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Research papers

A Buck-Boost-Flyback integrated converter for grid-connected wind-photovoltaic battery energy storage system using hybrid optimization assisted model

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Highlights

- An innovative structure for grid-tied PV-wind-BESS systems that increase the voltage gain of the BBFIC
- This study uses a hybridized technique called the Reminiscence-Insisted Sand Cat Swarm Optimization Approach (RI-SCS).
- The approach had chosen for irradiation pattern 1 works better with lower error rates than conventional methods.

Abstract

The power demand has increased dramatically in the modern era, which has caused a rapid exhaustion of fossil resources. Consequently, RES are used as input sources by the energy processor. Nowadays, power converters used in renewable energy sources like solar, wind, and fuel cells are commonplace for producing electricity for a load. A single fly-back converter and two buck-boost converters are combined into a single power switch with a single-phase layout to create the Buck-Boost-Fly Back Integrated Converter (BBFIC). Despite having the characteristics of buck-boost and fly-back converters, it avoids the problem of inverted voltage polarization and recycles the energy stored in the leaked inductor without the need for additional active clamp circuits. Additionally, for grid-connected gadgets, the BBFIC raises the voltage of the photovoltaic (PV) module to extremely high rates. The goal of this research is to provide an innovative structure for grid-tied PV-wind-BESS systems that increase the voltage gain of the BBFIC. It is intended to improve the converter's duty cycle to increase the voltage gain of the BBFIC. To achieve precise optimization, this study uses a hybridized technique called the Reminiscence-Insisted Sand Cat Swarm Optimization Approach (RI-SCS), which combines the principles of the Sand Cat Swarm Optimization Algorithm (SCSO) and the Crow Search Optimization Algorithm (CSA) for optimal results. In instance 2, the approach had chosen for irradiation pattern 1 works better with lower error rates than conventional HBA, AQO, CSO, and SCS designs, respectively, by 0.15%, 0.08%, 0.28%, and 0.07%. Finally, the experimental outcomes reveal the superiority of the suggested strategy with the number of metrics.

Introduction

The requirement for power has increased dramatically in the modern era, which has caused an explosive decrease in fossil resources. [1]. To attach to the grid, energy production is necessary. Other examples involve electric cars, water pumps, traffic signals, street lights, etc., An inverter's DC input voltage must be high enough to supply electricity to a utility in grid-tied operations [2] [3]. Therefore, to raise the final voltage of solar energy panels or fuel cells, a frond-end DC/DC converter with a large voltage gain is needed. A higher-gain voltage of dc/dc converter is designed for solving these problems.

To achieve an increased output voltage, a high voltage gain dc/dc converter often uses linked inductors and/or switching capacitors [[4], [5], [6], [7], [8]]. A converter will handle flyback and/or forward behaviors when including a linked inductor [9] [10] [11]. Two high step-up converters are shown in the literature [12] [13], however, to obtain high voltage gain, both of them use four active switches for voltage clamping and current regulation. Commercial uses suffer from the use of a high number of power switches. By their complementing qualities, renewable energy clusters may efficiently control uncertainty risks, which can improve market competitiveness and foster cooperative benefits. Advantages of shared energy storage include higher investment levels and higher use rates [14] [15].

By layering voltage multiplier cells rather than running in heavy-duty ratio or high turns ratio, the converters in [16] [17] are possible to achieve extra-high voltage gain; nonetheless, the voltage multiplier cell incorporates an active switch. These converters achieve a large step-up voltage characteristic by use of cascading power stages [18] [19]. A basic architecture of the maximum voltage-gain converter is worked out in [20], but it is devoid of thorough analysis, theoretical derivation, and meticulous practical testing. Nevertheless, the only options to obtain noticeably greater voltage gains are through heavy-duty ratios and high turn ratios; as a consequence, these strategies nevertheless have lower conversion efficacy.

This paper's primary significance is as outlined below: