University of Peradeniya

Deep Learning based Novel MPPT Algorithm for Solar PV Appliances.

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Abstract- The study introduces a novel MPPT algorithm utilizing Artificial neural networks and irradiance forecasting to maximize solar panel power output, validated with real data from Sri Lanka. Results show significant improvement over conventional methods, with faster response times and improved performance in varied weather conditions.

Introduction

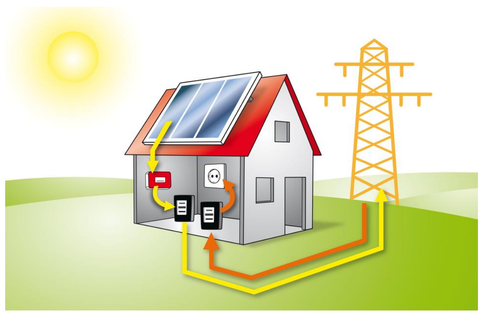


Figure 1: Solar PV system

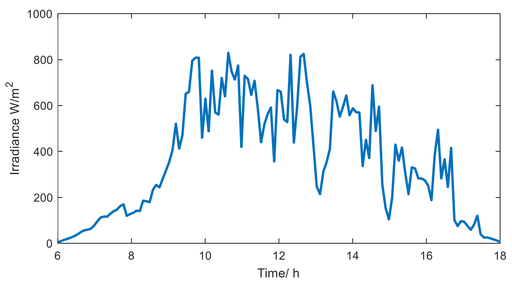


Figure 2: Daily solar irradiance variation

- Grid connected solar PV system generate renewable energy for local consumption.
- Solar panel, Inverter, grid connection, meter equipment included.
- Maximum power point tracking (MPPT) ensures optimal power output despite solar fluctuation, maximizing energy yield.

Different types of MPPT algorithms

- Perturb and Observe (P&O)
- Incremental Conductance
- Hill Climbing (HC)
- Artificial Neural Network (ANN) based methods
- Fuzzy Logic Control (FLC)
- Particle Swarm Optimization (PSO)
- Hybrid methods combining multiple techniques.

Objectives & Methodology

- AI in power electronics enhances renewables, mitigates losses, boosts efficiency
- Addresses solar energy intermittency, paving new AI-powered pathways for optimization
- Novel hybrid MPPT algorithm combines ANN-based technique with irradiance forecaster (LSTM), mitigating solar energy intermittency for enhanced efficiency and stability.
- Detailed case study showcases proposed method's superior tracking performance, dynamic response, rise time, settling time, and accuracy across varied conditions.

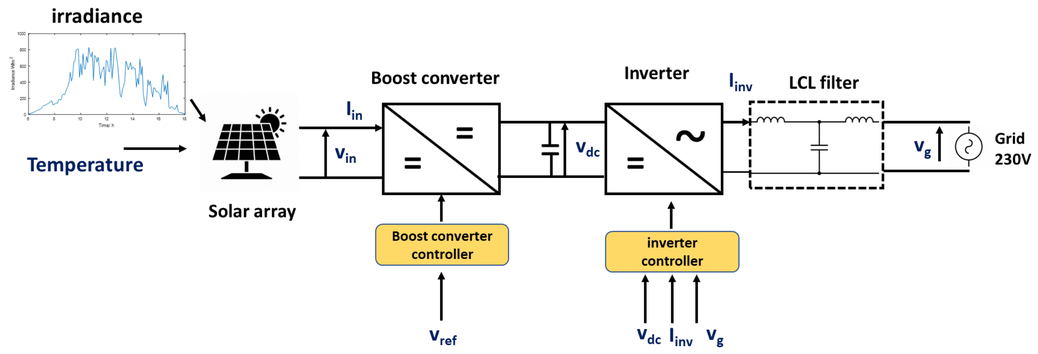
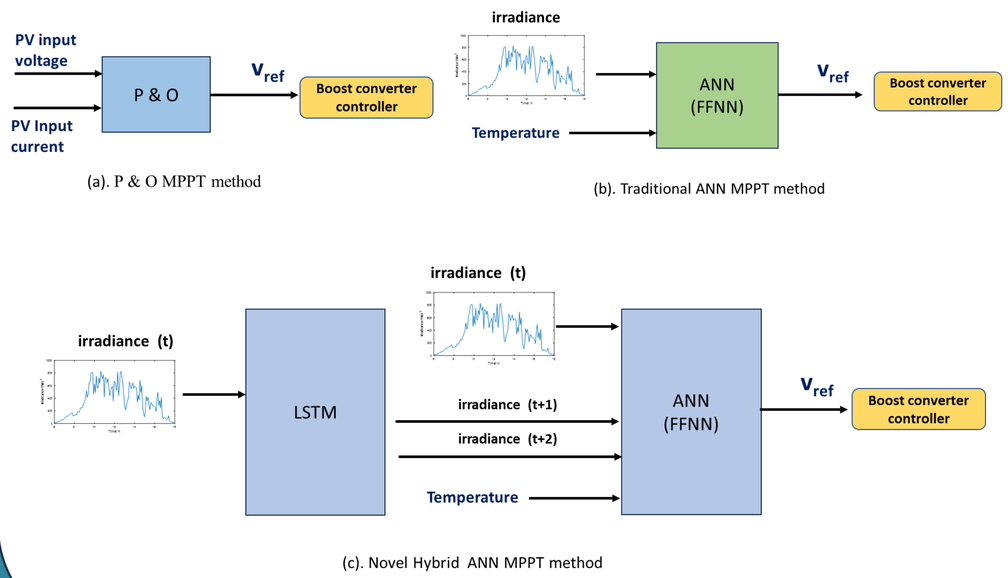


Figure 3: Architecture of PV system used for simulation

Exploring AI adaptation for MPPT



(a). P & O MPPT method

(b). Traditional ANN MPPT method

(c). Novel Hybrid ANN MPPT method

Results

Table 1: Performance comparison of different MPPT method

method (Figure 2 dataset)	total active power (kW)	Energy (kWh)
theoretical power	88.293	7.357
P&O MPPT with step size 0.5	82.268	6.855
P&O MPPT with step size 0.1	82.372	6.864
P&O MPPT with step size 0.05	82.767	6.897
Traditional ANN	82.596	6.883
new ANN	82.884	6.907

- The new ANN hybrid MPPT method demonstrates optimal performance in solar power systems, as confirmed by total grid-fed power and grid power setting time analyses

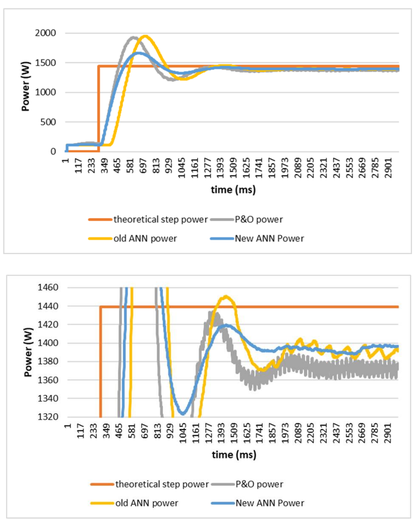


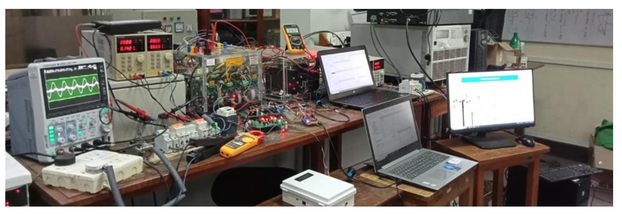
Figure 4: Rise time & settling time comparison of different MPPT method

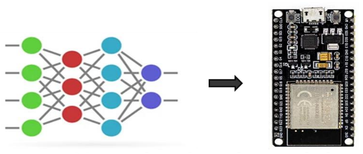
Conclusion

- Novel hybrid MPPT method integrates ANN and irradiance forecaster (Hybrid method), outperforming competitors in tracking performance and dynamic response, promising efficiency

Future work

- Future work involves implementing irradiance forecasted model and 4-input ANN to embedded system, testing lab setup inverter operation





Neural network model deployment

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