A Modified MPPT Algorithm with Integrated Active Power Control for PV-Battery Systems

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- Introduction
- Configuration of the system
  - Analysis of battery charging
  - Analysis of two operating points
  - Analysis of the modified MPPT algorithm
- Experiment results
- Conclusions

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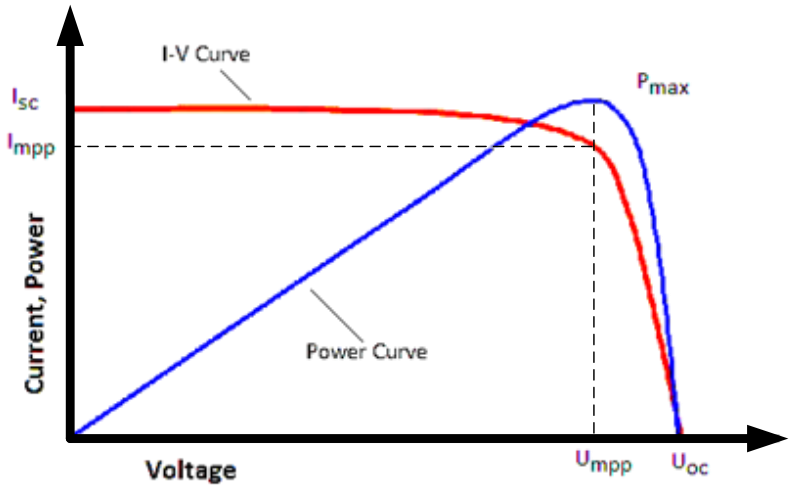
Introduction

- Cleanness
- Sustainability

Maximum power point tracking (MPPT)



Introduction

Objective: limit PV output power

Why?

- Grid-tie PV systems
  - Causing the grid overloaded
- Off-Grid PV systems
  - Overcharging the battery
  - Battery lifespan
    - Mainly reduced by improper control method
  - Causing the instability

Introduction

Methods

- Add more batteries → add extra money
- Limit PV output power
  ---- no need to switch on PV again → faster

limit PV output power

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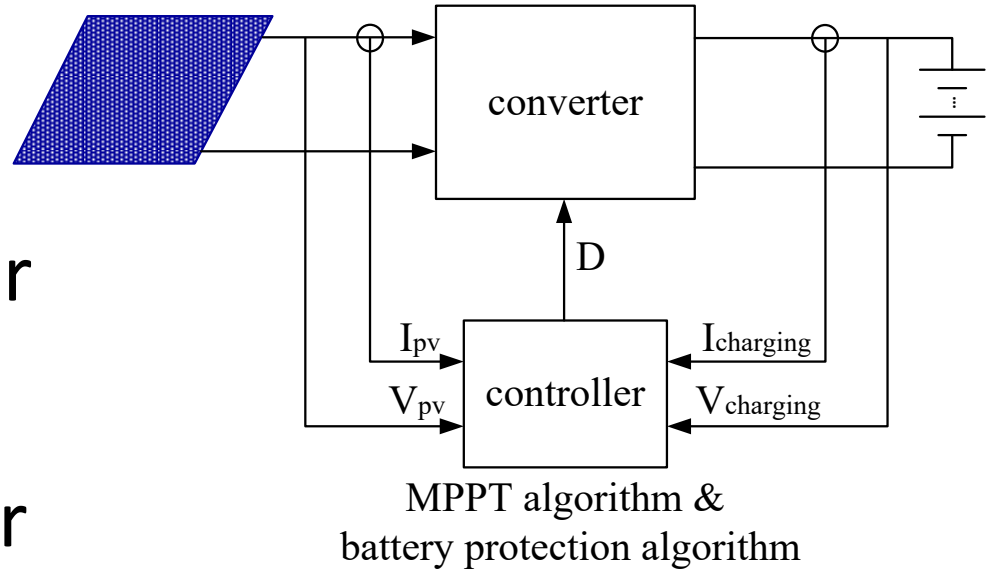
Configuration

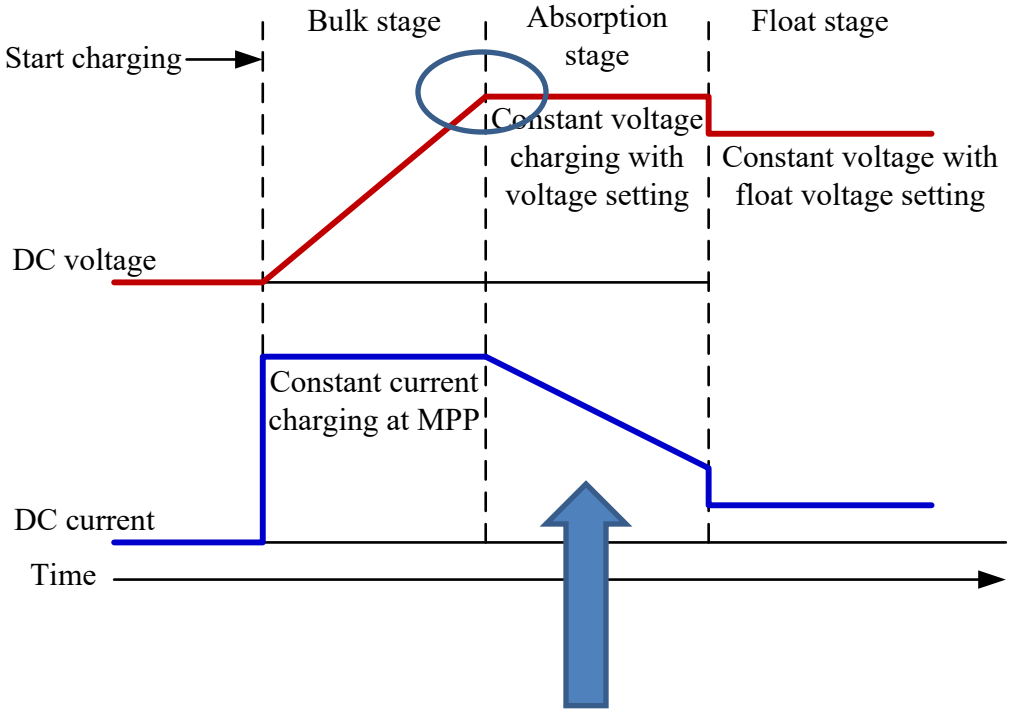
A typical off-grid PV energy storage system

- PV
- DC/DC converter
- Batteries
- Digital controller



Battery charging analysis

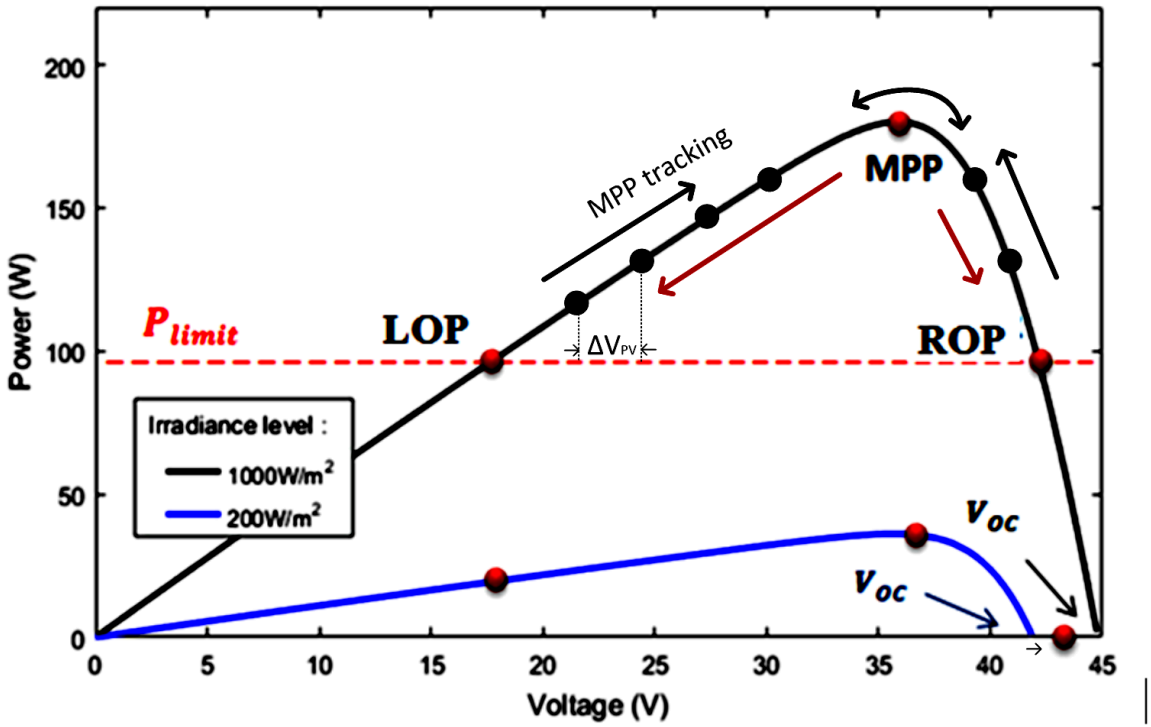
- Bulk charge stage
- Absorption stage
  - Voltage limit
- Float stage



When PV output power is LOW→MPP
When PV output power is HIGH→NO MPP

Modified MPPT with Active Power Control

- P&O MPPT method
- PV output limitation



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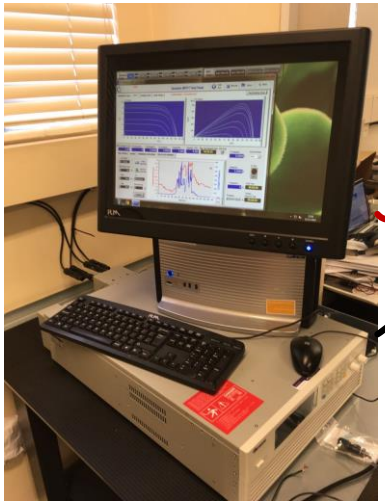
Experimental setup

- PV emulator (62050H-600S)
- Four 12V VRLA batteries (YPC33-12)
- Boost converter
- TMS320F28335 micro-controller

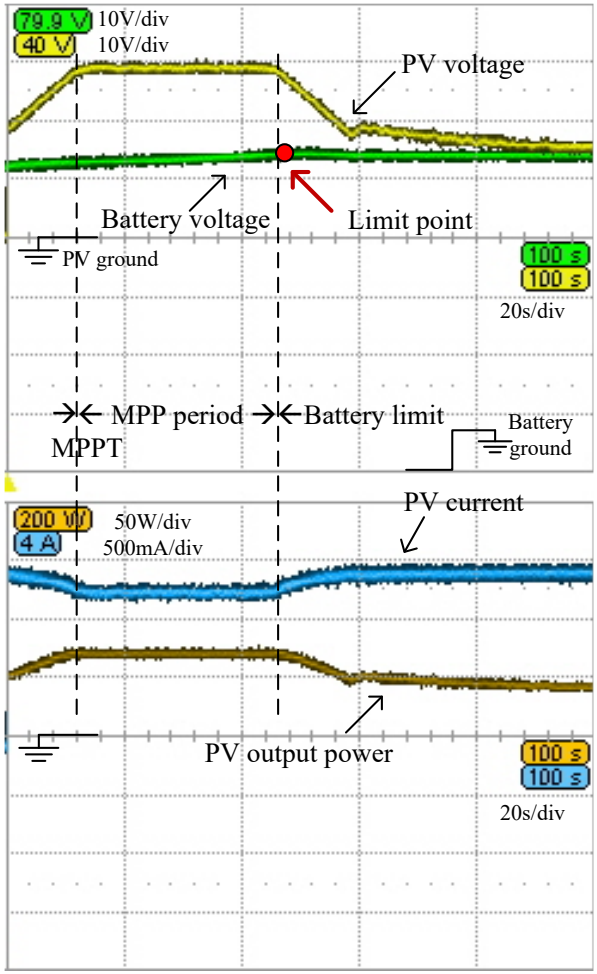


PV emulator

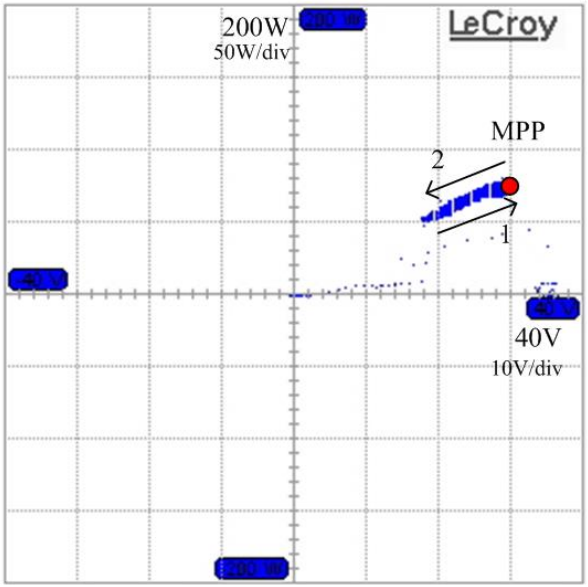
Booster converter

Batteries(48V)

Experiment results



(a)

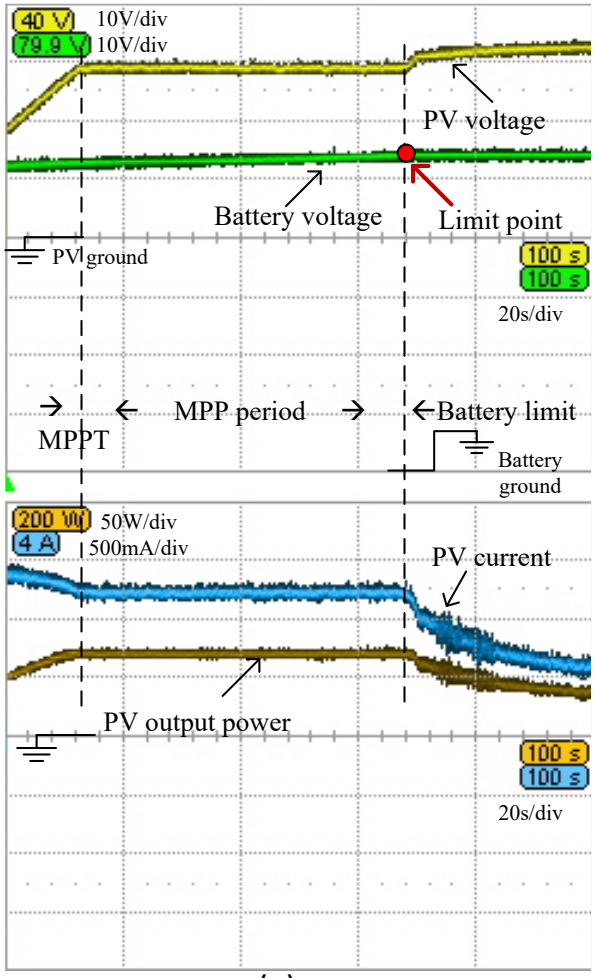


(b)

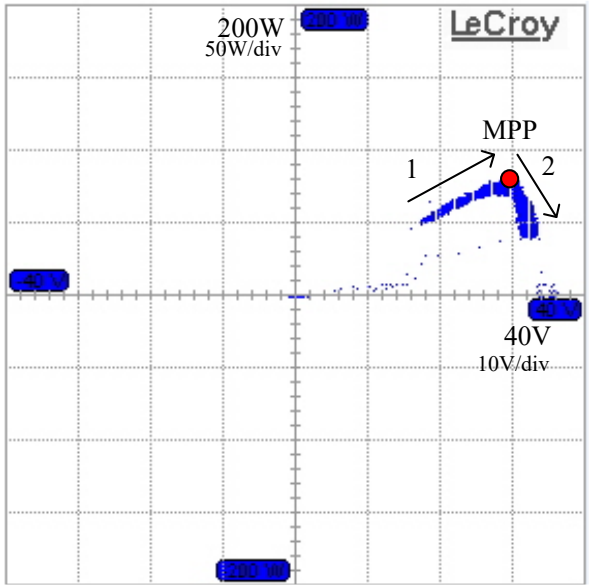
Left operating point when limiting the output of PV

Experimental waveforms of PV output,(a) left operating point;(b) dynamic process of left operating point

Experiment results



(a)

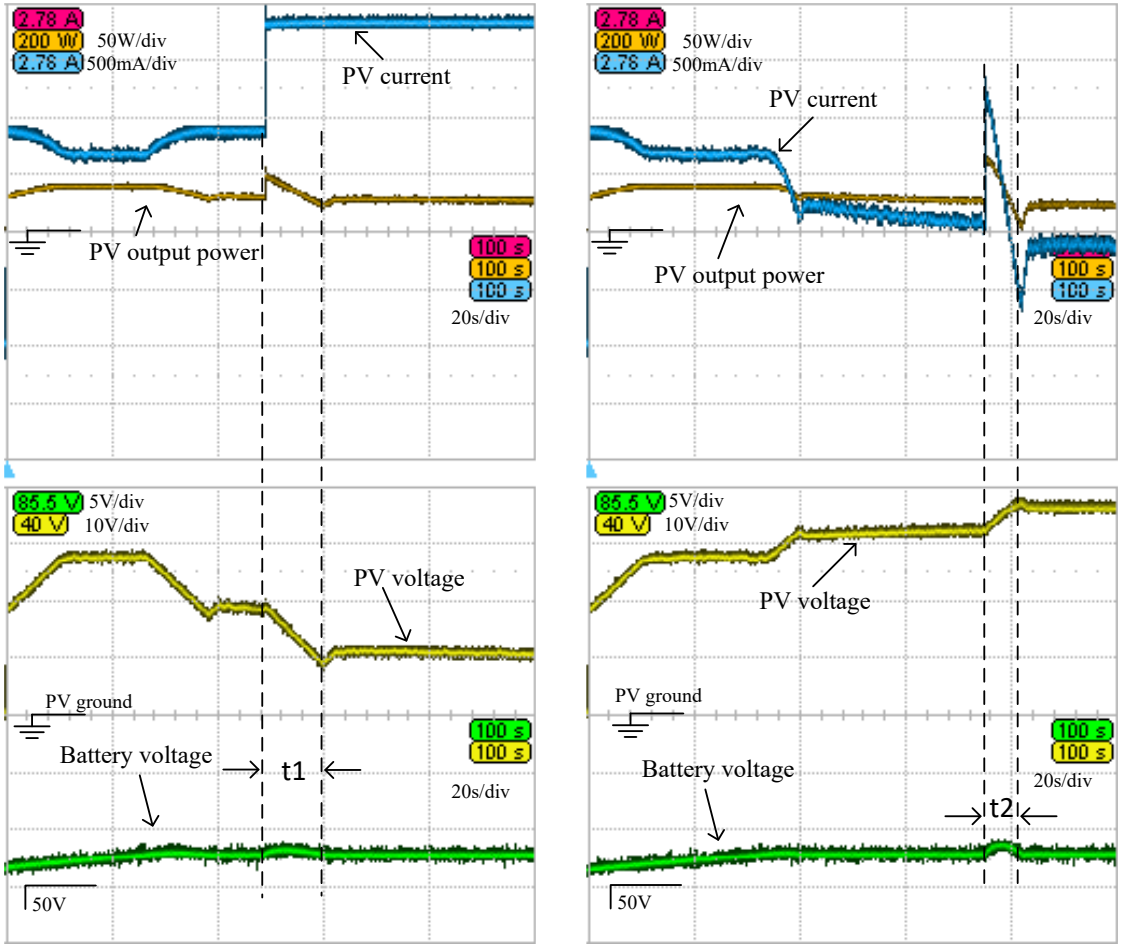


(b)

Two possible operating point when limiting the output of PV

Experimental waveforms of PV output,(a) right operating point;(b) dynamic process of right operating point

Experiment results



Fast solar irradiance change test, (a)left operating point; (b)right operating point

600W/m^2 →1000W/m^2

Compare two possible operating point when fast changing in PV's output

LOP: slower, more smooth

ROP: quicker, less smooth

Conclusions

- The proposed modified MPPT algorithm is experimentally verified

- Two possible operating points are compared:
  - LOP: smooth & steady transition period
  - ROP: quicker response to irradiance change

Thank you!

Questions?