



# Study of the MPP tracking algorithms: Focusing the numerical method techniques



A. Amir<sup>a,\*</sup>, A. Amir<sup>a</sup>, J. Selvaraj<sup>a</sup>, N.A. Rahim<sup>a,b</sup>

<sup>a</sup> UM Power Energy Dedicated Advanced Centre (UMPEDAC), Level 4, Wisma R&D, University of Malaya, Jalan Pantai Baharu, 59990 Kuala Lumpur, Malaysia

<sup>b</sup> Distinguish Adjunct Professor, Renewable Energy Research Group, King Abdulaziz University, Jeddah 21589, Saudi Arabia

## ARTICLE INFO

### Article history:

Received 5 November 2015

Received in revised form

18 February 2016

Accepted 19 April 2016

### Keywords:

Maximum power point tracking (MPPT)

Numerical methods (NM)

Analog and digital techniques

Photovoltaic (PV) array modeling

## ABSTRACT

A comparative review between different algorithms for maximum power point (MPP) tracking is presented, particularly focusing Numerical Method (NM) techniques. This paper presents a wide range of efficient NM schemes which have been neglected by most of the MPPT review papers. As, NM techniques are one of the simplest and fastest tracking algorithms. These techniques offer advantages of exact MPP tracking, standalone applications, flexible searching step sizes and no steady state oscillations. In addition, many different MPPT schemes are discussed and compared with the NM techniques. There are many ways of grouping and categorizing the MPPT algorithms for the Photovoltaic (PV) Array. However, evaluation of the NM schemes in comparison with other techniques is provided effectively through analog and digital classification, in terms of implementation and circuitry involved. Therefore, a comparative review majorly focusing on the importance of NM schemes to track the MPP is presented in comparison with other techniques, through analog and digital classification.

© 2016 Elsevier Ltd. All rights reserved.

## Contents

1. Introduction	351
2. Model of a pv module	352
2.1. Mathematical model of a solar cell	352
2.2. Temperature and irradiation effects	352
3. Digital techniques	352
3.1. Numerical methods (NM)	352
3.1.1. Root location methods to track the MPP	352
3.1.2. Numerical interpolation (NI) and extrapolation methods	356
3.1.3. Combination of numerical methods	356
3.2. MPPT algorithms iterative in nature (IN)	356
3.2.1. Firefly algorithm (FA)	356
3.2.2. Steepest-descent technique (SD)	357
3.2.3. Predictor method (PM)	357
3.2.4. Chaos optimization search (COS)	357
3.2.5. Ant colony optimization (ACO)	357
3.2.6. Genetic algorithm & differential evolution (G&D)	358
3.2.7. Particle swarm optimization method (PSO)	358
3.2.8. Shuffled frog leaping algorithm (SFLA) technique	359
3.2.9. Bayesian network (BN)	359
3.2.10. Artificial bee colony (ABC)	359
3.2.11. Gray wolf optimization technique (GWO)	359
3.2.12. Cuckoo search method (CuS)	359

\* Corresponding author.

E-mail addresses: [aamir.a@siswa.um.edu.my](mailto:aamir.a@siswa.um.edu.my) (A. Amir), [asim20588@gmail.com](mailto:asim20588@gmail.com) (A. Amir), [jejrj@um.edu.my](mailto:jejrj@um.edu.my) (J. Selvaraj), [nasrudin@um.edu.my](mailto:nasrudin@um.edu.my) (N.A. Rahim).