

# Artificial Neural Network-based Maximum Power Point Tracker for the Photovoltaic Application

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**Abstract**—This paper proposes a new artificial neural network-based maximum power point tracker for photovoltaic application. This tracker significantly improves efficiency of the photovoltaic system with series-connection of photovoltaic modules in non-uniform irradiance on photovoltaic array surfaces. The artificial neural network uses irradiance and temperature sensors to generate the maximum power point reference voltage and employ a classical perturb and observe searching algorithm. The structure of the artificial neural network was obtained by numerical modelling using Matlab/Simulink. The artificial neural network was trained using Bayesian regularisation back-propagation algorithms and demonstrated a good prediction of the maximum power point. Efficiency of proposed ANN-based MPP tracker has been estimated for linear shadow expanding and constant partial shading of any one PV module.

**Keywords**—*photovoltaic system, artificial neural network, maximum power point tracker, efficiency, partial-shaded photovoltaic*

## 1. INTRODUCTION

The renewable energy sources are considered as essential component of the future energy due to the rises in price of slowly depleting fossil sources and environmental concerns of nuclear power. Photovoltaic (PV) technology has become the fastest growing branch of renewable energy in the recent years. At the beginning of 2013 the total installed capacity of all PV plants have reached milestone 100GW [1], and continued to grow through the latest two year with additional 35GW in 2013 and planned 40GW in 2014.

The expansion of PV technology in power installations across the world restrains by relatively low overall efficiency of conversion of insolation into electricity and its dependence on day time prevent. Therefore the increasing conversion efficiency is the crucial issue of photovoltaic technology attracted attention of researches over the last few decades.

The total efficiency of PV systems can be increased in some ways. The first way is development of new materials able to improve the irradiance conversion. The second approach is the use of PV panel orientation systems (solar trackers) to adjust its position to perpendicular the photosensitive surface to sun rays. Such tracker can partially compensate the irregularity of power production during the day (especially in morning and in evening hours). They can be classified by hanger type as single-axial [2] and bi-axial [3]. The efficiency of solar trackers depends on many conditions, including tracker type, PV system location coordinates, irradiance level, etc. Lorenzo et al shown [4] that the average annual efficiency improvement of PV systems using trackers can reach 40%.

The third way to improve overall efficiency is based on maximum power point tracking (MPPT) on the  $P$ - $I$  curve of PV panels. Such trackers can adjust a load point on the  $P$ - $I$  curve of PV to produce a maximum power. The main principle of operation of such devices is changing resistance of the converter (DC/DC, DC/AC) to equal it with PV internal resistance [5], [6], [7], [8], [9].

Maximum power point (MPP) can be searched and determined using different control techniques. Classical methods such as perturb and observe (P&O) [10] or incremental conductance (IncC) has been extensively studied in recent years. However, these techniques provide proper operation under uniform irradiance level only. Non-uniform irradiance, such as partial shadowing of some PV modules or even some PV cells can change  $P$ - $I$  curve (Fig. 1) and make some local MPP, whereas classical MPPT algorithms search one maximum point only. Neither P&O nor other classical algorithms can identify the type of MPP (global or local) has been founded.

However, there are some MPPT techniques which can find the global MPP for partial-shaded PV modules, for example,

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**Razieh Khanaki**



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## **Table of Contents Artificial Neural Network Maximum Power Point Tracker For**

1. Understanding the eBook Artificial Neural Network Maximum Power Point Tracker For
  - The Rise of Digital Reading Artificial Neural Network Maximum Power Point Tracker For
  - Advantages of eBooks Over Traditional Books
2. Identifying Artificial Neural Network Maximum Power Point Tracker For
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Artificial Neural Network Maximum Power Point Tracker For
  - User-Friendly Interface
4. Exploring eBook Recommendations from Artificial Neural Network Maximum Power Point Tracker For
  - Personalized Recommendations
  - Artificial Neural Network Maximum Power Point Tracker For User Reviews and Ratings
  - Artificial Neural Network Maximum Power Point Tracker For and Bestseller Lists

5. Accessing Artificial Neural Network Maximum Power Point Tracker For Free and Paid eBooks
  - Artificial Neural Network Maximum Power Point Tracker For Public Domain eBooks
  - Artificial Neural Network Maximum Power Point Tracker For eBook Subscription Services
  - Artificial Neural Network Maximum Power Point Tracker For Budget-Friendly Options
6. Navigating Artificial Neural Network Maximum Power Point Tracker For eBook Formats
  - ePub, PDF, MOBI, and More
  - Artificial Neural Network Maximum Power Point Tracker For Compatibility with Devices
  - Artificial Neural Network Maximum Power Point Tracker For Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Artificial Neural Network Maximum Power Point Tracker For
  - Highlighting and Note-Taking Artificial Neural Network Maximum Power Point Tracker For
  - Interactive Elements Artificial Neural Network Maximum Power Point Tracker For
8. Staying Engaged with Artificial Neural Network Maximum Power Point Tracker For
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Artificial Neural Network Maximum Power Point Tracker For
9. Balancing eBooks and Physical Books Artificial Neural Network Maximum Power Point Tracker For
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Artificial Neural Network Maximum Power Point Tracker For
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Artificial Neural Network Maximum Power Point Tracker For
  - Setting Reading Goals Artificial Neural Network Maximum Power Point Tracker For
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Artificial Neural Network Maximum Power Point Tracker For
  - Fact-Checking eBook Content of Artificial Neural Network Maximum Power Point Tracker For
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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