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Design of Interleaved Cuk Converter with fuzzy based MPPT in standalone PV Application

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Abstract—**In recent days, the demand for energy is rapidly growing due to industrial revolution. The best option for supplying the rising need for energy is renewable energy. Because of its vast availability, environmental friendliness, and adaptability, solar energy is seen as the most promising energy source. However, there are a lot of benefits to solar energy. Due to variations in solar light, it has challenges in producing a high conversion ratio and steady supply of energy. The proposed strategy addresses the aforementioned issues. An Interleaved Cuk Converter with an intelligent maximum power point tracker and fuzzy logic is coupled to a photovoltaic (PV) solar module in the proposed system. An Interleaved Cuk Converter used in this approach improves the voltage with minimized switching stress and ripples. To track the peak power, fuzzy based Maximum Power Point Tracking (MPPT) is used which is highly efficient in tracking as well as it shows dynamic response in case of changing atmospheric conditions. The proposed method provides higher efficiency and better performance regarding tracking efficacy and response time. The efficiency of the system is validated through MATLAB simulation.**

Keywords— Interleaved Cuk Converter (ICC), Fuzzy based MPPT, Peak power, MATLAB, Solar energy

I. INTRODUCTION

The industrial revolution has increased the need for energy in our everyday lives. In the most developing countries, such as India, a major portion of energy output is based on non-renewable energy sources. The progressive depletion of these sources, such as fossil fuels, oils etc, is pushing emerging countries towards civilization's unsustainable end. In addition, the production of energy from traditional sources contributes to greenhouse gas emissions. So, it has become a great task to deteriorate the emission of greenhouse gases like CO2 and CO3. By making sure there is clean, secure, and economical energy, the objective is accomplished, where all these conditions get satisfied through renewable energy sources. But there are several renewable sources like solar, wind and hydro energy are available. Among these sources, PV is found as the best one as it is the most efficient renewable sources with benefits like clean, no noise due to absence of moving parts, pollution and maintenance free. However, it has complexities like low efficiency of energy conversion and fluctuation due to weather conditions which hinders the stability at the side of load [1-3]. In order to solve this issue, a DC-DC converter that serves as a conduit across the PV module and the load is needed.

Several DC-DC converters were used to increase efficiency of PV system. Buck and boost facilities, which are used for power handling, are included in basic circuit configuration for DC-DC converters [4-6]. Due to the availability of an inductor at either input or output, they generate pulsed currents on either side. Consequently, pulsed power has an impact on the power quality. SEPIC has a pulsing output current, just like buck-boost converters do. As it lowers ripple voltage and current levels without changing polarities [7] [8], the Luo converter is utilised to prevent these problems. However, a large output capacitor is required to lower the ripple voltage [9]. As a result, the Cuk converter is utilised to solve these issues. The presence of inductor at input and output avoid pulsated current and generates continuous flow of current. At continuous conduction mode, the Cuk converter [10] produces a significant input current ripple and introduces unwanted harmonics into the source. High voltage gain, constant input current, decreased voltage ripples, and minimal input current ripple are all features of the interleaved DC-DC Cuk converter.

Although constant input current is fed to load. To monitor the maximum power generated by solar cell, several MPPT algorithm is used such as voltage and current feedback, hill climbing, neural network, perturb and observation ,fuzzy logic and incremental conductance. Hill climbing [11] and voltage feedback are two of these methods that are simple to use, but they are less effective in detecting the peak power in cases of rapid variations brought on by weather conditions. In the aforementioned algorithm, incremental conductance and perturb and observation (P&O) are widely used techniques. It's tracking efficiency shows good result but it consumes too much of time as it involves an additional P-I loop [12], [13]. In recent days, Artificial Neural Network (ANN) based algorithm has gained great attention with impressive enhancement and high efficiency but the implementation process is difficult as a result of the choice of neurons and the

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