Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 6 (2011) 493–502

Energy Procedia

MEDGREEN 2011-LB

Investigation of the behavior of a three phase grid-connected photovoltaic system to control active and reactive power with DPC

I.Hamzaoui[a], F.Bouchafaa[a*], A.Hadjammar[a]

[a]Laboratory of Instrumentation, Faculty of Electronics and Computer, University of Sciences and Technology Houari Boumediene, BP 32 El-Alia 16111 Bab-Ezzouar Algiers, Algeria.

Abstract

This paper proposes an extended direct power control (DPC) for a three-phase PWM multilevel inverter fed by photovoltaic generation system (PVGS) and connected of a grid. The model contains a detailed representation of the main components of the system that are the solar array, and the grid side inverter multilevel inverter NPC VSI. In order to extract the maximum amount of from the photovoltaic generator, we propose an intelligent control method (fuzzy logic controller) for the maximum power point tracking (MPPT) of a PVGS. The DPC approach for multilevel inverter NPC which makes it possible to achieve unity power factor (UPF) operation by directly controlling its instantaneous active and reactive power. The other is a fuzzy logic controller, in the multi-DC-bus voltage control loop, developed to provide active power command. To achieve UPF operation, the reactive power command is set to zero. It is shown via simulation results that the proposed DPC has high performance. Moreover, the controller multi DC bus link voltages based on fuzzy logic has excellent performance in transient and steady states, a good robustness, a good dynamic behaviour response, and a good rejection of impact of load disturbance.

Keyword: Direct power control, Fuzzy logic control, MPPT, Photovoltaic, Multilevel inverter NPC, multi DC bus voltage.

* Corresponding author. Tel.: (213) 664 916 650; fax: 213 (0) 21 24 71 87.
E-mail address: fbouchafa@gmail.com

1876–6102 © 2011 Published by Elsevier Ltd. Open access under CC BY-NC-ND license.
doi:10.1016/j.egypro.2011.05.057

1. Introduction

In recent years, the efforts to spread the use of renewable energy resources instead of pollutant fossil fuels and other forms have increased.

PVGS are increasing in size as they become more affordable and supporting schemes start to include larger installations. In a near future, PVGS are going to be very common, and it is expected that they will contribute with a significant share to power generation.

One of the most common control strategies structures applied to decentralized power generator is based on Power direct control employing a controller for the multi DC link voltage and a controller to regulate the injected current to the utility network.

Control method is the key issue for the PWM inverters development. FLC regulator is adopted in the outer voltage control loop for maintain the DC output voltage. The currents drawn from the power system should be sinusoidal and in phase with respective phase voltages to satisfy required power factor. Many strategies are proposed to make currents sinusoidal [1].

As part of our work, we will focus on voltage inverter at three levels to NPC structure. The latter can increase the voltage supplied to the load through their topology. Thus, they can generate more voltage sinusoidal possible and improve the total harmonic distortion through the high voltage levels provided by the structure of this new converter.

The system components and power control scheme were modelled in terms of dynamic behaviours. The proposed models were implemented in Matlab/Simulink. This paper describes the dynamic performance of the PVGS connected through inverters to distribution network.

In the last, authors propose a DPC approach based to calculate active and reactive powers. The multi DC capacitor voltage is regulated and permits to obtain the reference of active power. Fuzzy logic control (FLC) is studied in order to give better performances in time response and system steadiness. This solution is simple and owns dynamics and robustness performances.

2. System configuration

Figure 1 show the configuration of the grid-connected PV system, which consists of two solar cell arrays and the three phase multilevel inverter NPC VSI. The control structure of the grid-connected PV system is composed of two structure control:

1. The MPPT Control,
2. The DPC Control the active and regulate the reactive power injected into the grid;

- Control the multi DC bus voltage;
- Ensure high quality of the injected power.

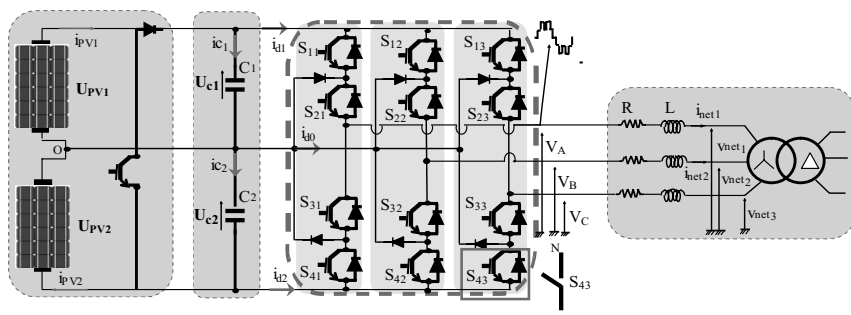

Fig.1. General diagram of grid connected photovoltaic system