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Efficient Electrical Power Improvement by Oscillating Buoy Wave Energy Converter

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Abstract:

The oscillating buoy wave energy converter which includes output power, annual electricity production and energy conversion efficiency. It is helpful to the performance test of the device and contributes to the dispatch control of the complex power and the study of the stability of the local power grid. To derive the prediction models, it is necessary to analyze the force on the buoy and the heaving motion. On this basis the torque and rotating speed models are given. Then the output power, annual electricity production and energy conversion efficiency models are built. Wave data are imported into the models to be simulated with MATLAB and the predicted values are obtained. Finally, the model of the wave energy converter integrated into power grid is built with Simulink and the results of the simulation verify the correctness of the previous models

***Keywords* — Oscillating buoy wave energy converter; prediction model; output power; annual electricity production; energy conversion efficiency.**

INTRODUCTION

The aspects related to the energy production are becoming extremely important and, between the different technologies, Energy density of wave energy is unevenly distributed worldwide. The energy density of Europe is generally higher than that of other areas like China [2]. The oscillating buoy wave energy converter is more suitable for these areas which have low energy density along the coastline . Some researches on the device have been carried out. In , the effect of shape on the performance of the oscillating buoy wave energy converter was investigated. In the mechanical dynamic equations of the device were derived and the emulation method is presented. But they did not present the prediction of the output power, annual electricity production and energy conversion efficiency [3]. The wave energy converter requires the performance test before being commercialized and output power, annual electricity production and energy conversion efficiency are important parts of the performance test[4]. Real time testing would need a fairly long process. And the stochastic volatility of output electricity of the device will impact on the safe and stable operation of the power system. The prediction of output electrical energy of the wave energy converter can reduce test cycles and the bad effect on power grid[5][6]. However, until now little relative research has been done. In this the force analysis of the buoy of the oscillating buoy wave energy converter and the model of the heaving displacement are presented on the basis of micro- wave amplitude theory and the wave motion equation[7]. The buoy and rack can be regarded as a whole because they are in direct contact with each other. Hence the force on the rack is equal to the force on the buoy. The torque of the gear-rack is deduced in the light of the force on the rack and the heaving displacement. The output power model is proposed in accordance with the models of the rotating speed and the torque[8]. Then annual electricity production model and energy conversion efficiency model are built. Wave data are imported into the models to be simulated with MATLAB and the predicted values are obtained [9]. Finally, the model of the wave energy converter integrated into power grid is built with Simulink and the results of the simulation verify the correctness of the previous models.

LITERATURE SURVEY

Marine energy represents a very promising source of energy available worldwide. Although this energy is available in several forms, wave energy is the more widespread source characterized by high power density. In order to exploit energy from waves, numerous systems have been designed and commercialized. The Inertial Sea Wave Energy Converter is a device based on a floating body slackmoored to the seabed, using a gyroscope as a reference frame to produce electric power. This paper describes the design of the proposed converter equipped with two linear tubular permanent-magnet generators, exploiting the reciprocating motion between the gyroscopic system and the hull to generate power. The design of a two-phase linear tubular generator is analyzed. Experimental tests on a scale prototype have been performed.

Wave energy conversion in most devices is based either on relative oscillation between bodies or on oscillating pressure distributions within fixed or moving chambers. Oscillators generally have pronounced resonances, which enable efficient power absorption in certain wave conditions. In order, however, to cope with the variations of wave spectra a control system can be designed to alter the oscillator dynamics such that the efficient energy conversion occurs in a wide range of wave conditions A wide literature review of recent advance on monitoring, diagnosis, and power forecasting for photovoltaic systems is presented in this . Research contributions are classified into the following five macroareas: (i) electrical methods, covering monitoring/diagnosis techniques based on the direct measurement of electrical parameters, carried out, respectively, at array level, single string level, and single panel level with special consideration to data transmission methods; (ii) data analysis based on artificial intelligence; (iii) power forecasting, intended as the ability to evaluate the producible power of solar systems, with emphasis on temporal horizons of specific applications; (iv) thermal analysis, mostly with reference to thermal images captured by means of unmanned aerial vehicles; (v) power converter reliability especially focused on residual lifetime estimation. The literature survey has been limited, with some exceptions, to s published during the last five years to focus mainly on recent developments. Solar energy is becoming increasingly popular day by day, so are grid-connected solar power generation systems. This proposes a solar power generation system with a seven-level inverter. A DC-DC power converter is used to boost the output voltage of the solar panel, which is controlled using MPPT. The capacitors of the capacitor selection circuit are charged with multiple relationships by the DC-DC power converter. These capacitors serve as input voltage sources for the seven level inverter. The output of the seven level inverter is fed into the utility grid such that the output current is sinusoidal and in phase with grid voltage. The inverter contains only six power electronic switches which is less complex when compared with conventional multi-level inverters. Photovoltaic (PV) power optimizers are introduced in PV systems to improve their energetic productivity in presence of mismatching phenomena and not uniform operating conditions. Commercially available converters are characterized by different DC-DC topologies. A promising one is the boost topology with its different versions. It is characterized by its circuital simplicity, few devices and high efficiency values - necessary features for a Distributed Maximum Power Point Tracking (DMPPT) converter. PV power optimizer designs represent a challenging task since they operate in continuously changing operating conditions which strongly influence electronic component properties and thus the performance of complete converters. An aspect to carefully analyze in such applications is the thermal factor. In this , a necessity to have a suitable temperature monitoring system to avoid dangerous conditions is underlined In addition, another important requirement for a PV power optimizer is its reliability, since it can suggest a useful information on its diagnostic aspects, maintenance and investments. In fact, a reliable device requires less maintenance services, also improving the economic aspect. The evaluation of the electronic system reliability can be carried out using different reliability prediction models. In this , reliability indices, such as the Mean Time Between Failure (MTBF) or the Failure Rate of a Diode Rectification (DR) boost, are calculated using the evaluation of the Military Handbook 217F and Siemens SN29500 prediction models. With the reliability prediction results it has been possible to identify the most critical components of a DMPPT converter and a measurement setup has been developed in order to monitor the component stress level on the temperature, power, voltage, current, and energy in the DMPPT design phase avoiding the occurrence of a failure that might decrease the service life of the equipment. The renewable energy industry has been growing remarkably over the last years and the recent Fukushima nuclear crisis has given a further incentive worldwide. In this context, solar radiation represents one of the most accessible energy resources and the involved industry has seen rapid expansion in the past decade with an ever-increasing share of the electricity-generating capacity. To this aim, both for manufactures and Photovoltaic Plant (PV) management, the assessment of the quality, reliability and electrical performances of their products are becoming more and more important. So, in order to fulfill such requirements, a Failure Modes, Effects and Criticality Analysis methodology (FMECA) has been proposed with the aim to classify the occurrence, the severity and the impact of all possible failure mechanisms on the PV module, which is the fundamental sub-system of the plant. The aim of the proposed approach is to reduce, or eliminate, the impact of potential failure modes before failures occur in the field and it highlights the final effects that show the occurrence of a fault or malfunction. Starting from the results of FMECA, it is also possible to implement suitable architecture of a monitoring system and its metrological characteristics, that can be applied in architecture devoted to Condition Monitoring (CM) techniques.

Research Methodology

The proposed model has been developed considering Energy density of wave energy is unevenly distributed worldwide. The energy density of Europe is generally higher than that of other areas like China. The oscillating buoy wave energy converter is more suitable for these areas which have low energy density along the coastline. Some researches on the device have been carried out. In , the effect of shape on the performance of the oscillating buoy wave energy converter was investigated. In , the mechanical dynamic equations of the device were derived and the emulation method is presented. But they did not present the prediction of the output power, annual electricity production and energy conversion efficiency. The prediction of output electrical energy of the wave energy converter can reduce test cycles and the bad effect on power grid. The model of the wave energy converter integrated into power grid is built with Simulink and the results of the simulation verify the correctness of the previous models. Model able to predict the electrical performance for varies values of concentration factor. The buoy does the reciprocal motion along the wave motion, and the rack is driven to do undulating motion to convert wave energy into mechanical energy. The generator is driven by the rack and converts mechanical energy into electrical energy.

PROPOSED WORK

In this the force analysis of the buoy of the oscillating buoy wave energy converter and the model of the heaving displacement are presented on the basis of microwave amplitude theory and the wave motion equation. The buoy and rack can be regarded as a whole because they are in direct contact with each other. Hence the force on the rack is equal to the force on the buoy. The torque of the gear-rack is deduced in the light of the force on the rack and the heaving displacement. The output power model is proposed in accordance with the models of the rotating speed and the torque. Then annual electricity production model and energy conversion efficiency model are built. Wave data are imported into the models to be simulated with MATLAB and the predicted values are obtained. Finally, the model of the wave energy converter integrated into power grid is built with Simulink and the results of the simulation verify the correctness of the previous models.

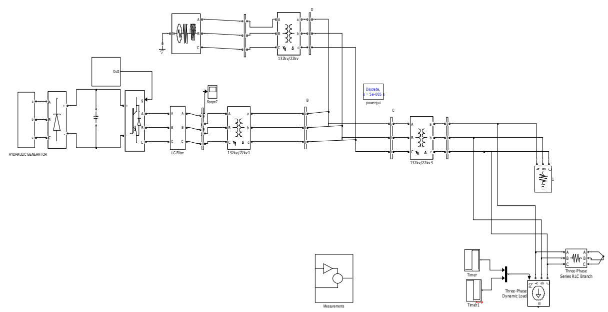


Figure1 Diagram of the System

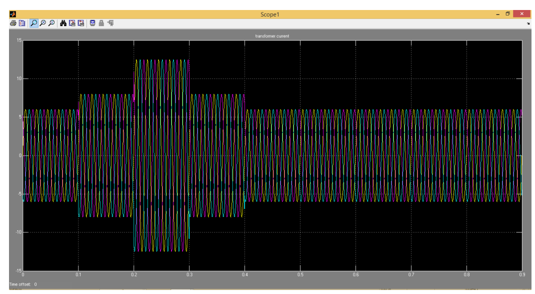


Figure 2. Unimproved wave from

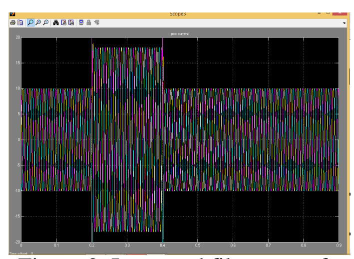
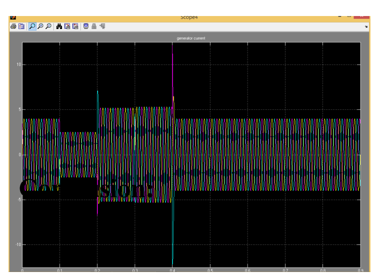


Figure 3. Improved filter wave from



In the prediction models of the oscillating buoy wave energy converter from wave data to the generator are presented. The models are verified by comparing the simulation of the wave data with MATLAB and that of wave energy electricity generating system with Simulink. The focuses on the modeling of output power, annual electricity production and energy conversion efficiency, which contributes to the performance test of the wave energy converter and the construction of the wave energy.

Figure 4. Final improved wave from

The displacement difference is smaller than expected, even for a generator terminal fault that is the biggest perturbation possible in this system. This is because of the inherent inertia and damping terms within the WEC system. This simulation shows how electromechanical events affect the motion of the buoy and demonstrates the bidirectional nature of the model.

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