

# Fuzzy Controller Design Using Particle Swarm Optimization for Photovoltaic Maximum Power Point Tracking

Y. Soufi<sup>1</sup>, M. Bechouat<sup>2</sup> and S. Kahla<sup>3</sup>

<sup>1</sup>Labget Laboratory, Department of Electrical Engineering, University of Larbi Tébessi, Tébessa, Algeria

<sup>2</sup>Department of Electronic and Telecommunication, University of 8 May 1945 Guelma, Algeria.

<sup>3</sup>Department of Electronic and Telecommunication, University of 8 May 1945 Guelma, Algeria

y\_soufi@yahoo.fr, mohcene.oui@gmail.com, samikahla40@yahoo.com

**Abstract**— Recently, researchers have strongly promoted the use of solar energy as a viable source of energy due to its advantages and which it can be integrated into local and regional power supplies. The P-V curve of photovoltaic system exhibits multiple peaks under various conditions of functioning and changes in meteorological conditions which reduce the effectiveness of conventional maximum power point tracking (MPPT) methods and the Particle Swarm Optimization (PSO) algorithm is considered to be highly efficient for the solution of complicated problems. In this paper, the application of this approach based MPPT algorithm for Photovoltaic power generation system operating under variable conditions is proposed to optimize and to design an intelligent controller comparing to conventional one.

**Keywords**—PV systems, Boost, PWM, MPPT, FLC, PSO.

## I. INTRODUCTION

Over last decade and with the development of society, energy and environmental issues became more and more serious. The research and the development of new energy sources such as wind, water, geothermal and solar energy around the world is continuously enhanced and it has become an increasingly important topic with the problem of energy crisis becoming more and more aggravated. Thus, the renewable energy sources have become a more important contributor to the total energy consumed in the world.

Photovoltaic power supplied to the utility grid is gaining more and more visibility while the world's powers demand is increases. Photovoltaic solar energy is a clean, renewable, green energy with a long service life and high reliability, which is inexhaustible and environment friendly. Photovoltaic source are widely used today in many applications such as battery charging, water heating system, satellite power system, and others, it becomes one of the most promising

alternatives for conventional energy sources and the most important renewable and sustainable energy system.

The research activities in PV systems are being conducted in an attempt to gain further improvement in their cost, efficiency and reliability. But, conversion efficiency of photovoltaic cells is low and the output of photovoltaic array is affected by the environmental conditions such as irradiation and temperature, it is necessary to track the maximum power point of photovoltaic PV[1][2]. Due to the obvious non linear, the maximum power tracking (MPPT) circuit was connected between the photovoltaic devices and for the effectiveness of photovoltaic cells and typical diagram of such connection system is shown in Figure1.

The FLC has become vital in very important research studies in many fields of electrical engineering due to its simple structure and robustness. It is considered a solution and effective tool in managing uncertainties and nonlinearities of systems [3] [4] [5]. The use of the fuzzy logic controller in photovoltaic systems has been considered by several researcher [6] [7] [8] and [9] which it depends on expertise and that whatever the results.

Conventional Maximum Power Point Tracking (MPPT) controllers are widely used due to simple implementation and show a good performance in tracking Maximum Power Point (MPP) when solar irradiance is uniform. However, considering their difficulty in tracking under variable conditions, tracking to MPP becomes complicated as multiple peaks exist on the Power-Voltage (P-V) characteristic curve [10].

Soft computing based algorithms were recently developed to obtain the global optimal solution under varying environmental conditions. The PSO is a swarm intelligence-based algorithm used to find the global optimal solutions. The reasons why PSO has gained the popularity is because it has only a very few parameters that need to be adjusted [11] [12].

This paper focuses on the performance of maximum power point tracking controller to extract maximum power from PV