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MODELING AND SIMULATION OF CONSTANT VOLTAGE PV SOURCE INCLUDING CUK
CONVERTER & PWM CONTROL INVERTER

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ABSTRACT

A synchronous cuk converter proposed for analyzing the performance of photo voltaic system is presented. In the proposed cuk converter, the conduction losses and switching losses are reduced. The conduction losses are reduced by replacing the diode with MOSFET. The recent upsurge in the demand of PV systems is due to the fact that they produce electric power without hampering the environment by directly converting the solar radiation into electric power. We have designed a circuit such that it delivers constant and stepped up DC voltage to the load. We have studied the open loop characteristics of the PV array with variation in temperature and irradiation levels. Then we coupled the PV array with the Cuk converter in such a way that with variation in load, the varying input current and voltage to the converter follows the open circuit characteristic of the PV array closely. At various insulation levels, the load is varied and the corresponding variation in the input voltage and current to the Cuk converter is noted. It is noted that the changing input voltage and current follows the open circuit characteristics of the PV array closely.

KEYWORDS : *pv array, cuk converter, dc to ac converter*

I. INTRODUCTION

The Conventional sources of energy are rapidly depleting. Moreover the cost of energy is rising and therefore photo voltaic system is a promising alternative. They are abundant, pollution free, distributed throughout the earth and recyclable. The hindrance factor is it's high installation cost and low conversion efficiency. Therefore our aim is to increase the efficiency and power output of the system. It is also required that constant voltage be supplied to the load irrespective of the variation in solar irradiation and temperature. PV arrays consist of parallel and series combination of PV cells that are used to generate electrical power depending upon the atmospheric conditions (e.g. solar

irradiation and temperature). So it is necessary to couple the PV array with a Cuk converter. Moreover our system is designed in such a way that with variation in load, the change in input voltage and power fed into the converter follows the open circuit characteristics of the PV array. Our system can be used to supply constant stepped up voltage to DC loads. Solar energy has been harnessed by humans since ancient times using a variety of technologies.

II. A LOOK INTO SOLAR ENERGY SYSTEM AND CONVERTER SYSTEM:

Renewable energy resources and significant opportunities for energy efficiency exist over wide geographical areas, in

contrast to other energy sources, which are concentrated in a limited number of countries. Rapid deployment of renewable energy and energy efficiency, and technological diversification of energy sources, would result in significant energy security and economic benefits. As of 2011, small solar PV systems provide electricity to a few million households, and micro-hydro configured into mini-grids serves many more. National renewable energy markets are projected to continue to grow strongly in the coming decade and beyond, and some 120 countries various policy targets for longer-term shares of renewable energy, including a 20% target of all electricity generated for the European Union by 2020. Some countries have much higher long-term policy targets of up to 100% renewable. Outside Europe, a diverse group of 20 or more other countries target renewable energy shares in the 2020–2030 time frame that range from 10% to 50%. Renewable energy often displaces conventional fuels in four areas: electricity generation, hot water/space heating, transportation, and rural (off-grid) energy services.

The efficiency of solar PV system used in space satellite mainly depends on the efficiency of DC-DC power conditioning process. High efficient DC-DC converter has to be designed which is more suitable in solar PV application. Unfortunately, the performance of solar PV system is affected due to non-linear dynamics in DC-DC converter used in system, and leads to undesirable operation in solar PV System. Also DC-DC converter used in solar PV system should be stable and the input voltage is kept within the specified range under disturbances at the source voltage and the change in irradiation. With above motivation, the PV powered DC-DC.

III. ABOUT CUK CONVERTER

The Ćuk converter is a type of DC/DC converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude. It is essentially a boost converter followed by a buck converter with a capacitor to couple the energy. The non-isolated Ćuk converter can only have opposite polarity between input and output. It uses a capacitor as its main energy-storage component, unlike most other types of converters which use an inductor. It is named after Slobodan Ćuk of the California Institute of Technology, who first presented the design. There are variations on the basic Ćuk converter. For example, the coils may share single magnetic core, which drops the output ripple, and adds efficiency. Because the power transfer flows continuously via the capacitor, this type of switcher has

minimized EMI radiation. The cuk converter allows energy to flow bi-directionally by using a diode and a switch.

IV. PROPOSED MODEL

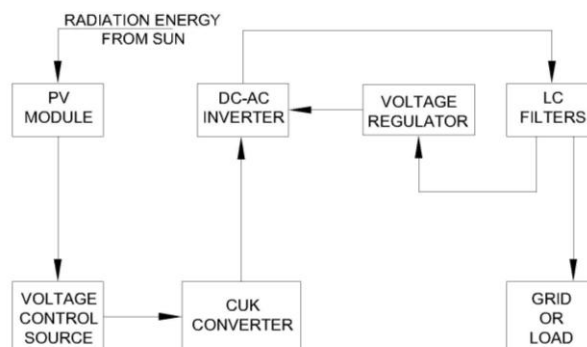


Fig. 1 Block diagram of pv system with cuk converter

V. OPTIMIZATION OF CUK CONVERTER SYSTEM WITH PV MODULE

Cuk converter-based system is considered in this research. The objectives of the research work are stated as follows:

- To model the solar PV module for studying the effect of temperature and irradiation on the performance of the PV module.
- To analyze, simulate and implement the Cuk converter using solar PV module.
- To implement and compare different control methods in terms of their performance in suppressing ripples, reducing peaky electromagnetic inference and increasing converter conversion efficiency in circuits of the solar PV powered Cuk converter system with good steady state performance.
- To investigate experimentally and control the non-linear dynamics such as chaos non-linearity in Cuk converter-based solar PV system.
- To design a voltage controller for regulating the output voltage of the solar PV module so that the input voltage of the DC-DC Cuk converter-based solar PV system is chaotic free and regulated for the change in irradiation. The stability of the DC-DC Cuk converter-based solar PV system is analyzed for the supply disturbances.

VI. SIMULATION DIAGRAM & RESULTS

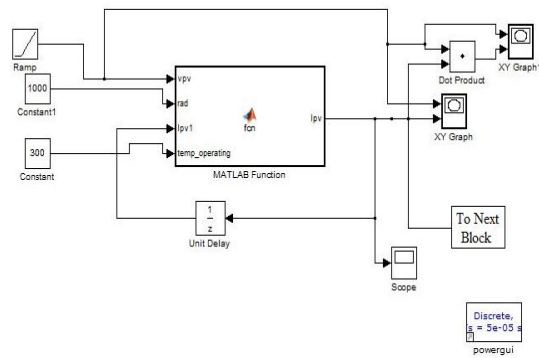


Fig. 2 simulation model of pv module

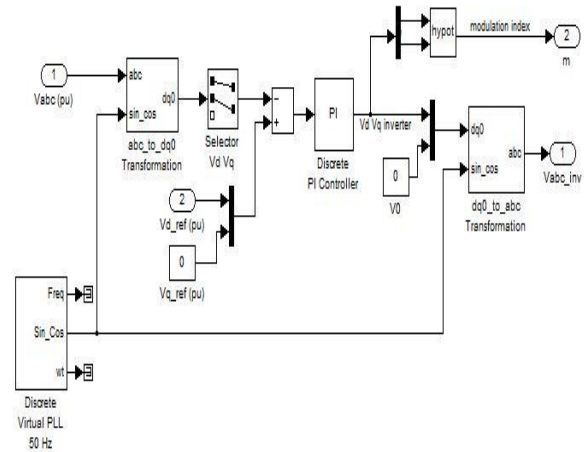


Fig. 5 simulation model of voltage regulator system

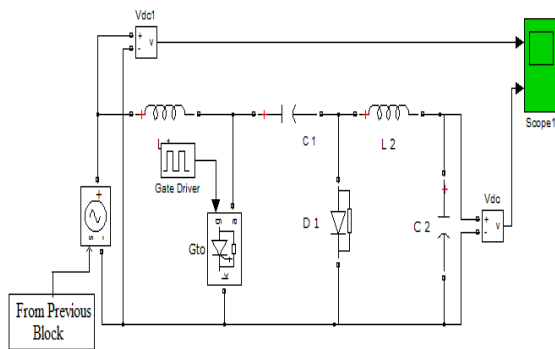


Fig. 3 simulation model of cuk converter block

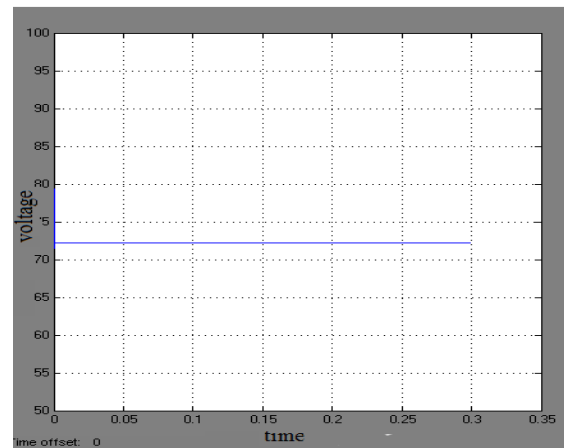


Fig. 6 output voltage waveform of pv module

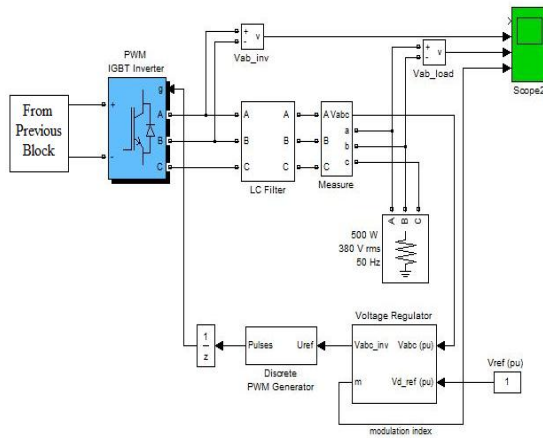


Fig. 4 simulation model of DC to AC converter with load

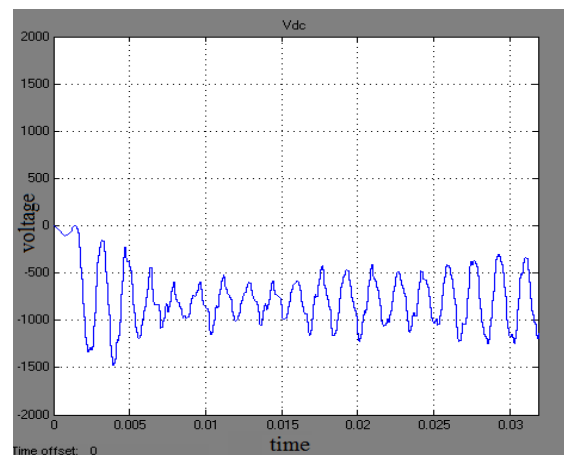


Fig. 7 output voltage waveform of cuk converter

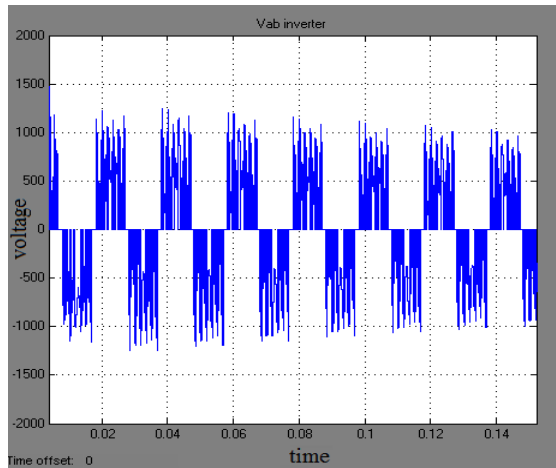


Fig. 8 output voltage waveform of inverter

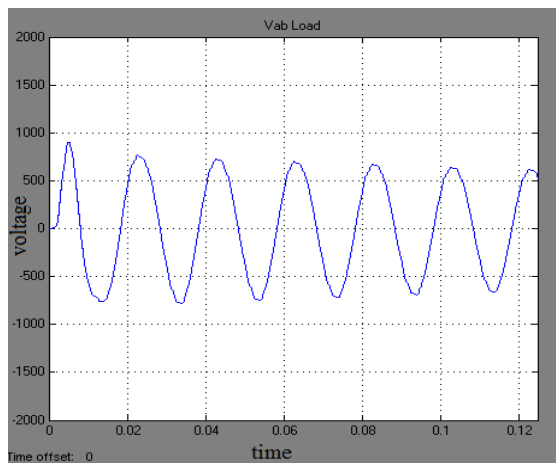


Fig. 9 output voltage waveform of filter system

VII. FUTURE OF POWER HARVESTING

Most of the countries receive 4 kWh/m²/day and PV array is the best way to convert electricity from solar. India can satisfy its power demand due to this future scope of PV based system is very bright in India but project can be most suitable and would be used below to application. In future after increase size of PV array and PV output power.

- This project would be used in farm and well to draw pumps. To use this project in this application requires arrangement which prevents connections to PV module to motor when radiation is below to one level.
- This project may be more efficient if it is integrated with wind mill so wind integrated system found which is more efficient.

- In the most of wind mill induction motor is used which is first driven by power supply and when it rotates then its synchronous speed its work as induction generator and gives power. The starting time need of power is satisfied by government power grid in present time. But in future this starting time need of power would be satisfied by PV system which makes operation of wind mill very efficient.

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