

# Predictive Control of a Grid Connected PV System Incorporating Active power Filter functionalities

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**Abstract**—This article proposes a multifunction of a double stage grid connected photovoltaic (PV) system, with insertion the active power filter (APF) functionalities. This system is used to compensate the harmonics currents, compensate reactive power, supply the nonlinear loads and inject the PV system's active power into grid. This study is based on grid side, a perturb and observe algorithm is used to extract the maximum power point tracking (MPPT) from the PV array regardless of solar irradiance. On the grid side, a modified instantaneous active and reactive power theory (P-Q) based on a multi-variable filter (MVF) is applied to correctly identify the harmonics currents reference under distorted source voltage condition, also a modified predictive current control (PCC) algorithm is used to generate the switching signals for the source voltage inverter in order to ensure compensate reactive power and harmonic currents, feed the non linear load and inject the surplus of active power into the grid. In Matlab/Simulink™ software environment, the performance of the proposed control scheme is investigated under load change and irradiance change conditions. Simulations results demonstrate that the proposed PCC of the APF ensure a manage of active power exchanges with the grid with power factor correction. Furthermore, the grid current recovers its sinusoidal waveform with a total harmonic distortion (THD) meet to IEEE-519 standard.

**Keywords**— Photovoltaic system (PV); active power filter (APF); predictive current control (PCC); active and reactive power theory (P-Q); multivariable filter (MVF); total harmonic distortion (THD).

## I. INTRODUCTION

Unlimited use of fuels and nuclear resources leads to serious problems of pollution and environmental safety. Given the facts of this energy source, the world is turning to environmentally friendly and safe sources of renewable energy such as photovoltaic (PV), wind power, etc. it is very appropriate to install the PV generation systems in the places that have an excellent level of solar irradiance, to supply local loads power system needs. The grid-connected photovoltaic system allows

transmitting active power from the photovoltaic generator to the grid or non linear load by means voltage source inverter [1].

Currently, electrical loads using static converters are so-called non linear loads, they are indispensable for different industrial and domestic needs, this type of loads inject harmonic currents into grid. If the grid-connected PV system is applied to supply non linear loads, the power quality of the grid is relatively poorer, due to the active power supply by the PV generator. By consequence in the point common coupling of the use of the main source, the quality of the electric power is degraded [2]. As a modern solution, the shunt active power filter (SAPF) has been chosen as an effective solution for compensating harmonic currents, it is connected in parallel with the grid and non linear load, and can inject the harmonic currents equals in amplitude and in opposition of phases with the harmonic currents generated by the nonlinear load.

It is useful to integrate PV system into the distribution network to supply local loads, also integrate the features of the active power filter with PV system. The resulting system is better suited, on the one hand, to supply the local loads and, on the other hand, to compensate the reactive power and to suppression the harmonic currents from the utility grid. That means the sinusoidal waveform of the grid current is recovered and guarantees a unit power factor of the grid [3].

The control of the proposed system is focused in two parts, the first one consist to extract maximum power point tracking (MPPT) from the PV array, under irradiance change condition, by using the MPPT algorithm based on perturb and observe method. The second one consists to use two algorithms in order to control the grid side .A modified instantaneous P-Q theory is used as the first algorithm, to generate the filter reference currents, which are used for controlling the APF. This new method is based on MVF and enable to solve the control problem in distorted source voltage condition[4], because it can be extract the fundamentals component of current and voltage, these last are used in control current loop applied of APF in