Optimizing MPPT: A Comparative Study of P&O, Predictive Control, Fuzzy Logic, and Neural Network Methods

Md Suruj Ali[1,2], Masud R. Rashel[1,2], Md Tofael Ahmed[1,2] and Mouhaydine Tlemçani[1,2]

[1]Department of Mechatronics Engineering, University of Évora, Portugal
[2]Instrumentation and Control Laboratory, Institute of Earth Sciences, University of Évora, Portugal

Corresponding/Presenting author: m54057@alunos.uevora.pt

Talk Abstract

Optimizing the energy efficiency of solar PV panels is pivotal for advanced energy harvesting and utilization. Solar PV panels energy generation depends on environmental parameters such as irradiance and temperature which can increase the maximum power point tracking (MPPT) algorithm complexity due to its nonlinear characteristics. This study investigates a comparative analysis of four MPPT algorithms based on P&O, Predictive Control Method, Fuzzy Logic, and Artificial Neural Network (ANN) [1]. A robust boost converter is designed along with a classical P&O-based MPPT algorithm and compares the simulation results with artificial intelligence-based MPPT algorithms. The P&O technique is evaluated with the predictive control method which leverages next-state predictions towards enhancing accuracy. The study indicates Fuzzy Logic can manage system uncertainties along with adaptive decisions, while Artificial Neural Networks (ANN) explore the potential to learn dynamically and adapt to changing conditions [2–4]. The simulation shows the variation in response time, efficiency, and stability across the algorithms. This comparative study provides a guide to selecting the most effective and efficient MPPT algorithms to elevate the performance and reliability of solar PV systems [5,6].

Keywords: MPPT, P&O, Predictive Control, Fuzzy Logic, Artificial Neural Network, Photovoltaic Systems, Renewable Energy.

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