IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

AN ADAPTIVE ZONE BASED MPPT SCHEME FOR EXPLOITING THE MAXIMUM POWER FROM THE SOLAR PV ARRAY

IITM Technology Available for Licensing

Problem Statement

- Solar photovoltaic (PV) systems are widely accepted in recent times but are heavily dependent on the irradiance level, which fluctuates throughout the day; hence to overcome this a power electronic converter is essential
- Maximum Power Point Tracking (MPPT) is employed but are subjected to increased **steady-state error**, selection of parameters, such as the **step-size and frequency of perturbation, impacting the performance of MPP tracking**

Technology Category/ Market

Category – Energy Energy Storage and Renewable Technology
Applications –Solar energy converters, clean energy systems
Industry - Energy / Infrastructure
Market -Photovoltaic Market Size was valued at USD 93.15 Billion in 2022 and is expected to reach USD 243.81 Billion by 2032, at a CAGR of 10.1%

Key Features / Value Proposition

Technical Perspective

- ❑ The present invention discloses solar photovoltaic (PV) Maximum Power Point Tracking (MPPT) technique and the adaptive zone based perturbs and observes (P&O) MPPT technique that is used to **exploit maximum power from the solar PV array.**
- ❑ The buck-boost converter helps in implementation due to **high DC voltage gain, continuous input and output current and better transformer utilization.**
- ❑ The said technique improves both the steady-state and dynamic performance under **changing climatic conditions with natural drift-free tracking**

User Perspective

- ❑ Used to **improve a steady-state MPPT efficiency** and tracking speed under **constant/slow/fast varying irradiance conditions.**
- ❑ **No additional sampling and sensors apart from voltage and current sensors required.**

Intellectual Property

- **IITM IDF Ref. 1778**
- **IN471082- Granted**

Technology

The present invention discloses a method for Maximum Power Point Tracking (MPPT) in a solar photovoltaic (PV) system, which includes:

Operating Zone Identification:
- ✓ The solar PV system identifies an operating zone based on zone boundaries.
- ✓ Zone boundaries are defined according to the present operating solar PV current.

Direction Adjustment of Perturbation Step-Size:
- ✓ The solar PV system automatically adjusts the direction of a perturbation step-size based on the identified operating zone.
- ✓ The direction adjustment is performed to optimize MPPT.

Optimal MPPT Identification:
- ✓ The solar PV system identifies an optimal MPPT based on the adjusted direction of the perturbation step-size

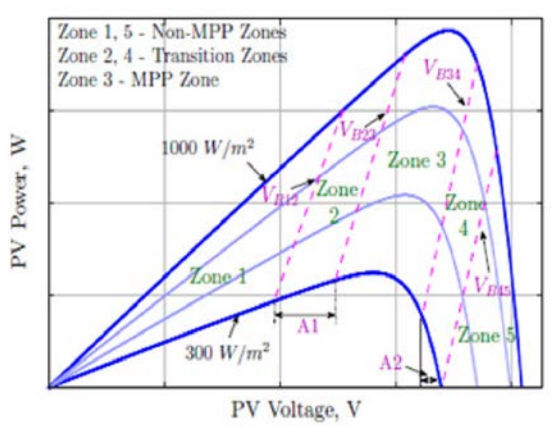

FIG. 1 illustrates a solar PV characteristics of proposed adaptive-zone P&O technique indicating the zonal boundaries

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The invention further includes **a solar photo-voltaic (PV) system comprising:**

Associated with a hybrid control scheme (HCS) feeding a DC load.

A Buck-boost full bridge (BBFB) direct current-direct current (DCDC) converter

- Includes DC current compensation controller & MPPT controller

HCS controller is connected with the buck-boost full bridge (BBFB) DC-DC converter

- The said MPPT controller comprising Identification of operating zone based on defined boundaries, Automatic adjustment of perturbation step-size direction based on the operating zone and Identification of MPP tracking based on adjusted perturbation
- The perturbation step-size for each zone is different and wherein the perturbation step-size varies adaptively for non-MPP zones and transitions zones.
- Automatic Direction Adjustment involves determination in MPP zone available and non-available areas

Images

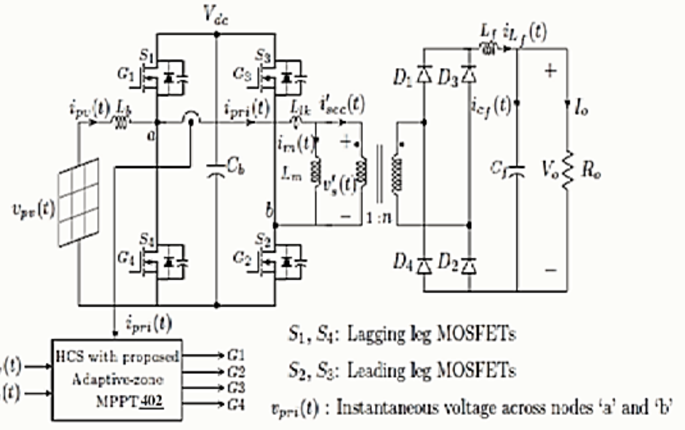


FIG. 2 is a circuit arrangement of a Solar PV fed buck-boost full bridge (BBFB) converter with a hybrid control scheme (HCS) and adaptive-zone MPPT

TRL (Technology Readiness Level)

TRL- 4, Technology Validated in the Lab

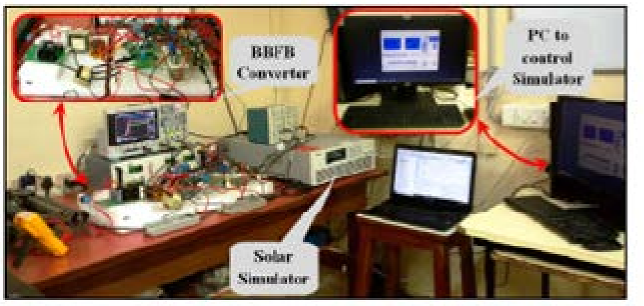
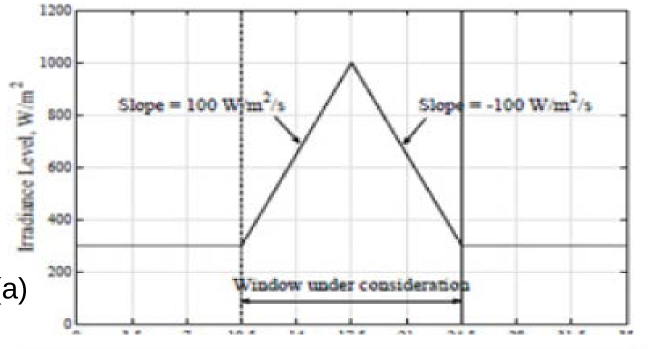


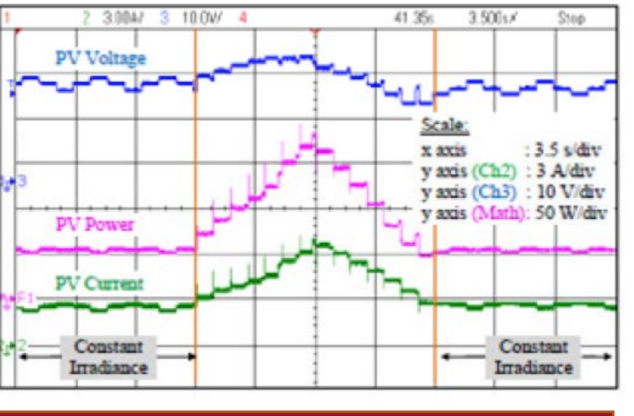
FIG. 3 illustrates a 200 W hardware prototype

The said MPPT technique is tested under continuously varying irradiance with a triangular profile having 100 W/m2 / s slope as shown in **Fig.4(a).**The performance result is given in **Fig.4(b). The MPPT efficiency under this condition for the period of (10.5s - 24.5s) is 94% .** From this results, it is concluded that the said adaptive zone MPPT scheme tracks the continuously varying irradiance

(a)



(b)



Research Lab

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