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A Novel IWD Algorithm Based Stability Improvement of PV- Hydro System

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ABSTRACT: The paper proposes a novel Adaptive Intelligent Water Drop algorithm based on Inference System for Maximum Peak Power Transfer technique for multi-junction solar cells connected to a grid. The multi-junction solar cells can be supposed to provide better efficiency as opposed to their single junction counterparts. IWD based algorithm is designed utilising meta-heuristic approach and weight tuning. The objective functions are formulated using an initial inference and then the weights of the common objective functions are found by using Meta-heuristic approach. Gradient Learning is utilised for tuning. The firing angle's optimal value is calculated and fed to the Boost converter. The converter output is given to a three phase inverter and the inverter output is connected to a grid. The inverter is controlled using a PWM regulator. The results are compared to that of an incremental conductance technique and it is found that the IWD based MPPT performs quite better than its other counterparts in terms of transient state and the magnitude of voltage obtained.

KEYWORDS: MPPT, Multi-junction Cell, PV system.

I. INTRODUCTION

Nowadays, consumption of energy is increasing, idea of exploring renewable energy sources are also growing. Due to our limited energy sources, renewable energy sources are the future. Significant processes are made over the later years in development and research of the renewable power systems such as sea, wind, solar energy and wave systems. With these resources, the sun power energy can be used nowadays as most reliable, and environmental friendly energy source. Although sun power energy systems can be suffer with high costs and low efficiencies. To control these problems, maximum power can be extracted from PV panel while using the MPPT methods to optimize an efficiency of all the PV system. The PV-Hydro technology can be made attractive option because the features various merits like as low maintenance requirement, environmental friendliness and absence of fuel cost. The efficiency of energy conversion a PV generation system may low because sun power cell exhibits to the nonlinear voltage and current and power versus voltage characteristics. These nonlinear characteristics contain weather functions conditions like as panel temperature and solar isolation. This is used to maintain the maximum power point tracking algorithm, efficient operation which can quick response and extract the maximum power from PV arrays in the real time becomes important in PGSs.

Global warming or energy policies may become well-popular idea on international agenda at intervals last years. The developed countries area unit tried to chop the rear of gas emissions. To instance, EU committed to the shrink emissions of gas to low of 2 hundredth below 1990 levels and provide with no however 2 hundredth of energy consumption from the renewable sources by 2020 [1]. While this, electrical phenomenon power generation are often important role to play undeniable fact that it's inexperienced provide. The big emissions area unit associated with the PV power generation unit whose assembly of components. Once the installation generates electricity from star irradiation whereas not emit greenhouse gases. In fundamental quantity, it's around twenty 5 years; PV panels prove heap of the energy for his or her manufacturing [2]. In addition place in places with no alternative different use, like deserts and roofs, or prove to the electricity for remote locations, where the electricity done not any network. The latter kind of installations has understood off-grid facilities and customarily the foremost economical completely different to get electricity within the isolated areas. Hence, most of the PV power generation takes place from the grid-connected



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installations, where facility could feed at intervals electricity network. Actually, it's the expansion of business within the developed countries like Federal Republic of Germany that in 2010 is out and away the world leader within the PV current generation which will be followed by state, USA, Japan and Italia [3]. On opposite hand, the instrumentation is required, power generation PV are often costlier than different resources. Governments unit are often promote with subsidies or feed-in tariffs, expecting the event of the technology therefore at intervals near future become competitive [3]. The Increasing efficiency in PV plants that the facility generated can increase may be a key aspect, as a result of it will increase the incomes, and reduces consequently value of facility created therefore approach the worth of facility made of different sources. The efficiency of PV plant are often affected in main by three factors: efficiency of PV panel between 8-15% [3], the efficiency of converter and therefore efficiency of most electric outlet following algorithmic rule [6]. Rising efficiency of PV panel and thus the converter is not easy as a result of it depends on the technology available, it ought to want higher components that may increase drastically value of installation. Instead, rising the subsequent of most electric outlet with the new management algorithms has simpler, not dear and may well be worn out plants that unit already in use modification the management algorithms, which could lead to an immediate increase within the PV power generation and consequently discount in its value.

A. Maximum Power Point Tracking

Maximum Power Point Tracking Maximum Power Point Tracking, frequently referred to as MPPT, is an electronic system that operates the PV-Hydro (PV) modules in a manner that allows the modules to produce all the power they are capable of. MPPT is not a mechanical tracking system that "physically moves" the modules to make them point more directly at the sun. MPPT is a fully electronic system that varies the electrical operating point of the modules so that the modules are able to deliver maximum available power. Additional power harvested from the modules is then made available as increased battery charge current. MPPT can be used in conjunction with a mechanical tracking system, but the two systems are completely different.

All types of solar installations will benefit by using MPPT technology. The higher the module operating voltage (V_{mp}) the more benefit you will gain by using MPPT. Recreational Vehicles (RV) have very limited roof space for solar modules. If you do not tilt the modules, considerable power is lost in the winter months due to the low angle of the sun. Because of these limitations, it is very important to transfer all the power you can by using MPPT technology. For off-grid systems, MPPT will allow you to wire the PV modules in series for high voltage, even up to 600 volts DC! This is extremely beneficial for long wire runs as the higher the operating voltage, the smaller the wire can be for a given length.

B. Multi-junction solar cell

Multi-junction (MJ) solar cells are solar cells with multiple p-n junctions made of different semiconductor materials. Each material's p-n junction will produce electric current in response to different wavelengths of light. The use of multiple semiconducting materials allows the absorbance of a broader range of wavelengths, improving the cell's sunlight to electrical energy conversion efficiency. Cells made from multiple materials have multiple band gaps. So, it will respond to multiple light wavelengths and some of the energy that would otherwise be lost to relaxation. For instance, if one had a cell with two band-gaps in it, one tuned to red light and the other to green, then the extra energy in green, cyan and blue light would be lost only to the band-gap of the green-sensitive material, while the energy of the red, yellow and orange would be lost only to the band-gap of the red-sensitive material., it can be demonstrated that the perfect band-gaps for a two-gap device are at 1.1 eV and 1.8 eV.

II. PROPOSED METHODOLOGY

It is proposed to use an Intelligent Water Drop model for improvement of the MPPT technique. A model will be simulated in which the algorithm will be implemented and the controller will be included with the load. To simplify the design procedure, numerical method instead of analytical technique is employed to obtain the EML in this paper. For PV panels, the MPP locus can be defined as the point (V_{MP} , I_{MP}), which expresses a function of panel irradiation at a given operating temperature. When the PGS is subjected to a step change in irradiation level, conventional P&O methods require a few perturbation steps to reach the MPPT value. On the other hand, the operation along the EML is carried out by the fast voltage regulating loop. Thus, the tracking time of the proposed method can be greatly reduced.

In addition, this voltage regulating loop is commonly utilized in switching power converters and can simply be implemented using a commercially available pulse-width modulated (PWM) IC in analog form. This paper aims at developing a novel technique based on Meta-heuristic approach for improved performance of MPPT method for solar cells connected to a grid. The design will be made on SIMULINK of MATLAB and algorithm codes will be written in editor of MATLAB. The Meta-heuristic approach will be designed using NN-toolbox of MATLAB.

A. Intelligent Water Wave Optimization

The WWO takes inspiration from shallow water wave models for solving optimization problems. Without losing generality, suppose we have a maximization problem with objective function f . In WWO, the solution space X is analogous to the seabed area, and the fitness of a point $x \in X$ is measured inversely by its seabed depth: the shorter the distance to the still water level, the higher the fitness $f(x)$ is. It should be noted that by analogy the 3-D space of the seabed is generalized to an n -dimensional space. The propagation operator makes high fitness waves search small areas and low fitness waves explore large areas; the refraction operator helps waves to escape search stagnation, and thus improves the diversity of the population and reduces premature convergence; the breaking operator enables an intensive search around a (potentially) promising area. The combination of the three operators provides the algorithm with a good balance between exploration and exploitation.

III. RESULTS

All the simulations have been done in MATLAB R =2015b in a computer having i5 2.20 GHz processor and 8 GB RAM. Figure 1 represents PV-Hydro model with IWD

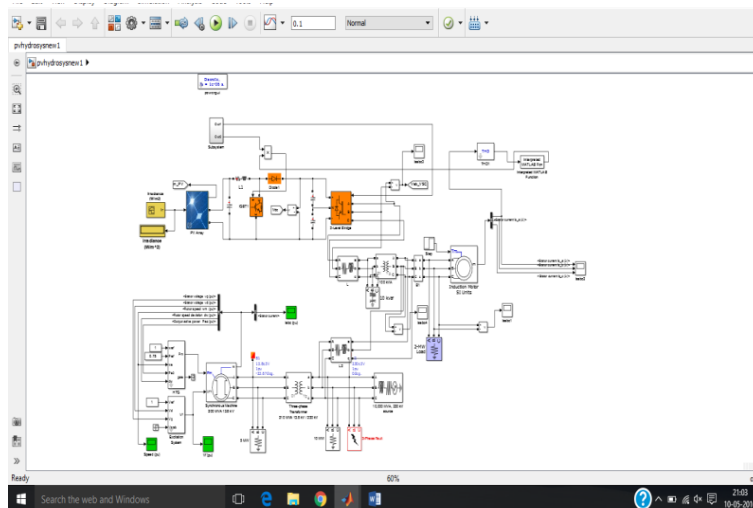


Fig.1: Representing PV-Hydro model with IWD

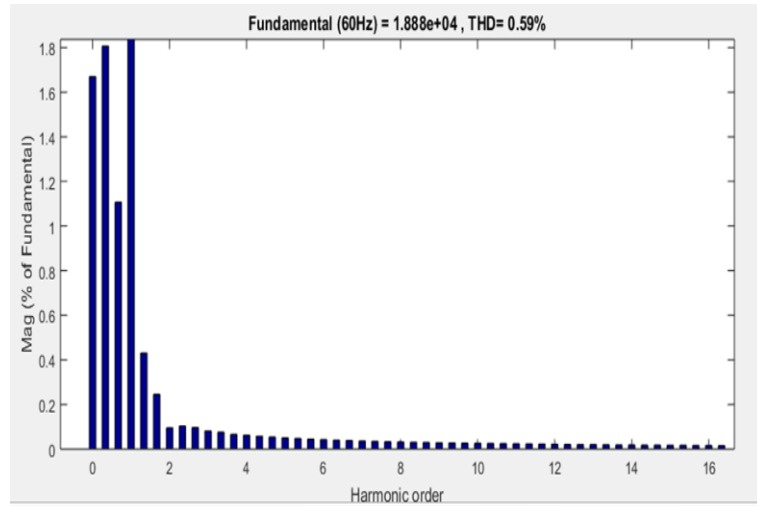


Fig.2: FFT Analysis with IWD of Phase A

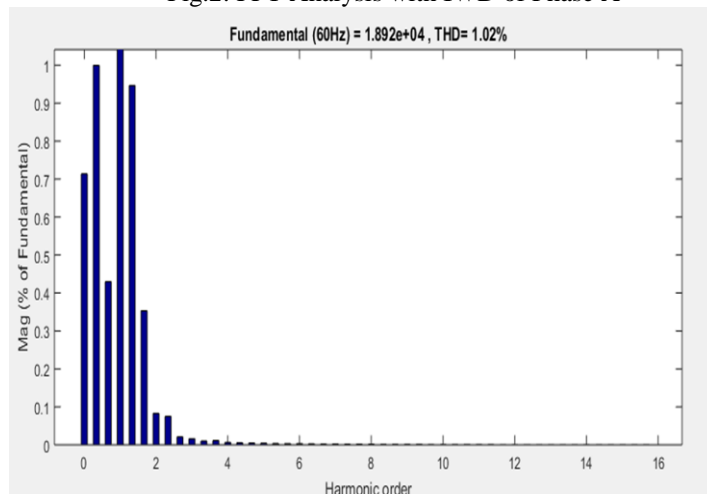


Fig.3: FFT Analysis with IWD of Phase B

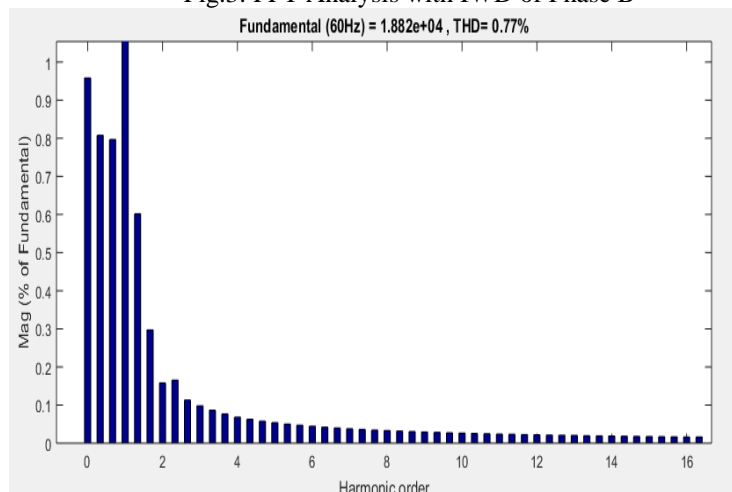


Fig.4: FFT Analysis with IWD of Phase C

THD	Without IWD	With IWD
Phase A	28.88 %	1.91 %
Phase B	20.75 %	1.29 %
Phase C	25.13 %	1.40 %

Table: Comparison of THD

As we can observe from the table that value of harmonic distortion is high when we analysed the solar hydro hybrid system in MATLAB. So, we worked on reducing these distortion values.

III. CONCLUSION AND FUTURE SCOPE

This paper proposed a novel approach of utilising an Intelligent Water Drop approach to solve the MPPT problem in multi-junction PV-Hydro cell connected to a grid using three phase inverter. The result of IWD algorithm was found to be quite better than the incremental conductance technique in terms of output voltage magnitude and THD content. The THD content reduces using our proposed approach. Also when the current is compared, the oscillations die out very fast in case of IWD algorithm while in I&C approach it is more or less sustained.

In future this algorithm can be improved using other techniques. Hybrid with other algorithms can be utilised and the performances can be compared. Also clustering and other gradient learning methods can be utilised and the model can be tested for grid connection.

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