MPPT based LUO Converter Controlled PV Panel for Speed Control of DC Motor Application

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Abstract: -   In recent years, Renewable energy sources are becoming a very attractive solution for DC power generation. DC-DC converter is required to maximize the DC power from PV. LUO converter is used better solution for this conversion. Because, it satisfies larger output range, high power density, low inrush current etc. it employs voltage lift technique to increase the output voltage stage by stage. It also has Impedance network (Z network) for simple start up and smooth power conversion. Chopper B circuit with PID controller is used to control the speed of the motor by controlling the output voltage of LUO converter.

I.INTRODUCTION:

Nowadays, photovoltaic energy appears quite attractive for electricity generation because of its noiseless, pollution free, scale flexibility and little maintenance. Because of the PV power generation dependence on sun irradiation level, ambient temperature and unpredictable shadows, and a PV based power system should be supplemented by other

The DC-DC converters are used to convert a DC power at one voltage level to another one. In recent years, the modern power electronic systems require power supply with high reliability, high efficiency, low input ripple. In all DC-DC converter voltage and efficiency is limited by parasitic elements. LUO Converters are newly developed DC-DC converter to overcome the above limiter effects. LUO converter with Voltage Lift (VL) Technique is a popular method widely used in electronic circuit design. It can be a good way of improving DC-DC converters characteristics and has been successfully applied for DC-DC converters. However, the output voltage increases in stage by stage just along the arithmetic progression.
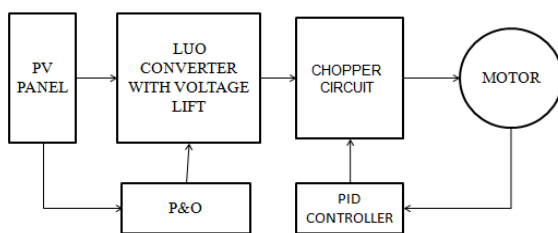

Fig.1 Block Diagram

The PV fed LUO converter is developed mainly for water pumping application. The speed control of DC motor is done by using Class B Chopper circuit.

II.PV CELL MODELLING WITH MPPT:

Solar energy is one of the clean energy source without polluting environmental pollution. The PV array can feed power to the system through a DC-DC converter. A Maximum Power Point Tracking (MPPT) control technique is required for the PV system to operate at the maximum power point. Many MPPT methods have been suggested over the past few decades. But P&O control technique has the advantage of an easy implementation to extract maximum power from PV.

III.LUO CONVERTER:

LUO converters are simplest form of DC-DC converter which operates on voltage lift technique. This LUO converter operates on PUSH-PULL state. The switched type LUO converter is developed. Switched-capacitor DC-DC converters are made only of switched-capacitors. Because switched capacitors can be integrated into power semiconductor integrated circuit (IC) chips, they have limited size and work at high switching frequency. They have been successfully employed in the inductorless DC-DC converters and have opened the way to constructing converters with high power density.

LUO converter can be incorporating Impedance network. It helps to Buck or Boost the output voltage of PV, depending on the value of Duty cycle and also acts as an second order filter.
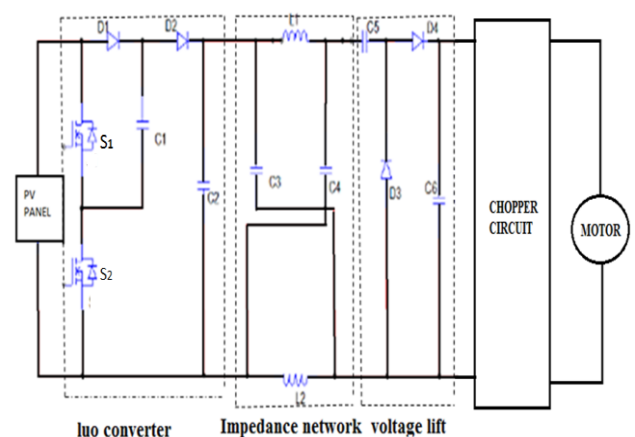

Fig.2 Circuit Diagram

Mode 1:

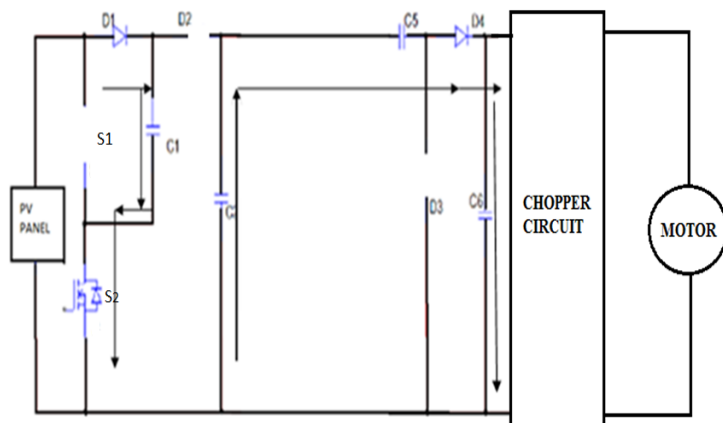When the switch S_2 is ON, capacitor C_1 is charged to V_{in}. C_2 will supply power to the impedance network.

Fig. 2(a) Mode 1

Mode 2:

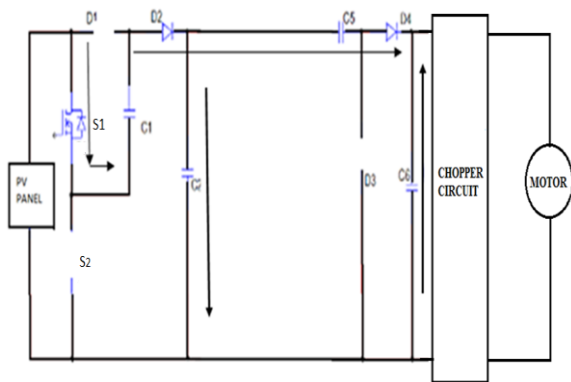When switch S_1 is ON, already charged capacitor C_1 starts to discharge. D_1 is forward biased.

Fig.2 (b) Mode 2

IV.CHOPPER CONTROL OF DC MOTOR:

A chopper is a static device which is used to obtain a variable dc voltage from a constant dc voltage source. The Class B chopper with PID controller used in a closed loop model of DC motor provides a very easy and common technique of keeping motor speed at any desired Reference speed under changing load condition. The PID controller is used to keep the speed at reference speed. During running condition, the motor speed is measured. The measured motor speed is compared with Reference speed to produce error signal. This error is then fed to PID controller to make the motor run at the desired Reference speed.

V.SIMULATION OF PV FED LUO CONVERTER:

A Solar PV module is mathematically modeled and connected at the DC input of the DC –DC LUO Converter. In order to switch the converter two complementary pulses were generated at a switching frequency 33 kHz. And in order to track the maximum power point using Perturb and Observe (P&O) algorithm is also implemented in the simulation and which will vary the duty cycle according to the V_{mpp} & I_{mpp}.
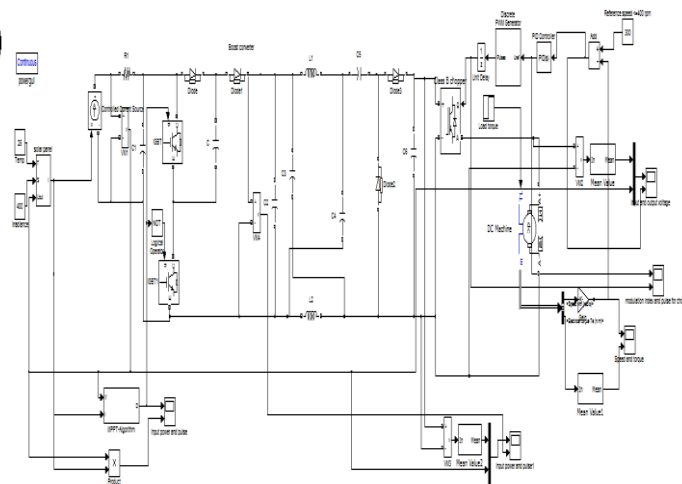

Fig.3 Simulink Model

The output power of PV panel is shown in fig. The maximum output power of PV panel is obtained using P&O MPPT technique.
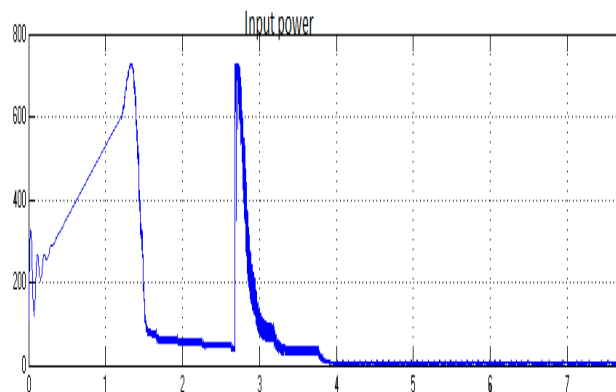

Fig.4 Output Power Of PV panel

The output voltage of PV is given to LUO converter. It increases the voltage level from 100V to 230V. The mid point voltage of LUO converter is 160V.
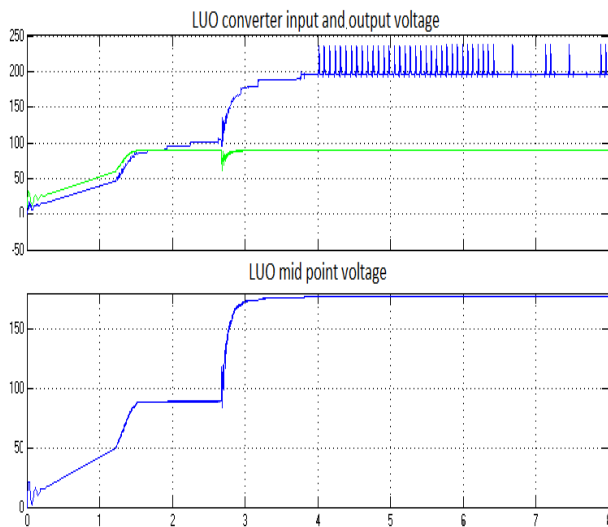
Fig.5 Input,Output and Mid point voltage of LUO Converter

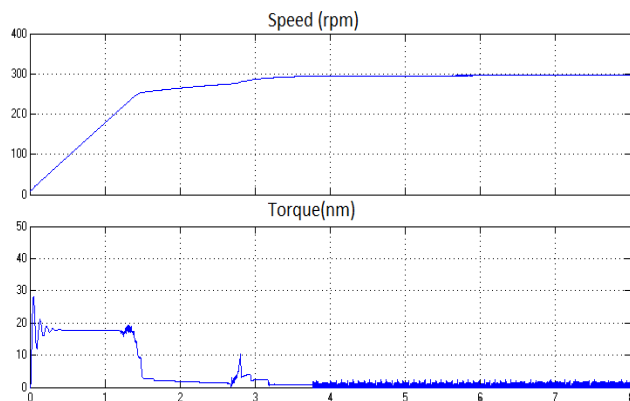During motor running condition, The speed of DC motor ir 300rpm. The range of torque also shown in fig.6

Fig.6 Speed and Torque Waveform

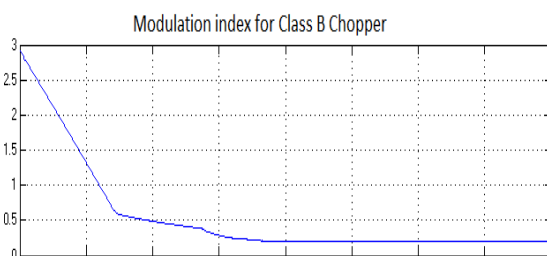The speed contol of motor is done by using Chopper B.

Fig.7 Modulation Index for Class B Chopper

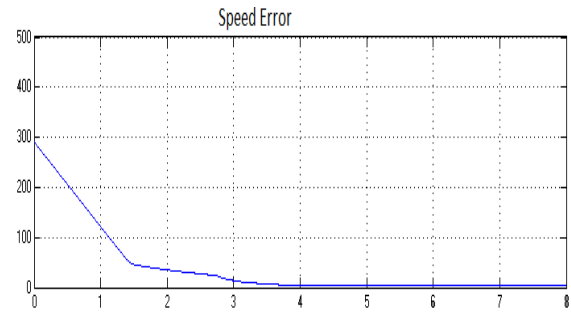The Actual speed of motor is compared with Reference speed and then Error is produced shown in fig.8

Fig.8 Waveform of Motor Speed Error

The error signal is fed to PID controller to run the motor at reference speed.

VI.CONCLUSION:

The Simulation of LUO converter connected to a motor load fed by a PV is carried. The output voltage of PV panel is improved by using P&O MPPT technique. The DC-DC LUO converter can be incorporating Z network for smooth power conversion and also acts as filter. The Voltage lift technique is used to increase the voltage level. The Class B Chopper circuit also implemented to control the speed of the motor. From the simulation analysis, PV fed LUO converter is applied for various domestic and industrial applications. Because of its simple structure, low cost, high voltage gain etc.

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