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JAN 2-5, 2022

233	3P4W Grid Interactive PV-BES System with Seamless Transition Capability	PAVITRA SHUKL*; Bhim Singh
240	An Intelligent System for Domestic Appliance Identification Using Deep Dense 1-D Convolutional Neural Network	Subho Paul*; Nitin Upadhyay; Apurti Jain; Narayana Padhy
241	Analysis of a PM-Assisted Synchronous Reluctance Machine for Electric Vehicles	Dwaipayan Barman*; Vikram Roy Chowdhury; tauquir iqbal; Debabrata Barman
244	Electrolyte based Equivalent Circuit Model of Lithium ion Batteries for Intermittent Load Applications	Chalukya Bhat; Janamejaya Channegowda*; Kali Naraharisetti
253	Analysis and control of SEIG-based wind energy conversion system supplying low voltage dc microgrid	Mahaboob Subahani A*; Senthil Kumar; Kumaresan N.
254	Investigating Accurate Electrochemical Battery Models for Intermittent Discharge Applications	Chalukya Bhat; Janamejaya Channegowda*
256	Management of Energy Storage Dispatch in Unbalanced Distribution Networks using OpenDSS	Tripti Gangwar*; Narayana Prasad Padhy; Premalata Jena
260	Non-Isolated Multi-Port High Gain Interleaved Boost DC-DC Converter for Base Transceiver Station Application	Dr. Saravana Prakash P*; Kalpana R
261	Design & Analysis of Push-pull Converter Fed Battery Charger for Electric Vehicle Application	SUPRABHA PADIYAR*; Kalpana R
263	Power Management of Hybrid Storage using Rule Based Adaptive Filtering in Electric Vehicle	ABHISEK PANDA*; Mahesh K. Mishra
264	PI Controlled Synchronization Converter using SHO in Grid-Interactive Three-Phase Solar PV System	Kingsuk Majumdar*; Nishant Kumar; Provas Kumar Roy; Subrata Banerjee

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PI Controlled Synchronization Converter using SHO in Grid-Interactive Three-Phase Solar PV System

Kingsuk Majumdar
Dr. B C Roy Engineering College
Durgapur, India
kingsuk.majumdar5@gmail.com

Nishant Kumar
Senior Member IEEE
Indian Institute of Technology, Jodhpur
Jodhpur, India
nishant.kumar1729@gmail.com

Provas Kumar Roy
EE, Professor
Kalyani Goverment Engineering College
Kalyani,India
roy_provas@yahoo.com

Subrata Banerjee
Senior Member IEEE (USA)
National Institute of Technology, Durgapur
Durgapur, India
bansub2004@yahoo.com

***Abstract*—The world is gradually upgrading from thermal power generation to non-conventional resources, say wind, geothermal, and solar photovoltaic (PV) as a generation unit. In this manuscript, the solar PV system has been studied. The PV system has some inherent challenges when connected to a grid system or in stand-along mode, deciding parameters for its controller, keeping the DC-link voltage at the desired level, synchronising through the point of common coupling (PCC) with the grid system. This manuscript deals with stabilising the DC-link voltage of the inverter by PI controller parameters selection using the selfish herd optimiser (SHO). In this paper, IEEE 5 bus is taken as a test case, and the PV-solar system has its local linear and non-linear loads. The performance of the proposed approach is tested on the MATLAB Simulink platform under different test conditions and with a variation of solar irradiation and temperature.**

***Index Terms*—IEEE-519, PI controller, Power Quality, Selfish Herds Optimizer, Solar PV, Three Phase Two Stage Solar PV System in Grid operation**

I. Introduction

In a grid-connected PV-solar system, the DC-link voltage of the synchronising converter is played a deciding role to keep the PV-system remains in synchronism [1]. This synchronising converter is commonly known as an integrating converter. Due to the non-linear loads connected at the point of common coupling (PCC) and load change in the grid, harmonics are injected into this integrating converter, and the voltage profile of the DC-link is under challenge. Therefore, to extract the maximum power from the PV system and feed it to the grid, the control technique is crucial [2]. The goal of the control techniques is to stabilise the DC-link voltage and improve the power quality by maintaining the following objectives [3], [4]:

1) Holding DC-link voltage to its desired level even if solar irradiation and atmosphere temperature are changed.
2) Reduce harmonics from the supply current.
3) Load compensation and power factor correction.

The power quality improvement of the solar PV systems [5] is already reported in the 'grid-tied solar energy conversion system' literature, where synchronous rotating frame theory (SRFT) control is adopted [6]. The reactive power compensation and zero voltage regulation are achieved by this method. However, the dynamic performance of this said technique is poor due to the presence of a low pass filter in the control signal path. During the unbalancing load condition, the direct axis current has a considerable amount of second harmonics. To mitigate these second harmonics needs to have a high cut off frequency, implying an inadequate steady-state response of the overall system. On the other hand, due to the presence of Phase locked loop (PLL) in the reference direct axis current path, the robustness of the controller is poor. A notch filter can be a promising solution to those mentioned above. But a notch filter is not so feasible for a real-time based

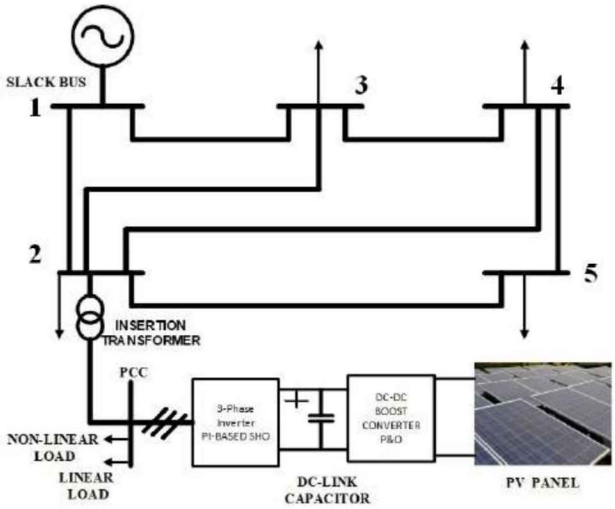

Fig. 1. IEEE 5 bus with PV system

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