Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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Inventors

Joseph Azzolini
Meng Tao

Contact

Shen Yan
shen.yan@skysonginnovations.com

Maximum Power Point Tracking through Load Management

Solar energy systems generate power intermittently, for example based on varying cloud coverage and other conditions. This inherent variability can lead to significant inefficiencies in utilizing the renewable energy source. The conventional approach is to utilize a central power converter in the solar energy system for maximum power point tracking. The power converter incurs cost and power losses. It also limits the size and reliability of the system.

Researchers at Arizona State University have developed a solar photovoltaic system with a new control strategy. This system eliminates the central power converter for maximum power point tracking. Instead, it employs a power sensor and associated controller to perform maximum power point tracking. The system includes multiple loads, and the power sensor with its controller determines if load(s) should be connected or disconnected in order to track the maximum power point. It responds to changes in operating conditions in real time (e.g., incident irradiance, operating temperatures, soiling, etc.). The system has been tested and validated on a real-world (outdoor) photovoltaic system.

Potential Applications:

- For intelligent control of loads driven by solar energy systems, e.g., used in the following:
  - Industrial electrolysis
  - Solar energy storage
  - Electric vehicle charging
  - Green hydrogen production

Benefits and Advantages:

- 10% lower upfront system cost
- 25% higher system energy efficiency (almost 100% efficiency)
- 35% lower levelized cost of electricity over traditional solar systems
- Scalability from a few kilowatts peak to a gigawatt peak
- Improved system reliability by eliminating power converter failures