MULTI LEVEL INVERTER BASED ON FLYBACK CCM BOOST CONVERTER

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ABSTRACT : Discrete-time repetitive controller(RC) is proposed for fly back inverter operating in continuous conduction mode, which has simple structure, low cost, and high efficiency converter for production of multi levels in the output is presented in this project. Conventional controller results in poor control performance due to the effect of the right-half-plane zero in CCM operation. To achieve the accurate tracking performance and disturbance rejection, the repetitive controller is developed and applied to fly back inverter in CCM operation. In the RC scheme, a low-pass filter is used to allow tracking and rejection of periodic signals within a specified frequency range. A phase lead compensator is also used to compensate for the system delay caused by digital implementation. Two fly back converters are connected to the windings of common core multi winding transformer and the secondary windings are connected to cascaded h-bridge inverters for production of multi level AC voltages. The proposed converters fed by a pv cell are modeled and simulated using MATLAB / Simulink and the results are presented.

INTRODUCTION:

Multilevel converters MLC have the later years been looked upon as a decent choice for medium- and high-voltage applications. It had been first given in Before the introduction of multilevel converters the standard answer has been to attach semiconductors asynchronous to resist the high voltages. This needs fast change to avoid unequal voltage sharing between the devices that may lead to a breakdown. MLC have the advantage of clamping the voltages that prevents the necessity of quick change. MLC even have a smoother output voltage than traditional two-level converters. Most multilevel inverters have an arrangement of switches and capacitor voltage sources. By a proper control of the switching devices, these can generate stepped output voltages with low harmonic distortions. Recently, multilevel inverters have drawn tremendous interest in the field of high-voltage and high-power applications because it has some advantages: it can realize high voltage and high power output through low-voltage switches without transformer and dynamic voltage balance circuits, with increased output level and reduced harmonics are decreasing Multilevel inverters are mainly classified as diode-clamped, capacitor-clamped and cascaded H-bridge inverters. Among the basic multilevel inverters the problem of voltage unbalance of dc link capacitors exists inherently in the diode-clamped inverter topology, which limits the further application of it, especially at the level above three. To balance the voltage of dc link series capacitors, three main approaches have been proposed. They are:

1) Using separate dc sources.
2) Adding some auxiliary balancing circuits, and
3) Improving the control method by selecting redundant switching states

By auxiliary circuits, the transferred current or power can be controlled accurately, but the additional feedback control strategies are also needed, so the control of these converters becomes more complicated, and inverters are less reliable.

Single Source Multilevel Inverter:

Single source multilevel inverter has only one DC source and remaining are the capacitors or clamping diodes to produce multilevel output voltage. A multilevel inverter topology was initially introduced with two topologies, and demonstrated using three level and five level inverters by Baker and Bannister 1975. A five level inverter with series connected clamping diodes was proposed by Baker 1980 which differs from the topology originally demonstrated earlier.

Diode clamped multilevel inverter:

The Diode Clamped Multilevel Inverter DCMLI is also known as neutral point clamped inverter. It consists of two capacitor voltages in series and uses the center tap as the neutral. Each phase leg of the three level inverter has two pairs of switching devices in series. The center of each device pair is clamped to the neutral through clamping diodes. The waveform obtained from the three level inverteris a quasi square wave output. An m level DCMLI consists of (m-1) capacitors on the DC bus, 2(m-1) switching devices per phase and 2(m-2) clamping diodes per phase. Diodes are used to clamp the each voltage levels in the output voltage so called diode clamped multilevel inverter. XiaomingYuanet al 2000 proposed a new diode clamping inverter. In this inverter, the series associations of the clamping diodes are neglected. The problem of indirect clamping of the inverter devices solved with auxiliary resistive clamping network for both the new and conventional diode clamping inverter.

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Flying capacitor multilevel inverter:

Gangui Yan et al 2002 achieved a significant reduction in the volume of capacitors as well as scalable in terms of voltage levels and control flexibility. Stacked flying capacitor inverter had gained great industrial attention recently. The PWM method is applied to control the balance of flying capacitor voltages in stacked FCMLI, which can be readily implemented on a digital signal processor and also to guarantee the switching frequency of each switching device. Corzine et.al 2003 described a flying capacitor MLI with full binary combination scheme. The number of voltage levels can be increased for a given number of semiconductor devices when compared to conventional method which is the main feature of this approach.

Multi Source Multilevel Inverter:

Multisource multilevel inverter can increase the level with same number of DC sources with different values. The topologies are cascaded, hybrid and new hybrid H-bridge multilevel inverter. The topology was achieved by connecting the H-bridge inverter in series with other H-bridge inverter. The topology is a series connected H-bridge inverter which is also known as a cascaded H-bridge inverter. It was developed by Baker and Bannisterin1975.

The interest in the multilevel inverter except three level inverter faded during the 1980s, but in the 1990s this technology began to draw more attention again. For example Marchesoni et al 1990 proposed a cascaded multilevel inverter which could be used in nuclear fusion experiments. Moreover, Marchesoni and his research group made a significant contribution to the multilevel inverter research, especially in control and modulation, in the early 1990s; Marchesoni 1998, Marchesoni and Tenca 2002, Marchesonietal1990,Carraraetal 1990, Fracchiaetal1992.

Cascaded H-bridge multilevel inverter:

The serially connected H-bridge with separate DC source is called as cascaded H-bridge multilevel inverter. In this type of configuration voltage on each DC source is same value. LiLi 2000 proposed a multilevel selective harmonic elimination PWM technique in series connected voltage inverters. Selective harmonic elimination pulse width modulation method was systematically applied for the first time to multilevel series connected voltage source PWM inverters. The method was implemented based on optimization techniques. The optimization starting point is obtained using a phase shift harmonic suppression approach. Corzine Keith et al 2004 introduced a new type of multilevel inverter which was created by cascading two, three phase three level inverter using the load connection, but requires only one DC voltage source. This new seven level inverter splits the power conversion into a higher voltage lower frequency inverter and a lower voltage higher frequency inverter.

Hybrid H-bridge multilevel inverter:

A serially connected H-bridge with separate DC sources arecalled as hybrid H-bridge multilevel inverter. Each succeeding voltage source has the voltage values in the order of $1V_{dc}$, $2V_{dc}$ and $4V_{dc}$. Manjrekar and Lipo 1998 reported various topologies and modulation strategies for utility and drive applications. This paper was devoted to the investigation of a 500 HP induction machine drive based on a seven level 4.5 KV hybrid inverter. Various design criteria, spectral structure and other practical issues such as capacitor voltage balancing are discussed. Manjrekar et al 2000 devoted to the investigation of a hybrid multilevel power conversion system for medium voltage high power applications. By trends in power semiconductor technology, the authors selected different power devices based on their switching frequency and voltage sustaining capability and created a new hybrid topology. The new power inverter topologies permit modular realization of multilevel inverter using a hybrid approach involving Integrated Gate Commutated ThyristorsIGCT and Insulated Gate Bipolar Transistors IGBT operating together. With this modular H-bridge topology, realization of multilevel inverter using a hybrid approach involving IGCTs and IGBTs is possible, which are useful in required high power applications.

New hybrid H-bridge multilevel inverter:

The multilevel inverter using cascaded H-bridge with separate DC sources synthesizes a desired voltage from several independent sources of DC voltages. Each succeeding voltage source has the voltage values in the order of $1V_{dc}$, $3V_{dc}$ and $9V_{dc}$ called new hybrid H-bridge multilevel inverter. Ayob and Chee 2005 proposed a new hybrid multilevel inverter topology with harmonics profile improvement. As per the literature, a largest output levels and the lowest total harmonics distortion percentage can be achieved by the hybrid MLI with DC sources in trinary configuration.

However, the output contains low order harmonics topology, due to the impossibility of modulating all adjacent voltage levels among all adjacent levels of output waveform.

MATLAB Simulink model for the system under analysis

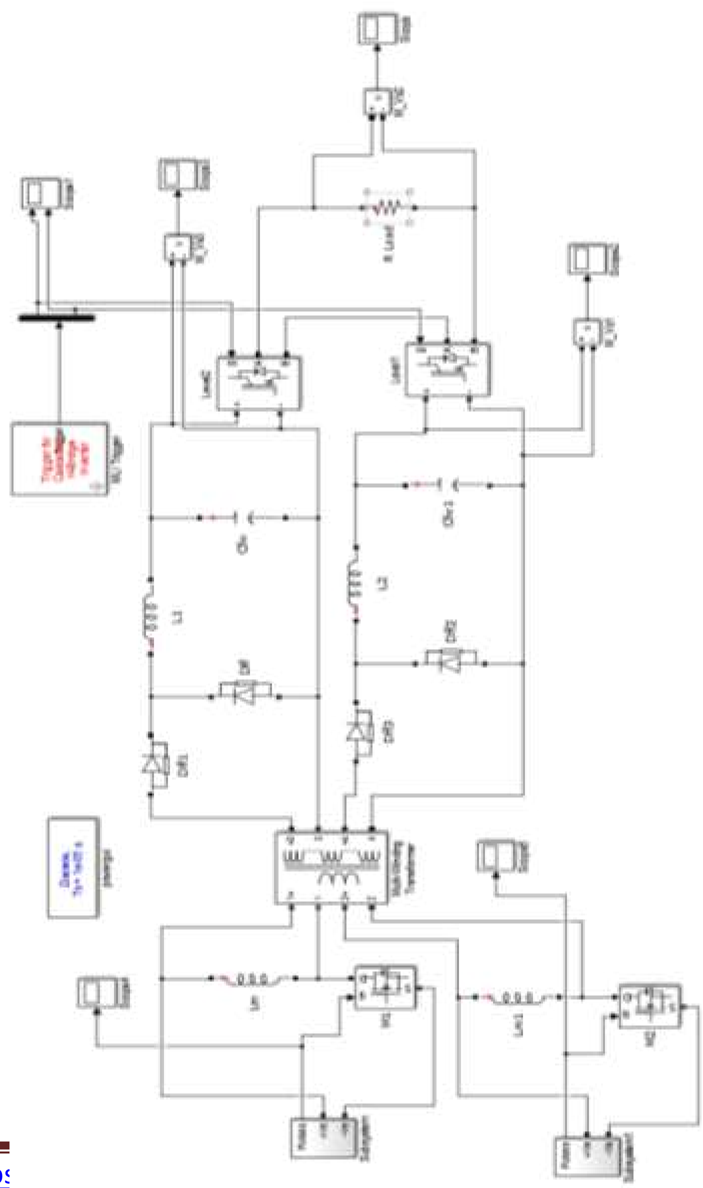

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Fig : MATLAB Simulation model for the PV Cell under analysis.

MPPT algorithm used to control the PV Cell model under consideration for analysis is presented in Fig 6.3.

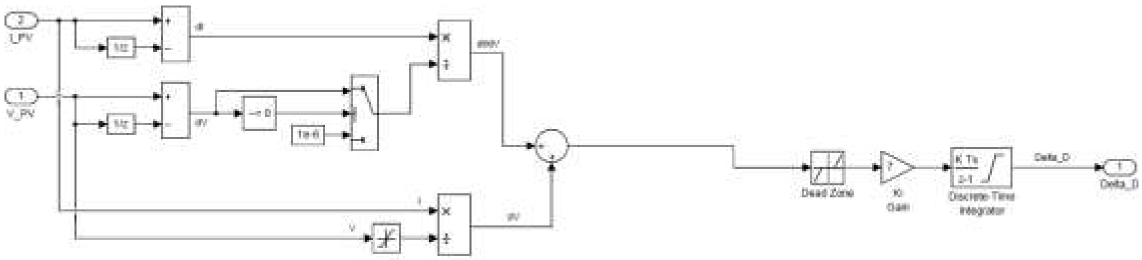

Fig : MATLAB Simulation model for the MPPT under analysis.

Output of DC-DC Fly back Converter:

The purpose of DC – DC Converter is to provide a stabilized DC Voltage at the input terminals of the inverter. High step up gain can be obtained by using Full – bridge dc – dc converters. In the proposed circuit a boost converter with a step up gain ratio 6 is used. Output voltage

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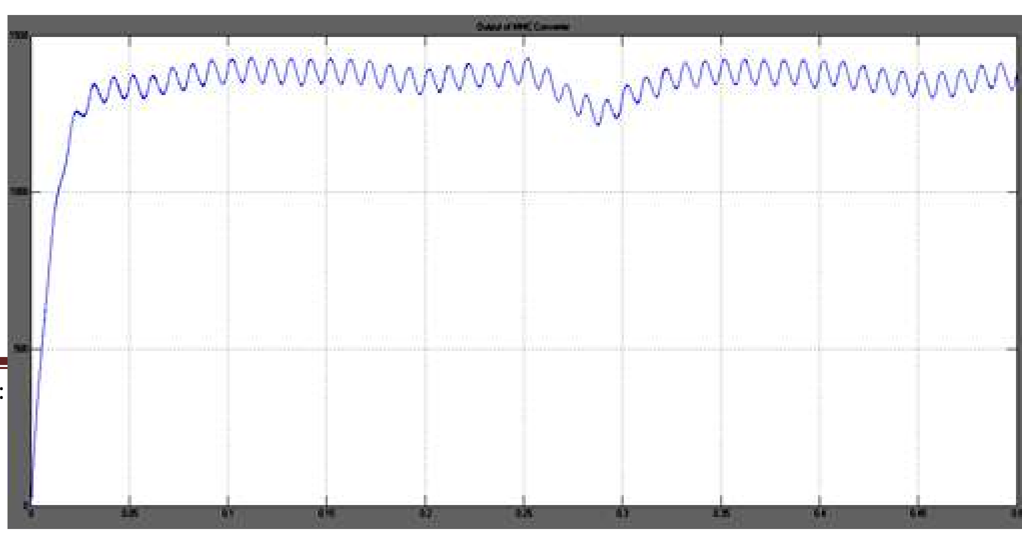


Fig : Output Voltage of Fly back Converter – 1

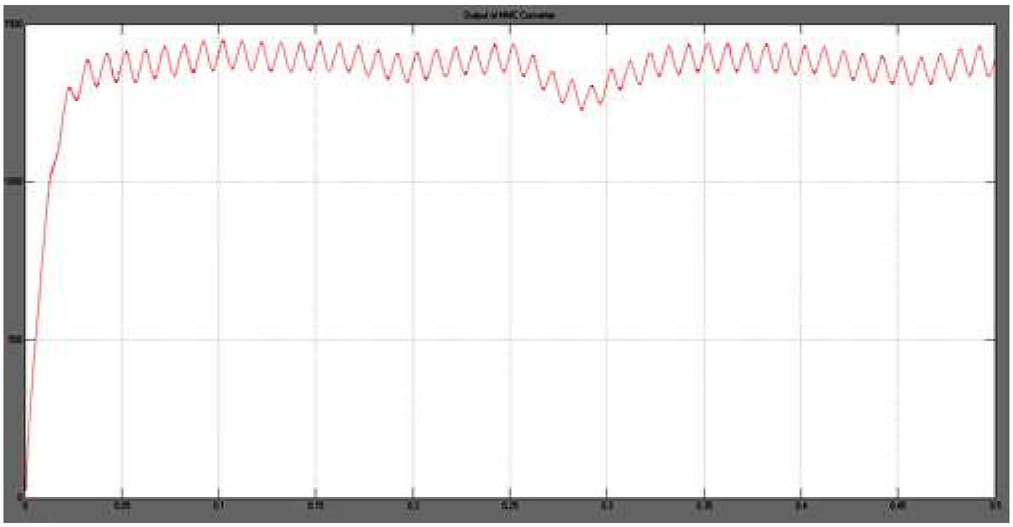
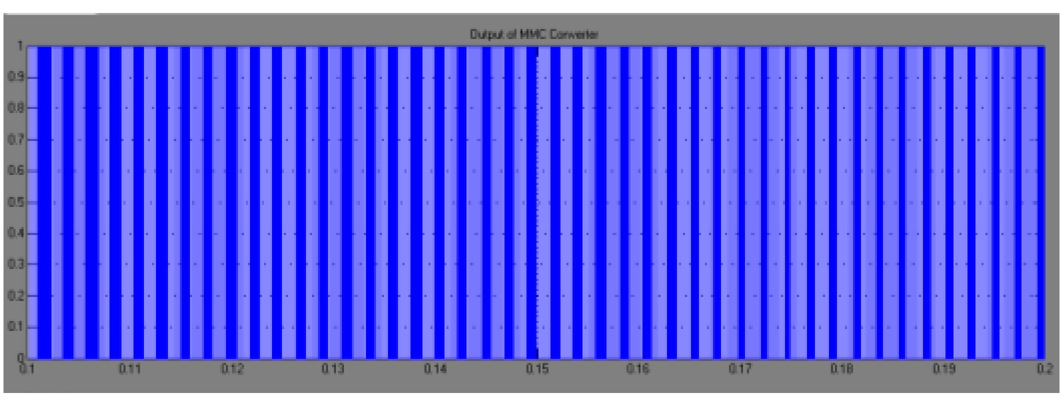
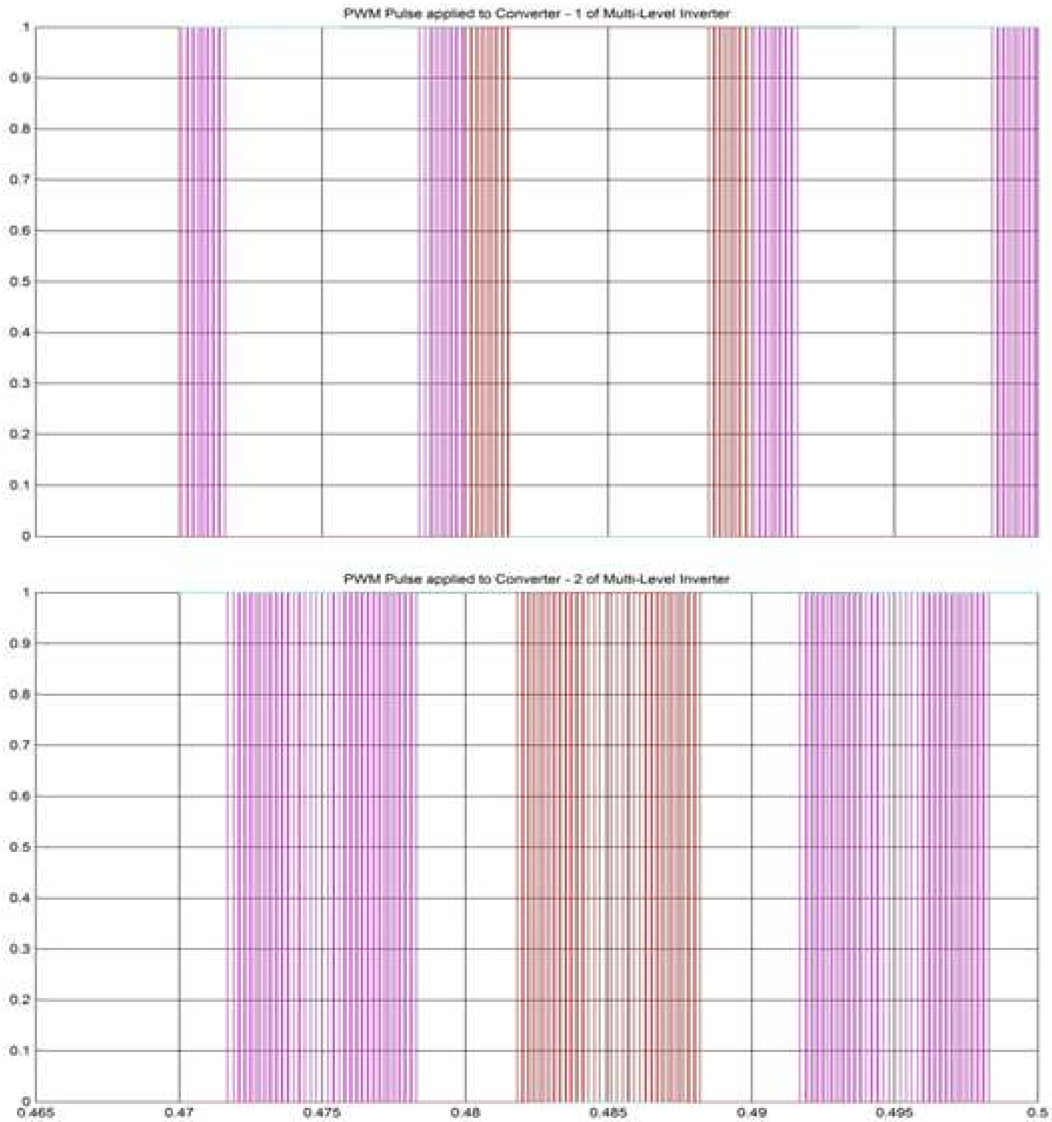


Fig : Output Voltage of Fly back Converter – 2



CONCLUSION:

A repetitive controller is proposed for fly back inverter operating in CCM, which has simple structure, low cost, and high efficiency. Conventional controller results in poor tracking ability due to the effect of RHP zero in CCM operation. To achieve a fast dynamical response, a repetitive controller is modeled an simulated in MATLAB / SIMULINK by cascading fly back with multi-level inverters in CCM operation. The low pass filter is adopted to allow tracking/rejecting periodic signals within a specified frequency range. The fly back inverter controlled by current maximum power point tracking (MPPT) for a small photovoltaic (PV) power system. This novel method can contribute to the space saving and cost reduction of the PV power conditioner from both the theoretical and simulation points of views. The simulation data show that the current fly back inverter can be applied to MPPT for the PV small power system with successful performance.



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