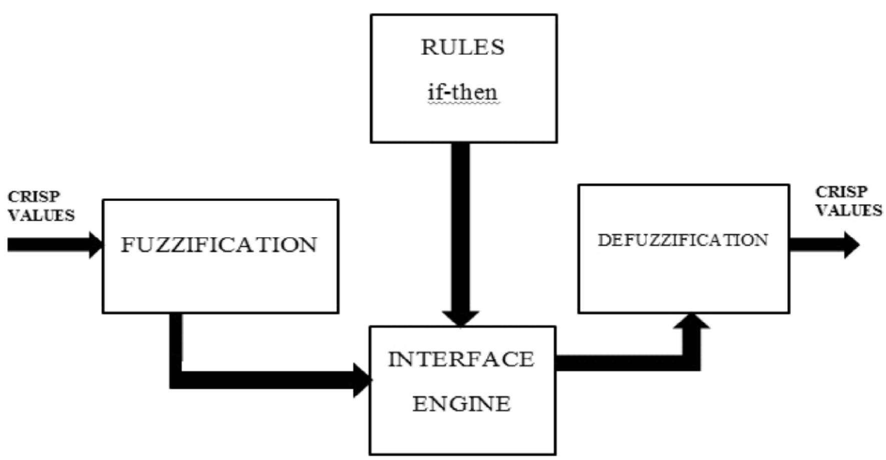


**Figure 3: Block representation of Fuzzy logic controller**

• FUZZIFICTION

Fuzzyfication is the procedure which is utilized to change over the fresh values into established qualities.

The decision of Fuzzyfication procedure is subject to the interface, whether it is arrangement type or singular standard terminating based.

- KNOWLEDGE INDEX

  The knowledge base is of the brain of the system.

It gives all the crucial definitions to the fuzzyfication process –membership limits, fluffy set. Input–output variables and the mapping limits between the physical and cushy space.

- DEFUZZIFICATION

  The enrollment capacities identified with a run of the mill fuzzy controller's yield variable characterized over its universe of talk.

  The mathematical way of converting fuzzy values into crisp values is known as 'defuzzyfication'.

## 2. Rulebase for the Controller

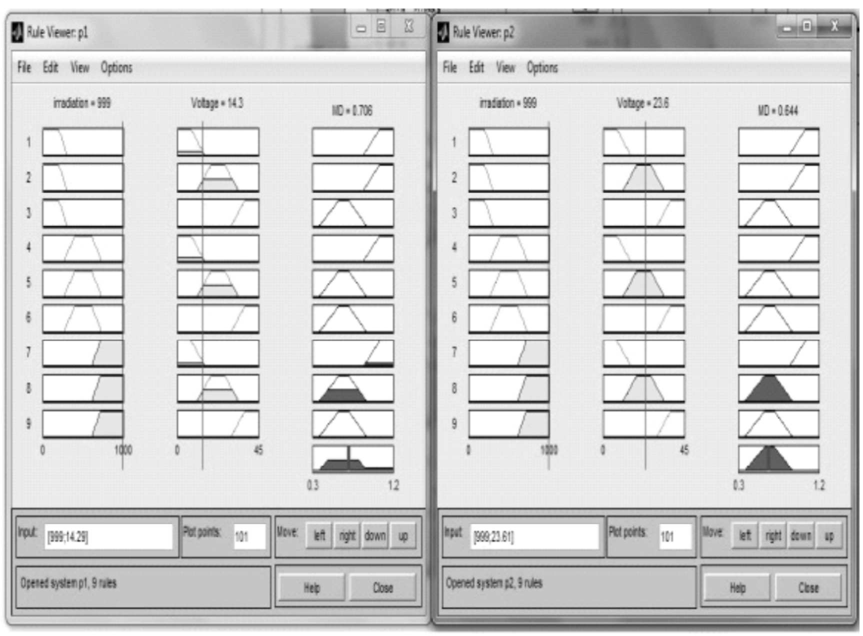


**Figure 3.1: Rulebase for controller 1&2**

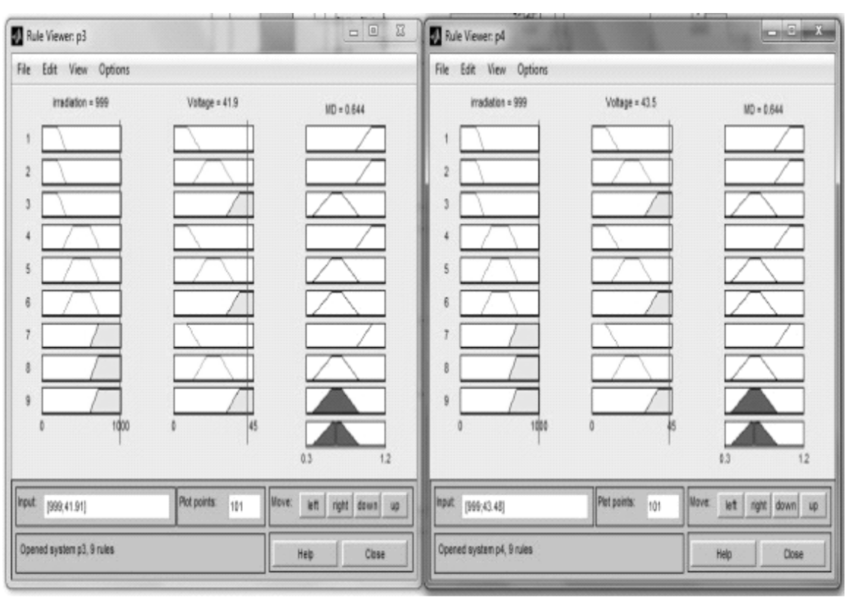


**Figure 3.2: Rulebase for controller 3&4**

The rules are formed based on the following table for the contoller

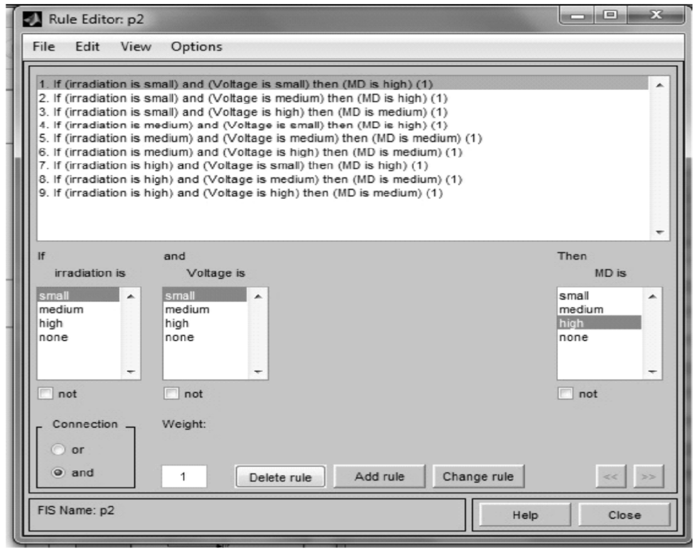


**Figure 3.3: Set of rules for controllers**

## IV. SIMULATION

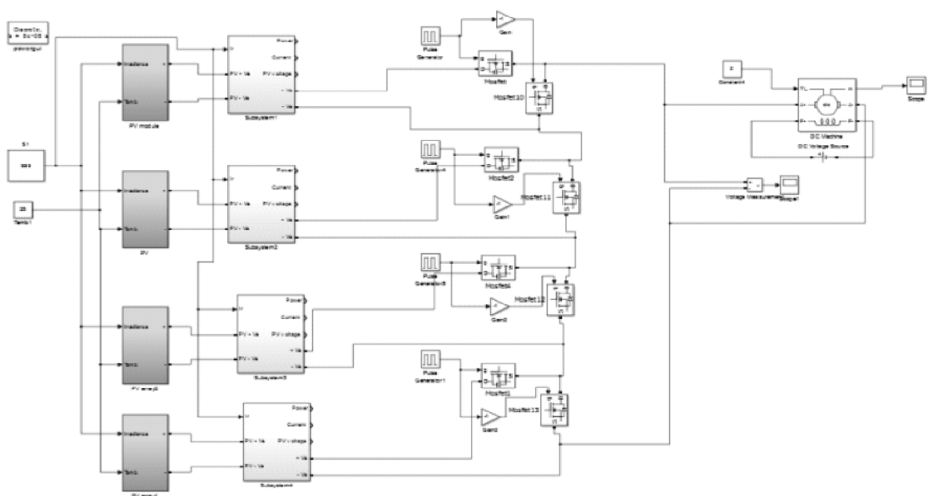

**Figure 4.1: Matlab model of multilevel convertor**

The model consist of the PV arrays rating total of 1kw and eash panel cosist of a MPPT controller and boost convertor the output is fed to the 4-level convertor which drives the DC motor load.

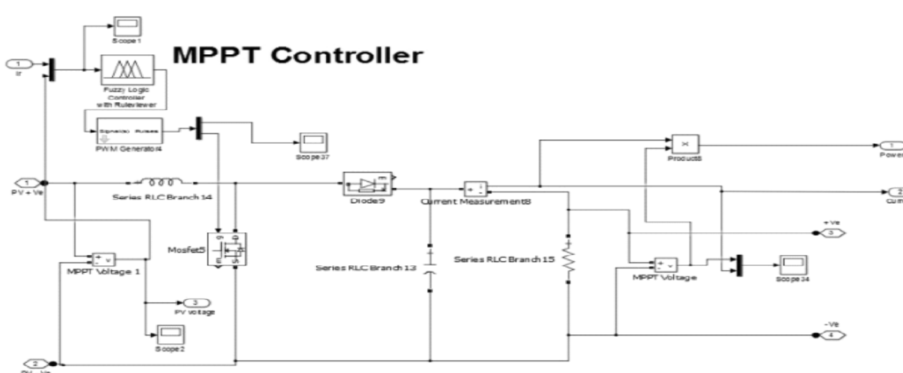


**Figure 4.2: MPPT controller**

A MPPT, or most extreme force point tracker is an electronic DC to DC converter that enhances the match between the sun powered exhibit (PV boards), and the battery bank or utility matrix. Basically, they change over a higher voltage DC yield from sunlight based boards (and a couple wind generators) down to the lower voltage expected to charge batteries[11].

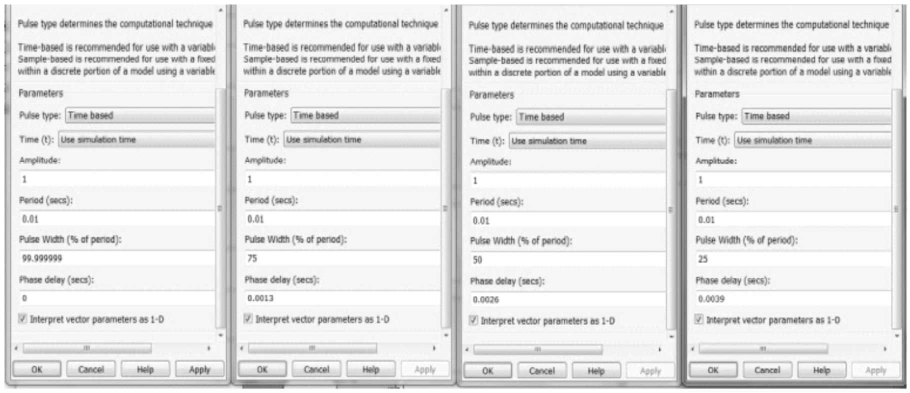

**Figure 4.3: Triggering pulses of $ generators**

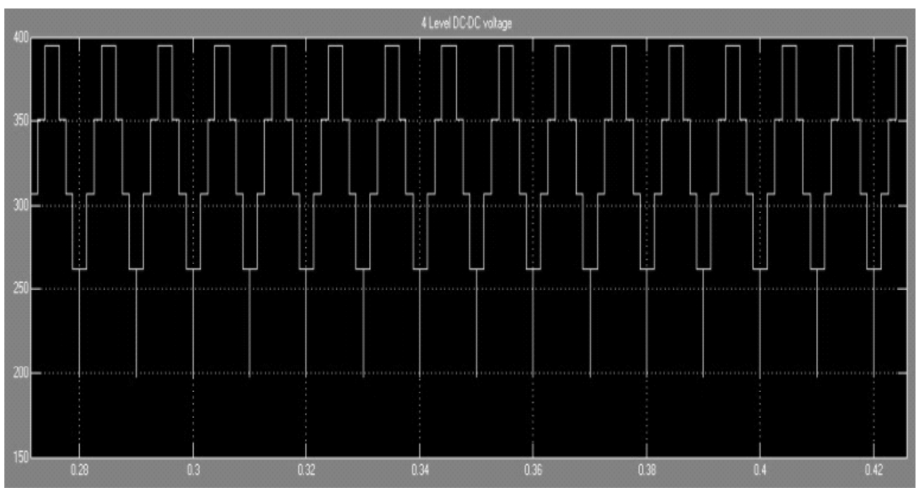


**Figure 4.2: Ooutput Waveform**

The output waveform consists of disturbances due to the non-linearity in voltages produced the solar panels.

## III. DISCUSSION AND CONCLUSION

### (A) Discussion

The multilevel converters be immediately supplant the present systems that use customary multi-beat converters without the prerequisite for transformers. For a 3-stage system, the relationship between the amount of levels, m, and the amount of beats, p, can be figured by p = (m - 1) x 6.[12][13]

The SVG is a phenomenal center for commercialization of these multilevel converters i~n high-voltage high-control systems. Each one of the three converters exhibited in this paper can be used as the static VAR generator. The second target could be the consecutive intertie system for a united force stream controller. The structure that is most suitable for the back to back intertie is the diode-snap sort. The other two sorts may in like manner be suitable for the back to back intertie, in any case they require more switchings per cycle and more refined controls to modify the voltage

## (B) Conclusion

This paper presenteds a transformer less multilevel voltage source convertors that mix the converter voltage by pretty much as isolated capacitor voltages. Each one of these converters have been completely explored and reenacted. Two hardware models have been collected and attempted to check the thought. Both multiplication and trial results show that these multilevel converters are to a great degree empowering for power system applications. The application that has been indicated most as frequently as could be allowed in the written work is SVG. Each of the multilevel converters can be associated with SVG's without voltage unbalance issues in light of the fact that the SVG does not draw real constrain.One of the field on which the multilevel voltage source converter might have the most imapct is the flexible rate drive. The business as of late reported various ASD bearing disappointments and winding protection breakdowns because of high recurrence exchanging PWM inverters. Utilizing multilevel converters takes care of music and EM1 issues, as well as maintains a strategic distance from conceivable high recurrence exchanging dvldt impelled engine disappointments. With an adjusted voltage stress in gadgets and utility perfect highlights, the multilevel converters have revealed an insight in the force gadgets stadium and they are rising asone of the type of force converters for high level voltage and high-control appliances.

## REFERENCE

[1] F. Blaabjerg and K. Ma, "Future on power electronics for wind turbine systems,"IEEE J. Emerg. Sel. Topics Power Electron., vol. 1, no. 3,pp. 139–152, Sep. 2013.

[2] Y. Cho, G. J. Cokkinides,and A P. S. Meliopoulos, "Modeling methodology suitable for converters integrating renewables: The QMQI method,"IEEE J. Emerg. Sel. Topics Power Electron., vol. 1, no. 4,pp. 269–276, Dec. 2013.

[3] A. Choudhury, P. Pillay, and S. S. Williamson, "DC-link voltage balancing for a three-level electric vehicle traction inverter using an innovative switching sequence control scheme,"IEEE J. Emerg. Sel.Topics Power Electron., vol. 2, no. 2, pp. 296–307, Jun. 2014.

[4] J. Han, S. K. Solanki, and J. Solanki, "Coordinated predictive control of a wind/battery microgrid system," IEEE J. Emerg. Sel. Topics Power Electron., vol. 1, no. 4, pp. 296–305, Dec. 2013.

[5] T. Kato, K. Inoue, and M. Ueda, "Lyapunov-based digital control of a grid-connected inverter with an LCL filter,"IEEE J. Emerg. Sel. TopicsPower Electron., vol. 2, no. 4, pp. 942–948, Dec. 2014.

[6] G. C. Konstantopoulos and A. T. Alexandridis, "Full-scale modeling,control, and analysis of grid-connected wind turbine induction generators with back-to-back AC/DC/AC converters,"IEEE J. Emerg. Sel. Topics Power Electron., vol. 2, no. 4, pp. 739–748, Dec. 2014.

[7] V. Dargahi, A. Khoshkbar Sadigh, G. K. Venayagamoorthy, andK. Corzine, "Hybrid double flying capacitor multicell converter for renewable energy integration," in Proc. IEEE Appl. Power Electron.Conf. Expo. (APEC), Mar. 2015, pp. 2365–2372.

[8] V. Dargahi, A. Khoshkbar Sadigh, and K. Corzine, "Analytic determi-nation of conduction power losses in flying capacitor multicell power converter," in Proc. IEEE Appl. Power Electron. Conf. Expo. (APEC),Mar. 2015, pp. 2358–2364.

[9] Y. Levron, D. R. Clement, B. Choi, C. Olalla, and D. Maksimovic,"Control of submodule integrated converters in the isolated-port differ-ential power-processing photovoltaic architecture,"IEEE J. Emerg. Sel.Topics Power Electron., vol. 2, no. 4, pp. 821–832, Dec. 2014.

[10] X. Li, S. Dusmez, U. R. Prasanna, B. Akin, and K. Rajashekara,"A new SVPWM modulated input switched multilevel converter for grid-connected PV energy generation systems,"IEEE J. Emerg. Sel. Topics Power Electron., vol. 2, no. 4, pp. 920–930, Dec. 2014.

[11] M. Mehrasa, E. Pouresmaeil, and J. P. S. Catalao, "Direct Lyapunov control technique for the stable operation of multilevel converter-based distributed generation in power grid,"IEEE J. Emerg. Sel. Topics Power Electron., vol. 2, no. 4, pp. 931–941, Dec. 2014.

[12] U. R. Prasanna and A. K. Rathore, "Dual three-pulse modulation-based high-frequency pulsating DC link two-stage three-phase inverter for electric/hybrid/fuel cell vehicles applications,"IEEE J. Emerg. Sel.Topics Power Electron., vol. 2, no. 3, pp. 477–486, Sep. 2014.

[13] V. Yaramasu, B. Wu, M. Rivera, and J. Rodríguez, "A new power conversion system for megawatt PMSG wind turbines using four-level converters and a simple control scheme based on two-step model predictive strategy—Part II: Simulation and experimental analysis," IEEE J. Emerg. Sel. Topics Power Electron.vol. 2, no. 1, pp. 14–25,Mar. 2014.