Fuzzy Based Constant Power Generation Two Stage Pv System with Model Based Mppt

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ABSTRACT: Solar panels are used in solar energy to transform the energy produced by the solar power plant system into electrical energy. Nevertheless, because solar PV is so dependent on irradiance, using it as a solar power plant has a drawback, which is the volatility of the power produced. Moreover, the efficiency of energy conversion is also quite low (around 30%). Power instability caused by the solar panels, which rely heavily on irradiance and have a low energy conversion efficiency, is one of the issues with the solar power plant system. The Type II Fuzzy approaches need the Maximum control of Power Point Tracking (MPPT) to tackle this issue. Solar PV operates at the MPP point thanks to this Type II fuzzy MPPT control. Nevertheless, the model MPPT control, which operates at the MPP point, creates overvoltage by making the output voltage to the load the maximum possible. So, the modification of the MPPT type II fuzzy algorithm for Constant Power Generation (CPG) is covered in this research. With the help of this method, you may configure the solar PV system's MPPT mode and CPG mode.

Keyword: Type II fuzzy algorithm for constant power generation (CPG),

1. INTRODUCTION

The widespread usage of fossil fuels has contributed to the issue of greenhouse gas emissions. As a result, solar power generation is becoming increasingly beneficial because it emits less pollution and is becoming more scarce as the price of solar arrays falls. Solar energy has several potential uses in domestic settings. Solar energy cannot be used at night, thus storing in order to have constant energy availability its energy is a crucial concern.

To change dc power into ac power, an inverter is required. In a small-capacity solar power generating system, a dc-dc power converter is utilised since the output voltage of a sun cell array is low. The inverter experiences a power loss due to its active and passive components. Conduction losses and switching losses are both a part of the power loss caused by active devices. The relationship between switching losses and voltage and current is linear. A multilayer inverter's switching action is done to increase the effectiveness of the power conversion process. Theoretically, greater voltage levels should be used when designing multilayer inverters in order to increase conversion efficiency, decrease harmonic content, and minimise electromagnetic interaction. To deliver a high output power from a medium voltage source, a multilevel inverter is required. Medium voltage sources include things like batteries, super capacitors, and solar panels.

2. EXISTING SYSTEM

For pvs with changeable topologies, in the current CPG. The consideration for quality issues and maintenance costs of PVPPs with variable yield voltage is demonstrated by the CPG metres. PVPP is made up of this completed single. with the capacity to regulate the inverter-related structure's yield dynamic power to meet system requirements. Remove the aforementioned burden and two-orchestrate PVPP structure to achieve CPG action voltage disruptive effects. The interleaved dc-dc converter also implements a short circuit current control operation that disregards MPPT and CPG. According to the power voltage (P-V) characteristics of the solar PV board, which is investigating the counts of a voltage increase as a reference for CPG development, With this process, there is no need to modify the dc-dc converter's controller before performing the CPG calculation. Similar to this, the action in a sun-arranged PV board beyond the open hover circuit in voltage in sun-dependent on PV board during rapid changes in irradiance, the action clarification at the back the PV board is shifted to left 50% of the MPP obliges its uses only for two PVPPs. Consequently, one condition for a general estimation of intensity expansion reference of sun-controlled PV board during CPG progression, which can be applied for both single- and two-create PVPPs during cross-zone voltage irritating effects or standard action. The hysteresis band controller is intended to alter how calculations are executed (time-step) and how voltage increases between back-to-back succeeding foci (voltage-step) in order to provide a smart stand-out response and low control while fluctuating the controller's intrepid state activity. Using preoccupation, the offered calculations' accuracy and adaptability are examined. and test underwriting on unique PVPP topologies in a similar way, outstanding power reference turn irradiance.

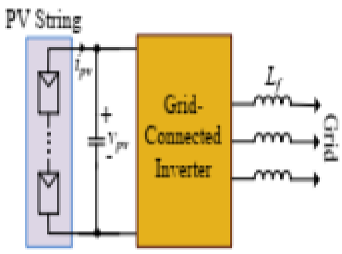

Fig 1: shows the Single-stage power conversion’s structure

3.2 PROPOSED SYSTEM

This project suggested a brand-new MPPT technique that is based on a PV source model. The method creates a new formulation for where the MPPs are. Additionally, the MPPT and CPG algorithms are combined as a secondary goal without the use of any external equipment (storage elements).In order to address the issue of DC-offsets, which arise when the PV power changes dynamically, a novel adaptive DC-link controller is developed. The proposed controller is regarded as a successful remedy for the problematic behaviour of the traditional PI controller. Moreover, it makes the injected currents' transitory stronger. To complete the active and reactive power exchange with the grid, a computationally effective FS-MPC technique is proposed. Also, a weighting factorless approach is used to reduce the DC/AC inverter stage's switching frequency. An efficient backup plan eliminates all grid voltage sensors and estimates voltage based on a control system.

3. PROPOSED BLOCK DIAGRAM

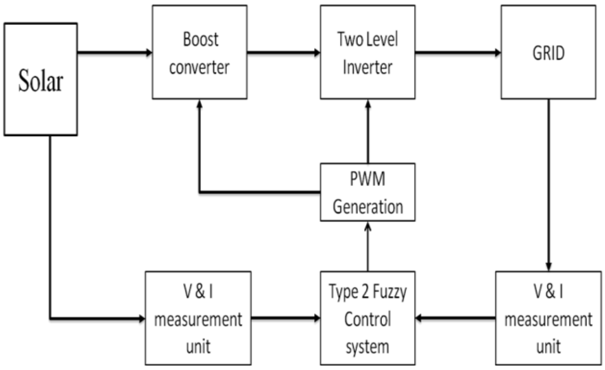

Fig2.Proposed block diagram

Proposed block diagram description

The proposed CPG technique, based on a Type 2 fuzzy logic controller, is depicted above in Fig. 3.1: As sunlight hits a solar panel, DC electricity is generated. Through the use of a DC/DC converter, the solar panel's output will be converted to a steady DC current. The system with the MPPT Type 2 fuzzy -CPG method is modelled on the modelling programme, and the solar PV module is connected to a two level inverter using a DC-DC converter. The grid integration filter, two-level inversion stage, and boost converter. In the part that follows, the PV source model will be examined. It is on this model that the suggested MPPT approach is built. Two states of operation connected to the function of its switch can be used to briefly characterise the boost converter. The converter's advantage is that it makes the PV system's MPPT function possible. the inverter stage connected to the grid.

4. PV EQUIVALENT CIRCUIT MODEL

A group of solar cells that can transform solar energy into electrical energy make up the photovoltaic module. An ideal current source, series resistance, and parallel resistances can be used to represent a PV module. The amount of light that the solar cell gets can be compared to the directcurrent produced by the optimal source of current sources. Resistance in series and parallel exhibits values for leakage current and drop voltage. Fig. 3.2 depicts the photovoltaic cell's equivalent circuit.

A characteristic equation for the current and voltage of photovoltaic modules is developed using the single-diode model.

$$I_{pv} = I_{ph} - I_s\left(e^{\frac{V_{pv}+I_{pv}R_s}{nN_sV_t}} - 1\right) - \frac{V_{pv}+I_{pv}R_s}{nN_sV_t} \quad (1)$$

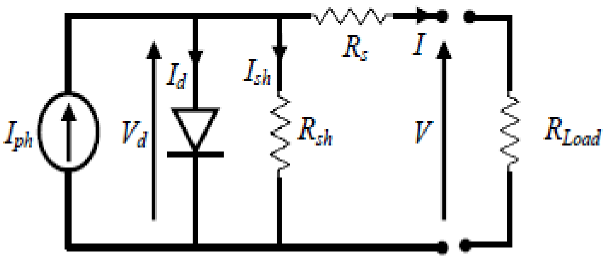

Fig 3: Photovoltaic cell equivalent circuit [3].

5. THE MODEL OF THE TWO-STAGE PV TOPOLOGY

The two-stage PV system is made up of a grid-integration filter, a boost converter, two levels of inversion, and a PV source. The PV source model will be examined in the section that follows, and the proposed MPPT method is based on that model. Two simple operational states connected to the switch's action can adequately describe the boost converter.The MPPT function in the PV system is made possible by that converter. This PV system component's behaviour can be expressed as

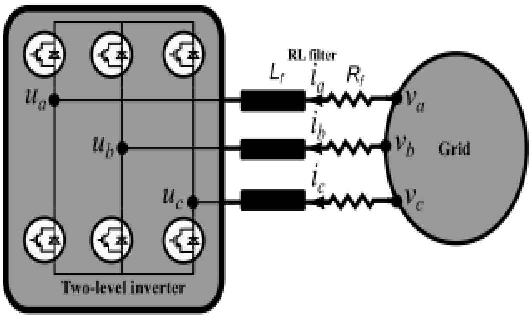

Fig 4: The configuration of the grid-connected PV inverter.

$$v_{abc} = u_{abc} + L_f \frac{di_{abc}}{dt} + R_f i_{abc}, \qquad (1)$$

where Lf and Rf are the filter parameters, vabc are the grid's three-phase voltages, iabc are line currents, and uabc are the inverter output voltages (inductance and resistance). Equation (1) is revised to become in the rotating reference frame (d-q) as

$$v_d = u_d + L_f \frac{di_d}{dt} + R_f i_d - \omega L_f i_q, \qquad (2)$$

$$v_q = u_q + L_f \frac{di_q}{dt} + R_f i_q + \omega L_f i_d, \qquad (3)$$

where the grid's angular frequency is. Moreover, the values of the active and reactive power in the same frame

$$P = \frac{3}{2}(v_d i_d + v_q i_q), \qquad (4)$$

$$Q = \frac{3}{2}(v_q i_d - v_d i_q). \qquad (5)$$

5. BOOST CONVERTER

A boost converter (also known as a step-up converter) is a DC-to-DC power converter that lowers current while raising voltage from its input (supply) to its output (load). At least two semiconductors (a diode and a transistor) and at least one energy storage device, such as a capacitor, inductor, or both, are present in this kind of switched-mode power supply (SMPS). Filters made of capacitors are often attached to such a converter's input (the "load-side filter") and output (sometimes in conjunction with inductors) in order to reduce voltage ripple (supply-side filter). The boost converter can be powered by any suitable DC power source, including batteries, solar panels, rectifiers, and DC generators. One DC voltage to another DC voltage is accomplished through a process known as DC to DC conversion. Boost converters are any DC to DC converters having an output voltage greater than the source voltage. A boost converter may also be referred to as a step-up converter because it "steps up" the source voltage. Due to the need to conserve electricity, the output current is lower than the source current.

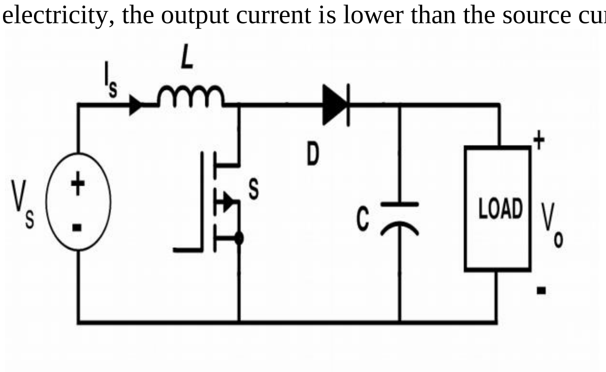

Fig5: Boost Converter

The inductor's tendency to resist changes in current by creating and releasing a magnetic field is the basic tenet of the boost converter. Boost converters always have higher output voltages than they do input voltages. Fig. 1 shows a schematic for the boost power stage.

(a)The inductor undergoes clockwise current flow when the switch is closed, storing some energy by creating a magnetic field. Positive polarity is present on the inductor's left side.

(b) When the switch is opened, current will drop as impedance rises. The previously established magnetic field will be eliminated in order to maintain the current flowing in the direction of the load. As a result, the polarity will alter (means left side of inductor will be negative now). The two sources are connected in series, therefore a higher voltage will be applied to the diode D to charge the capacitor.

If the switch is cycled quickly enough, the inductor won't entirely discharge between charging stages, and the load will always be exposed to a voltage that is higher than the voltage of the input source alone when the switch is opened. While the switch is open, the capacitor attached in series with the load is likewise charged to this total voltage. When the switch is then closed and the right side is shorted off from the left side, the capacitor is able to give the voltage and energy to the load. The blocking diode prevents the capacitor from discharging through the switch at this moment. Naturally, the switch needs to be opened quickly enough to prevent the capacitor from discharging too much.

6. TYPE 2 FUZZY LOGIC

As an expansion of the idea of a regular fuzzy set (henceforth referred to as a "type-1 fuzzy set"), Zaiden (1975) proposed the idea of a type-2 fuzzy set. A type-2 fuzzy set differs from a type-1 set in that the membership grade is a fuzzy set in [0, 1], as opposed to a type-1 set in which the membership grade is a crisp integer in [0, 1]. These sets can be utilised when there is uncertainty regarding the membership grades themselves, such as when there is uncertainty regarding the membership function's shape or some of its parameters. Think about the change from regular sets to fuzzy sets. We utilise fuzzy sets of type 1 when we cannot tell whether an element belongs to a set as 0 or 1. Similar to this, we utilise fuzzy sets of type-2 when the situation is so hazy that we struggle to determine the membership grade even as a crisp number in [0,1]. This does not imply that type-2 fuzzy sets can only be used in circumstances that are moderately fuzzy. The noise in the data makes it difficult to discern the precise shape of the membership functions in many real-world issues, such as time series prediction. Consider type-1 fuzzy sets as a first order approximation to the uncertainty in the real world as another way to look at this.. Thus type-2 fuzzy sets can be thought of as an approximation of second order. In course, higher type fuzzy sets can be taken into account, but doing so quickly makes the fuzzy system more complex. Due of this, type-2 fuzzy sets will only be briefly discussed. Let's look at a few straightforward type-2 fuzzy set examples.

Consider the scenario of a fuzzy set with a Gaussian membership function that has a mean of m and a standard deviation that ranges from [1, 2], $\mu(x)=\exp\{-½[(x-m)/\sigma]^2\}; \quad \sigma \in [\sigma_1,\sigma_2]$ --------------6

Every value of will result in a different membership curve (see Fig6). So, depending on the value of, the membership grade of any given x (aside from x=m) might take any of a number of possible values, i.e., the membership grade is not a precise integer but rather a fuzzy set. The membership function for the fuzzy set associated with x=0.7 is not depicted in Fig. 6, which instead depicts the fuzzy set's domain.

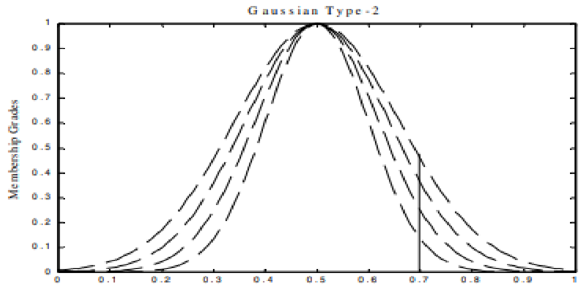

Fig 6: A type-1 fuzzy set with an ambiguous standard deviation represented by a type-2 fuzzy set.

Working of Type 2 Fuzzy logic controller

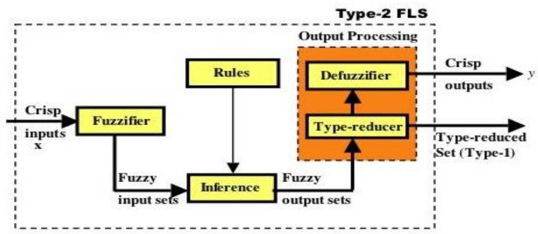

Fig 7: Type-2 Fuzzy tool box

Any one or all of the following types of uncertainty can be quantified using an interval type-2 FLS:

1. Words that are employed in the prefixes and suffixes of rules because different persons can have different meanings for the same term.
2. Uncertain consequences—When rules are derived from a collection of experts, consequences are frequently vary for the same rule, indicating that the experts are not always in agreement.
3. Parameters of the membership function because they are subject to uncertainty when they are optimised using noisy (uncertain) training data.
4. Noisy measurements—since the FLS is frequently activated by such measurements.

In Fig. 7, measured (crisp) inputs are first converted into fuzzy sets in the Fuzzifier block because rules that are expressed in terms of fuzzy sets rather than numbers are activated by fuzzy sets rather than by numbers. In a FLS of interval type 2, three different fuzzifier types are allowed. Measures are made when:

- They are modelled as a flawless pair;
- They are modelled as a type-1 fuzzy set because they are noisy, yet the noise is stationary; and

They are treated as an interval type-2 fuzzy set and are noisy, but the noise is non-stationary (this latter kind of fuzzification cannot be done in a type-1 FLS).

For the continuous power generation converters, a T2FL controller is suggested in order to obtain effective output voltage regulation and dynamic responsiveness. Type-2 fuzzy logic systems include a fuzzifier, rule base, inference engine, and output processor, just like type-1 fuzzy logic systems do. The output processing is where type-1 fuzzy logic and type-2 fuzzy logic systems most significantly diverge. The type reducer translates type-2 fuzzy output sets into type-1 sets as part of the output processing of type-2 fuzzy logic systems, and the defuzzifier maps type-1 fuzzy sets received from the type reducer into crisp data. Hence, compared to a crisp number, the type reduction captures more information regarding rule uncertainty. The membership sets applied by the fuzzifier in these systems are another significant distinction. A type-2 fuzzy set has a fuzzy membership function, meaning that each element's membership value (or grade) is a fuzzy number in the range [0, 1]. These sets can therefore be employed in circumstances when there is confusion regarding the membership grades themselves, such as when there is uncertainty regarding the membership function's shape or some of its parameters..

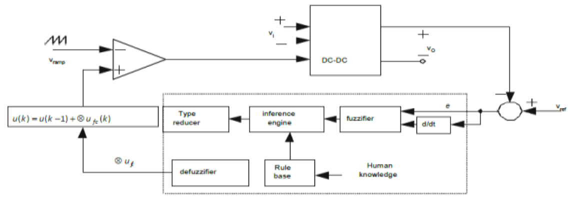

Fig8: Diagram of a type-2 fuzzy logic controller for controlling a steady power source

7. RESULTS & DISCUSSION

Figure 9 below shows a simulation of a two-stage PV system with model-based MPPT that is based on Type-2 fuzzy generation of constant power. We use Matlab 2020 to design.

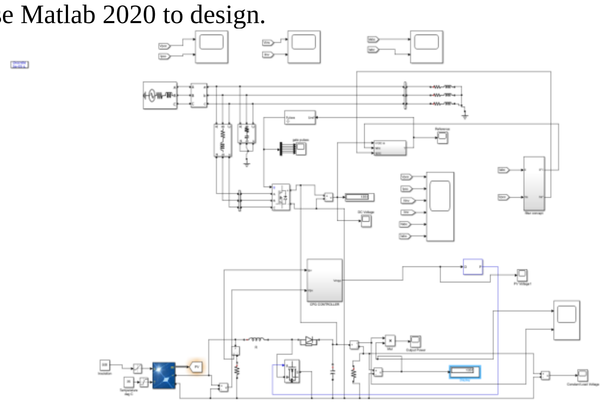

Fig 9: Simulink model in Matlab proposed for 2020

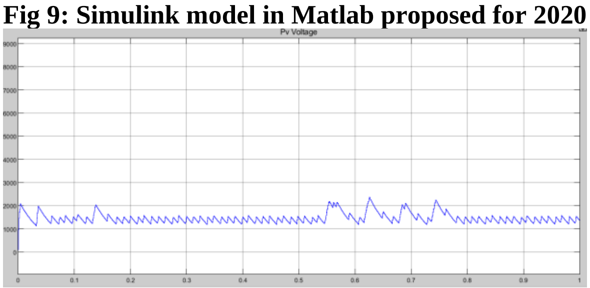

Fig 10: PV voltage

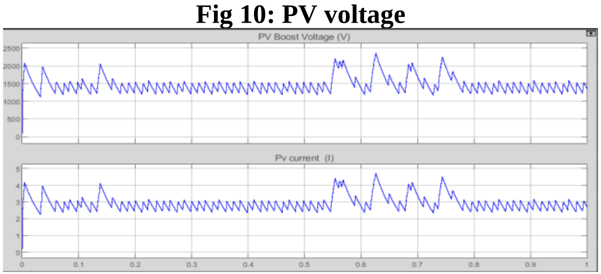

Fig 11: PV Boost Voltage & Current

PV panel voltage and MPPT output for PV Boost voltage and Current are depicted infigures 10 and 11 above.

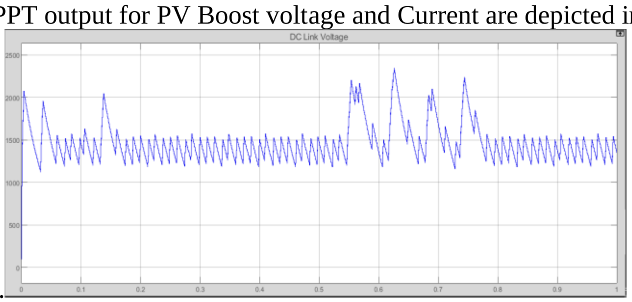

Fig 12: DC Link Voltage

The above image 12 is DC-DC converter to inverter input voltage link voltage.

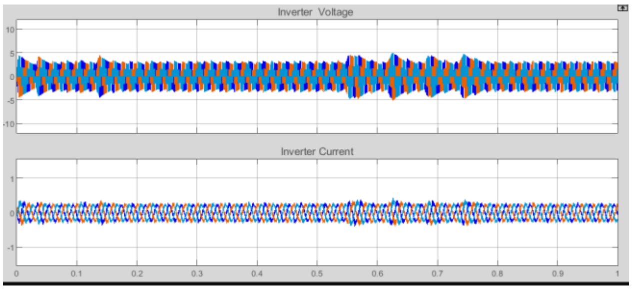

Fig 13: Output inverter voltage and Current in AC

The figure 13 is shown in PV inverter voltage and current in two level inverter output.

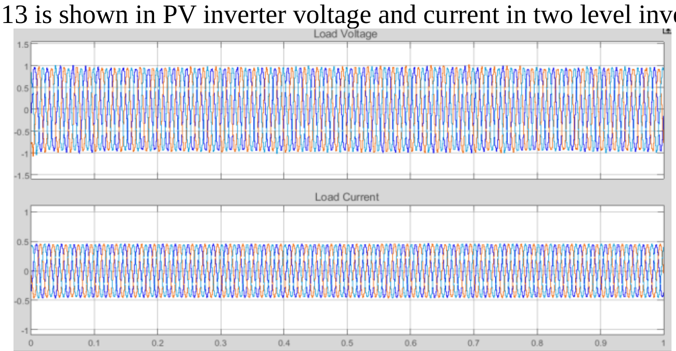

Fig 14: Output Load side voltage and Current

The load side output voltage and current in the constant power approach are shown in image 14 above.

8. CONCLUSION

A more efficient and effective control system is provided by the proposed Type-2 Fuzzy based constant power Generating two stage PV systems with Model-based MPPT. We used the Simulink platform in Matlab 2020 to develop the control system. In addition to the single stage acceptance engine, an MPPT and CPG controller are connected with a clever control method using type 2 fuzzy logic controls to increase the efficiency of the energy transformation. The lift inverter used in this instance has both conservative and specialised advantages over conventional voltage source inverters. On a variety of stressors, reproduction results fall well within the acceptable THD range. This suggested approach offers a few benefits, including reduced overall framework costs, a small footprint, and increased photovoltaic system effectiveness.

9. REFERENCES

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