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A Robust Hybrid Control Algorithm for a Single-Phase DC/AC Inverter

Tech ID: 24551 / UC Case 2015-047-0

BACKGROUND

Future energy distribution systems must be capable of interconnecting highly variable sources of electricity into the existing grid. The development of "Smart Grid" is needed due to increasing electricity demands and the need regulate input power sources. A particular challenge already impacting deployment of diverse renewable electric sources is the need to regulate the highly variable power these sources generate. While single-phase DC/AC inverters using Pulse Width Modulation (PWM) are one of the most common topologies used in power conversion, PWM is not robust with respect to changes in the DC input voltage. PWM also suffers from harmonic distortions that are less and less acceptable to downstream consumers of the power. One of the main shortcomings of converters controlled by PWM-based algorithms is that they are not robust to changes in the input DC voltage, which limits their use in renewable energy applications.

TECHNOLOGY DESCRIPTION

UCSC Researchers have invented a controller for a single phase DC/AC inverter that is characterized by a novel hybrid algorithm. Given an input voltage signal, the newly developed hybrid controller produces a pseudo-sinusoidal output signal and approximates a given reference signal by controlling the four switches defining a single inverter, using measurements of the output voltage and current. This controller is robust to highly varying input voltage, typical in renewable energy systems. The new algorithm implemented in the hybrid controller uses hybrid system methods to achieve such unique robustness. The algorithm has also undergone extensive numerical validation, which shows the output voltage has less harmonic distortion and is more robust to changes in input voltage than PWM-based control techniques. The system also allows for precision of the psuedo-sinusoidal signal based on parameters in the circuit and the controller.

APPLICATIONS

- ▶ Grid energy systems

ADVANTAGES

- ▶ Precision of the reference signal is tunable by the parameters of the controller
- ▶ Output signal approximates the reference and is generated for any input signal larger than a threshold, which can be tuned by the parameters of the circuit and of the controller
- ▶ Conversion is guaranteed even under highly varying input voltages (not necessarily DC voltages)
- ▶ In comparison to current methods, the algorithm produces a very low harmonic distortion

INTELLECTUAL PROPERTY INFORMATION

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,263,541	04/16/2019	2015-047
United States Of America	Issued Patent	9,876,442	01/23/2018	2015-047

RELATED MATERIALS

- ▶ [Enabling Design of Future Smart Grids via Input/Output Hybrid Systems Tools](#)

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OTHER INFORMATION

KEYWORDS

Single-phase DC/AC inverter, renewable energy, hybrid control, Pulse Width Modulation, PWM, energy, Smart Grid, grid energy,, Cat4

CATEGORIZED AS

- ▶ **Communications**
 - ▶ Other
- ▶ **Computer**
 - ▶ Other
- ▶ **Energy**
 - ▶ Other
 - ▶ Transmission
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