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# Harmonic Analysis Of Distributed Pv System Under High And Low Irradiance

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## ABSTRACT

The main objective of this paper is to analyze the feasibility of decentralized control approach in providing smart inverter functions for grid-tied AC-stacked PV inverter architecture. Decentralized controller allows fully distributed architecture both in terms of control and physical implementation of a PV system, resulting in higher reliability and potentially lower cost. In this paper, Relative Gain Array concept has been used to determine the best locally measured input-output pairing sets for designing the proposed decentralized controller. Proposed approaches by sending supervisory commands to only one inverter minimize the required communications for controlling reactive power and mitigating harmonics. Detailed modeling and analysis are provided to show the feasibility of the proposed decentralized approach. Proposed decentralized control scheme is verified by offline simulation and real-time hardware-in-the-loop setup.

## INTRODUCTION

Growing environmental concerns and energy independence have led to increase of penetration of renewable energy systems into power networks. Wind and photovoltaic energy are the major renewable sources of electricity production. Particularly, solar PV systems received significant research attention due to the advent of new technologies and cost reduction. However, increasing integration of PV systems may violate the grid standards and requirements. For example, in high penetrated PV networks, due to the intermittent nature of solar PV generations, power supplied by PV generation may not match with power demand and potential overloading or voltage rises can appear at power network buses. The suggested solution for this issue is the requirement of participation of PV inverter systems in voltage regulation through reactive power control.

Other Possible problems in high penetrated PV networks are harmonic

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emission of injected current, network resonance, false islanding detection, overloading of network equipment that should be considered. Consequently, new standard regulations are needed to achieve safe and reliable operation of power networks using renewable energies. Available grid codes are designed for grid connection of PV systems into low penetrated PV networks. However, in high penetrated PV networks, PV inverters should participate more in providing ancillary services and smart inverter functions during nominal symmetric operation and fault conditions. However, the new published amendment determines the PV inverter's reactive power control strategies for improving power quality and providing ancillary services.

Implementing main reactive power support strategies such as fixed reactive power (const. (Q)), fixed power factor (const. (cos j)), power factor as a function of generated active power (cosj (P)) and reactive power in terms of local voltage (Q (V)) requires accurate and fast PF control capability of PV inverter control schemes and proper communication bandwidth for transferring supervisory control commands and grid information to individual inverters. These requirements are critical, especially for new distributed panel level architectures such as AC-stacked PV inverter systems.

Central control of active and reactive power has an advantage that active and reactive power variation will not cause unbalanced in the system. If the active power changes, amplitude and phase of string voltage change accordingly. However, if the system is not controlled centrally and reactive power information is just sent to inverter this inverter will compensate for this variation and system will be unbalanced. Implementing central control algorithm or providing string voltage information to all individual inverters can balance the system. Later method requires significant communications band-width; particularly when number of inverters in a string increases. Impact of active and reactive power variation on string phase angle and symmetric operation of modular inverter system with central and de-central power control.

Lower active power condition at unity power factor with de-central control and no data transfer to inverters, inverter compensates for string phase change. Lower active power condition at unity power factor with central control and data transfer to inverters, balanced condition. Lagging condition when PF information is only sent

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to inverter. Lagging condition when PF information is sent to all inverters.

This paper by utilizing quantitative approach and mathematical analysis evaluates the capability of decentralized control scheme for controlling output active and reactive power and harmonic injection content. Decentralized controller enables higher frequency switching and shrinking passive components.

**EXISTING SYSTEM:**

This paper presents a unique modeling of harmonics and comparison between high irradiance and low irradiance in PV system connected to a grid. The signals used are actual tested waveforms in a distributed PV system. The percentage error has been calculated for the individual parameters in both cases.

The comparative study using Chirp Z transform (CZT) with 7 terms B Harris Window will enable to model harmonics using this algorithm in the future. The paper shows the performance of the method proposed in different measurement conditions.

**PROPOSED SYSTEM**

A new Chinese PV station code, then analyzed this code requirements and the phenomenon during photovoltaic system low voltage ride through (LVRT) period, especially focused on unbalanced grid faults condition.

Through the analysis, it's necessary to improve the traditional D-Q frame control strategy by additional methods such as positive (PS), negative (NS) and zero sequence (ZS) separation, stable phase-locked-loop (PLL) due to the 2nd order power harmonics and synchronization reasons during unbalanced grid faults.

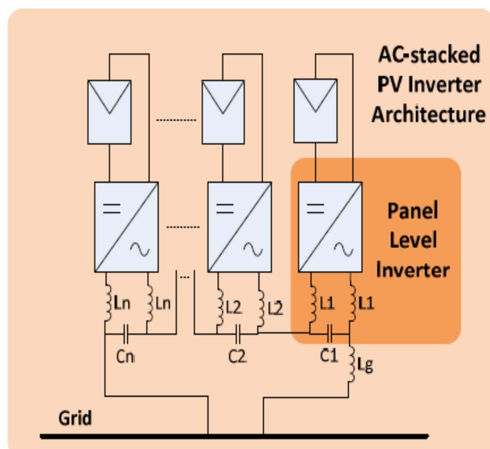


**Fig 3.1: AC-stacked PV inverter architecture schematic.**

**CONCLUSION:**

Generally speaking there is some strategies could solve the current distortion problem during unbalanced voltage sag, such as positive and negative sequence current independent control, which utilizes

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negative sequence compensation to eliminate the 2nd order power oscillation.

However this method would introduce negative sequence current to the AC current. Also the unbalanced voltage sag also could be compensated by additional facilities from AC grid side such as the method proposed by Gamesa "WINDFACT".

**REFERENCES**

[1] Y. Yang, H. Wang and F. Blaabjerg, "Reactive Power Injection Strategies for Single-Phase Photovoltaic Systems Considering Grid Requirements," in IEEE Transactions on Industry Applications, vol. 50, no. 6, pp. 4065-4076, Nov.-Dec. 2014.

[2] T. Stetz, F. Marten and M. Braun, "Improved Low Voltage Grid- Integration of Photovoltaic Systems in Germany," in IEEE Transactions on Sustainable Energy, vol. 4, no. 2, pp. 534-542, April 2013.

[3] Y. Yang, P. Enjeti, F. Blaabjerg and H. Wang, "Suggested grid code modifications to ensure wide-scale adoption of photovoltaic energy in distributed power generation systems," Industry Applications Society Annual Meeting, 2013 IEEE, Lake Buena Vista, FL, 2013, pp. 1-8.

[4] A. Cagnano, E. De Tuglie, M. Liserre and R. A. Mastromauro, "Online Optimal Reactive Power Control Strategy of PV Inverters," in IEEE Transactions on Industrial Electronics, vol. 58, no. 10, pp. 4549-4558, Oct. 2011.

[5] R. Langella, A. Testa, J. Meyer, F. Möller, R. Stiegler and S. Z. Djokic, "Experimental-Based Evaluation of PV Inverter Harmonic and Interharmonic Distortion Due to Different Operating Conditions," in IEEE Transactions on Instrumentation and Measurement, vol. 65, no. 10, pp. 2221-2233, Oct. 2016.

[6] H. Hu, Q. Shi, Z. He, J. He and S. Gao, "Potential Harmonic Resonance Impacts of PV Inverter Filters on Distribution Systems," in IEEE Transactions on Sustainable Energy, vol. 6, no. 1, pp. 151-161, Jan. 2015.

[7] I. Mazhari, H. Jafarian, B. Parkhideh, S. Trivedi and S. Bhowmik, "Locking frequency band detection method for grid-tied PV inverter islanding protection," 2015 IEEE Energy Conversion Congress and Exposition (ECCE), Montreal, QC, 2015, pp. 1976-1981.