Modeling PV Systems with Multiple MPPT Inverters

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October 18, 2018

SAM Webinars 2018

- Preview of SAM's New Model for Bifacial PV Modules, Today

- Preview of SAM's New Solar Resource Data Download Features, September 13

- **Modeling PV Systems with Multiple MPPT Inverters, October 18**

- sam.nrel.gov/webinars

System Advisor Model (SAM)

SAM is free software for modeling the performance and economics of renewable energy projects.

http://sam.nrel.gov
github.com/NREL/SAM
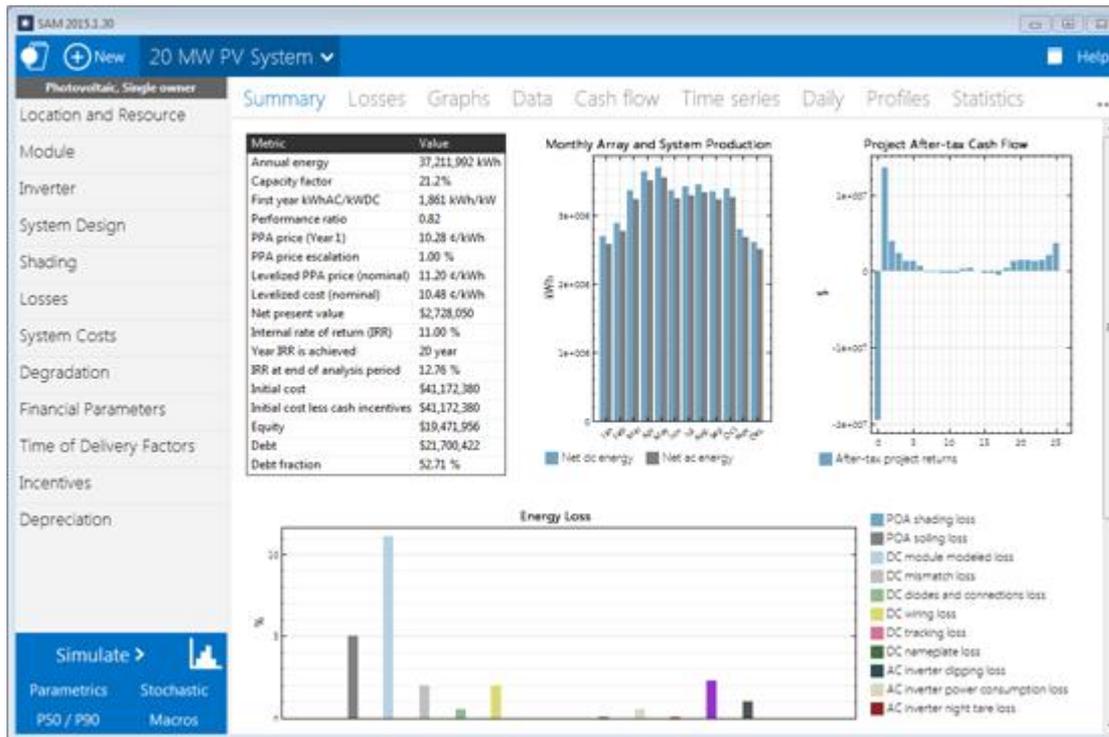
- Developed by NREL with funding from DOE

- Windows, OSX, and Linux

- One or two new versions per year

- Software Development Kit (SDK)

- Support
- Help system
- Documents on website
- Online forum
- Contact form on website

Outline

- Maximum Power Point Tracking Overview
- Why do you need multiple MPPT inputs?
- Mismatch vs Multiple MPPT Inputs
- Live Demo
- Limitations and Future Work
- Q&A

If you have a question or comment:
- Type it in the Questions box.
- We may unmute your phone so you can ask your question or follow up.
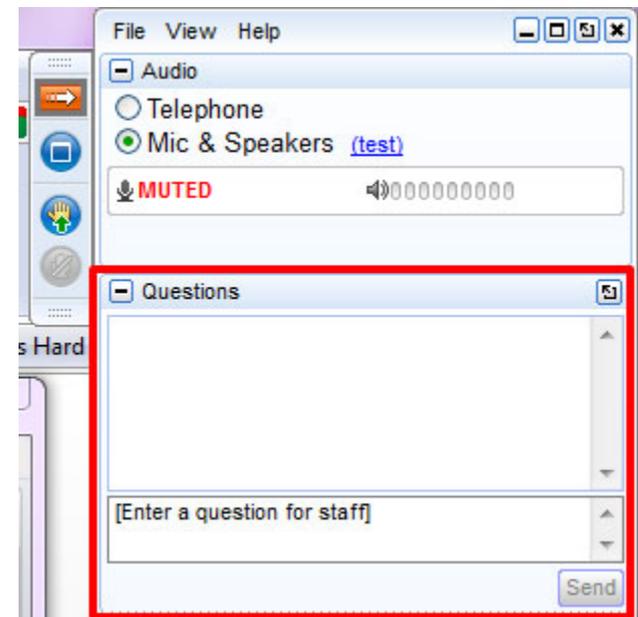
What is a Maximum Power Point?

- Modules have characteristic I-V curves that change as irradiance and temperature change

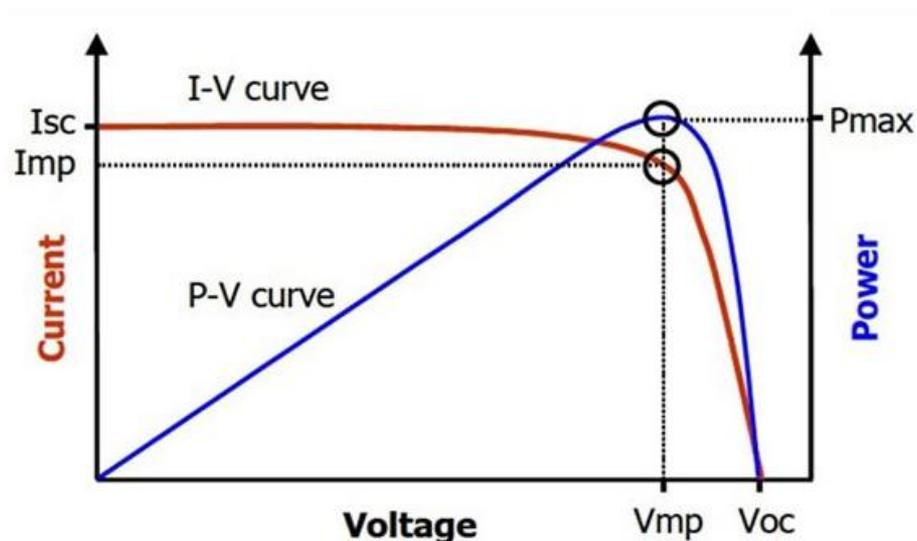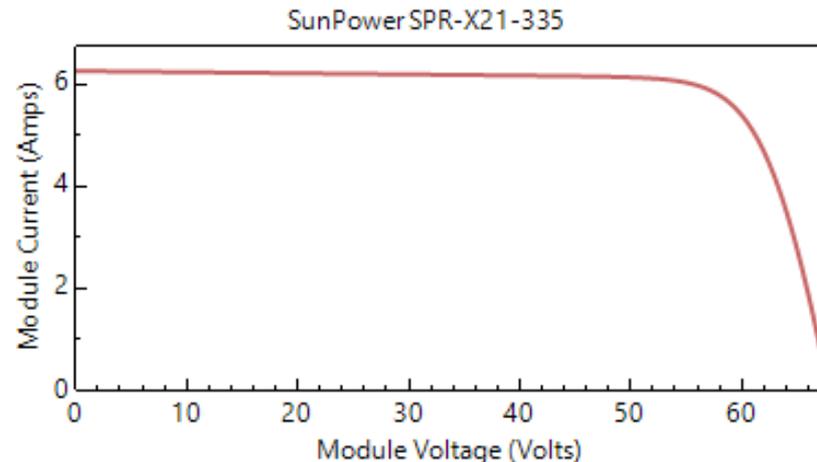- **Maximum power point (MPP)** is around "knee" of curve

SunPower SPR-X21-335

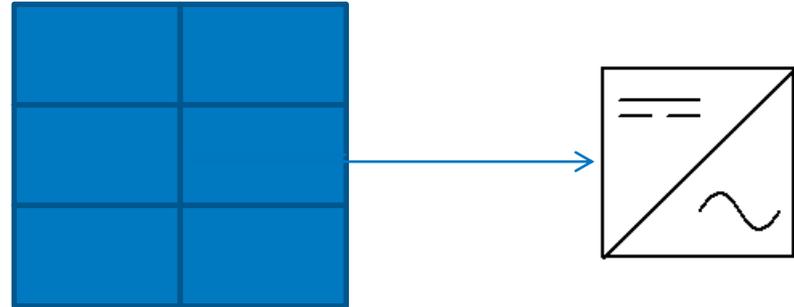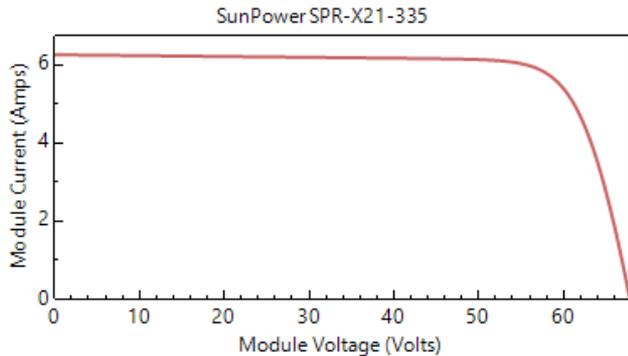Image from https://www.powerelectronictips.com/solar-cells-power-part-2-power-extraction/
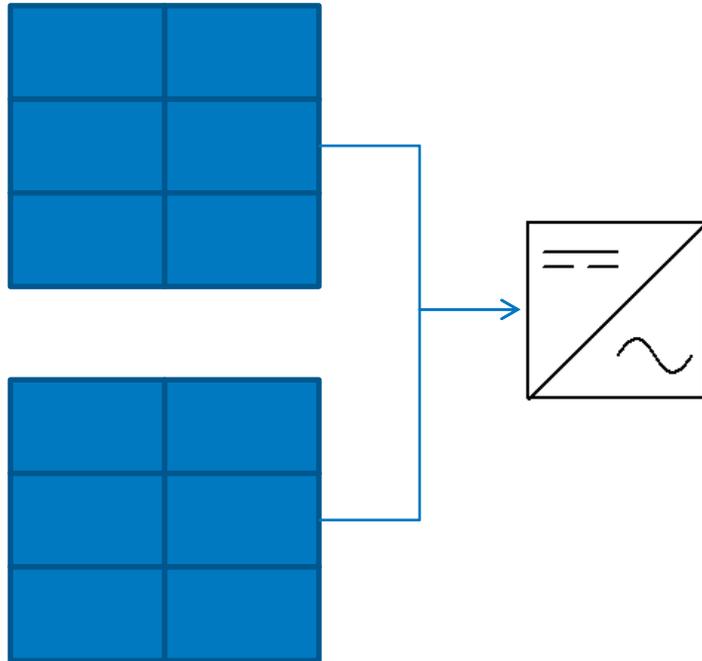
What is Maximum Power Point Tracking?

- Inverter controls voltage of string so that the panels operate at their maximum power point
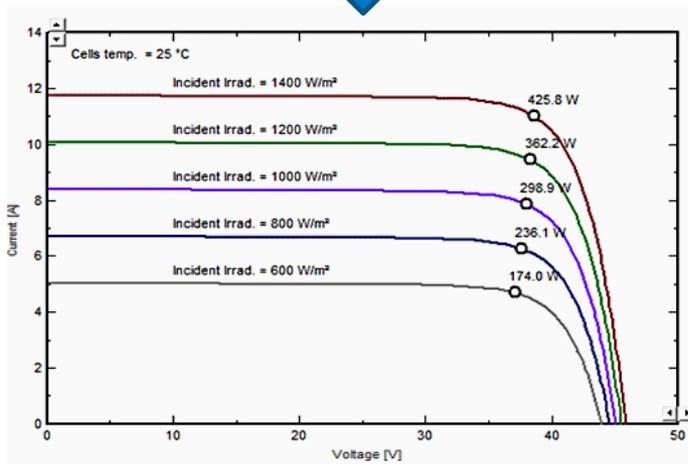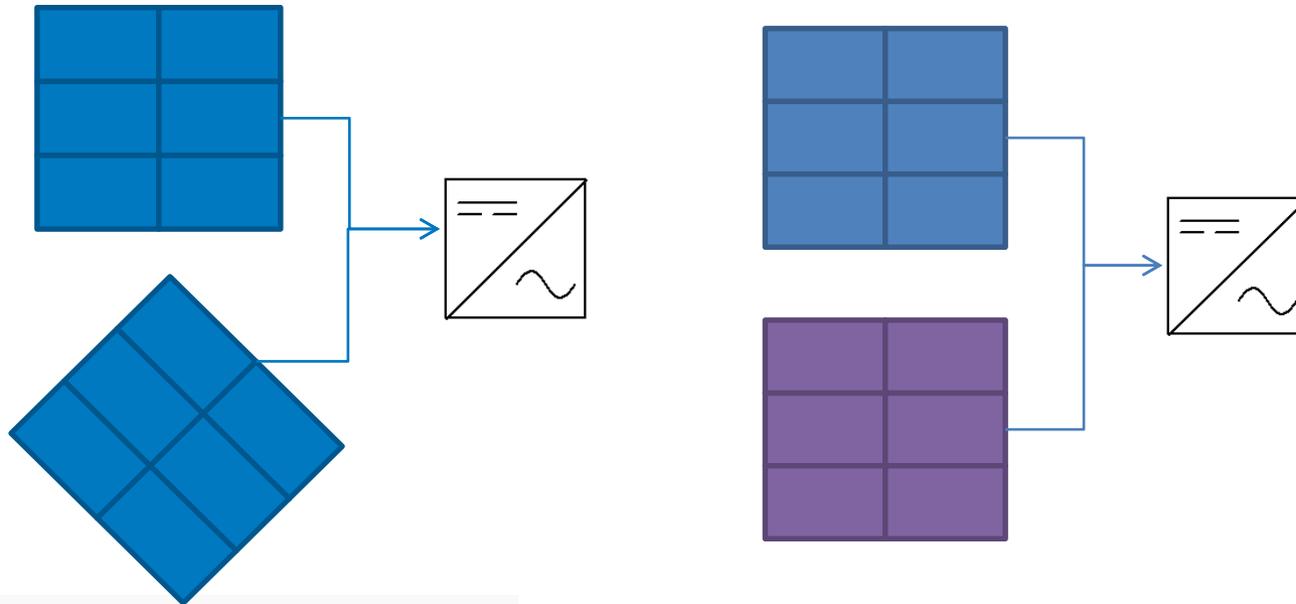- This is called **Maximum Power Point Tracking (MPPT)**

In today's webinar we will be ignoring module mismatch within a string, e.g., assuming that each panel in the string has the same IV curve, and therefore MPP

Maximum power point tracking still allows each module to operate at its MPP as long as all the modules on all the strings have the same IV curve

What if strings have different IV curves?

Image from http://solarpowerall.blogspot.com/2014/10/3-photovoltaic-installation-terms-to-be.html

- Different tilt
- Different azimuth
- Different types of modules

- Because modules are in series, voltages are added together, each string has a different voltage

- But a single MPPT circuit can only operate the system at one voltage
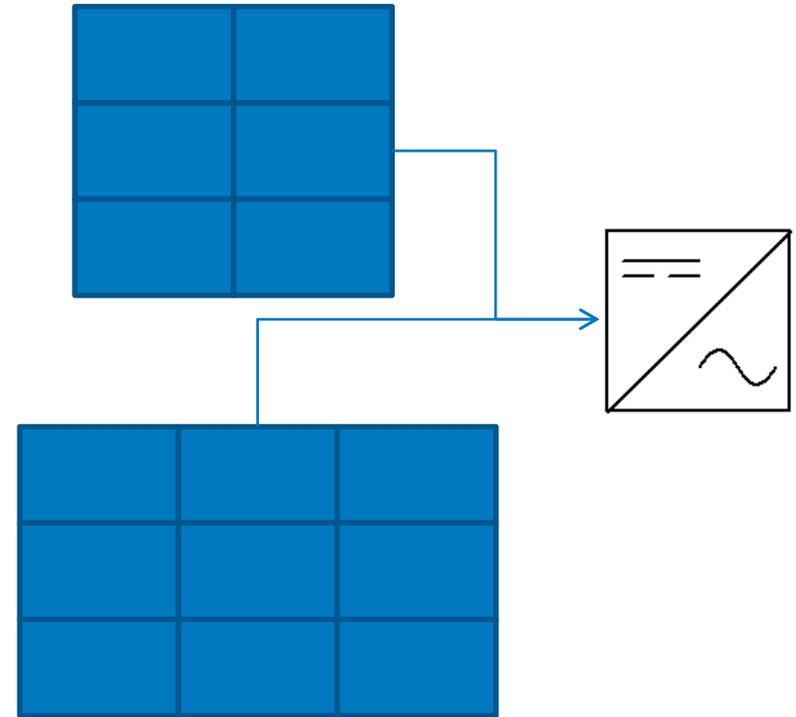
Single vs Multiple MPPT Inverters

- Single-MPPT Inverter: searches for global voltage that provides maximum power, resulting in *off-MPP* operation

  a) *In SAM, you can model this phenomenon using the Mismatch Voltage calculation for single-diode module models,*
     -OR-

  b) *The model will use the weighted average voltage. Note that this can significantly underestimate losses for a highly mismatched system!*

- Multiple-MPPT Inverter: mismatched strings can be connected to separate MPPT circuits, allowing each string to operate at its individual MPP

  *Module mismatch within a string is ignored in each of these scenarios, all modules in a string are assumed to have the same MPP

Live Demo in SAM

Future Work

- Allow >1 multiple MPPT inverter per system
- Enable >4 MPPT inputs on an inverter
- Enable DC-connected battery on a specific MPPT input of an inverter
- Improve representation of DC power electronics in conjunction with all inverter types
- Possibly combine multiple types of modules in a string

Thank you! Questions?

www.nrel.gov