PV MAXIMUM POWER POINT TRACKING BASED ON SIMPLIFIED FUZZY LOGIC

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To my beloved mother, father and two sisters for their encouragement

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ABSTRACT

The thesis focus is to develop Maximum Power Point Tracking (MPPT) algorithm that based on the Simplified Fuzzy Logic Controller (SFLC). It is known that the output of the PV panel is always fluctuates due to the changes in the irradiation of the sunlight and surrounding temperature. This inconsistency of the output voltage is no good to the load. To compensate the problem, a power converter is used to reduce the fluctuation. However, the efficiency of the power converter is much depends on the maximum power point tracked of the solar panel. Therefore, there is a need for a MPPT algorithm to be implemented in the power converter. In this thesis, Simplified Fuzzy Logic Controller (SFLC) is employed. The proposed of Simplified Fuzzy logic Controller (SFLC) has several advantages as compared to the conventional Fuzzy Logic Controller (CFLC), such as less number of rules and tuning parameters. To verify, full system model is developed in MATLAB-Simulink software and simulated. From the results, it was shown that the features of the proposed Simplified Fuzzy Logic Controller (SFLC) are justified.

ABSTRAK

Tujuan fokus tesis ini adalah membangunkan algoritma penjejakan takat kuasa maksimum berdasarkan konsep kaedah dipermudahkan Pengawal Logik Kabur (SFLC) aplikasi. Dikenalpasti bahawa hasil keluaran panel PV sentiasa berubah-ubah kerana berdasarkan kepada perubahan penyinaran cahaya matahari dan suhu persekitarannya. Ketidakan konsisten perubahan kerap berterusan adalah tidak sesuai untuk beban pada keluaran. Untuk mengatasi masalah ini, maka memperkenalkan litar pernukar kuasa bagi mengurangkan kekerapan perubah-ubahan berlaku. Bagi kecekapan untuk litar pernukar kuasa adalah bergantung kepada penjejak takat kuasa maksimum pada panel PV tersebut. Oleh itu, algoritma penjejakan takat kuasa maksimum perlu ada dalam melaksanakan dalam litar penukar kuasa. Dalam tesis ini, dipermudahkan pengawal logik kabur (SFLC) diperkenalkan. Tujuan kaedah dipermudahkan pengawal logik kabur (SFLC) mempunyai banyak kebaikan berbandingkan kepada kaedah konvensional pengawal logik kabur (CFLC), seperti mengurangkan jumlah langkah peraturan logik dan penalaan parameter. Bagi kenalpastikannya, semua model keseluruhan dibangunkan di dalam MATLAB-simulink perisian dan disimulasikannya. Daripada keseluruhan keputusan, ini menunjukkan tujuan ciri-ciri dipermudahkan pengawal logik kabur (SFLC) telah dijustifikasikan.

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LIST OF SYMBOLS & ABBREVIATIONS

PV	-	Photovoltaic
MPPT	-	Maximum Power Point Tracking
FLC	-	Fuzzy Logic Controller
CFLC	-	Conventional Fuzzy Logic Controller
SFLC	-	Simplified Fuzzy Logic Controller
DC	-	Direct Current/Voltage
MF	-	Membership Function
PWM	-	Pulse Width Modulation

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CHAPTER 1

INTRODUCTION

The world is offering the best natural resources of energy for human being to use it. Such as, sun, wind, ocean current wave, geothermal, biomass and lots more. One of the natural resources is the sun or sun radiation towards the earth atmosphere and surface. Sun had the strong energy onwards on earth around few hundred watts/meter square. In country like Malaysia which had the most sunlight from the sun, around 12 to 13 hours per daylight. This included direct sunlight, temperature and irradiation. Since fossil fuel which will run out sooner nor later, that's why renewable energy now plays an important role to sustain for the usage of household appliances.

1.1 General Background

Research of this project is to develop and analyze PV Maximum Power Point Tracking (MPPT) algorithm that based on the Simplified Fuzzy Logic Controller (SFLC). Solar panel or PV panel will received incoming non linear energy from the sun direct sunlight, temperature and irradiation, which based on the weather condition changes. It's had the wide available free natural clean energy, carbon emission free and environmental friendly. From the PV panel output, will be connected towards Maximum Power Point Tracking (MPPT) algorithm by using Fuzzy Logic Controller (FLC) to determine the algorithm progress process flow execution, and next connected to Boost Converter circuit to increase the output voltage level and retain or decrease output current level at suitable condition. The Fuzzy Logic Controller (FLC) is to reduce the numbers of inputs into one single input, which from conventional method to simplified method. The output of the DC-DC Boost Converter circuit is DC voltage and current. Finally, both of the output is analyzed with the differences of two Fuzzy Logic Controller (FLC) methods applied.

1.2 Objectives

- To develop and analyze PV Maximum Power Point Tracking (MPPT) algorithm by using MATLAB software.
- To analyze the difference between conventional method and simplified method of the Fuzzy Logic Controller (FLC) cum MATLAB software based.

- To optimized and reduce numbers of Maximum Power Point Tracking (MPPT) algorithm by Fuzzy Logic Controller (FLC) concept.
- An able to do simulation and determine the algorithm of Maximum Power Point Tracking (MPPT) by using Fuzzy Logic Controller (FLC) based via MATLAB software.
- To determine and obtain the suitable output DC voltage and current values from the MATLAB simulation results.

1.3 Scope

Solar PV panel plays an important role as one of the renewable energy concept or alternative energy, which determine by it characteristic of current, voltage and power. It's depends on the weather condition that can be changes around day light. Hereby, is to capture input of the non linear current based value of the solar PV panel. Output wise of the solar PV panel are in DC voltage and current values.

Maximum Power Point Tracking (MPPT) algorithm are consist Perturb and Observe or Hill Climbing, Incremental Conductance, fractional open circuit voltage and fractional short circuit current. All the functions of the Maximum Power Point Tracking (MPPT) stated as before, are in order to control the swing of the power maximum values. This is to prevent the power maximum values decrease sharply or rapidly drop neither left nor right of the characteristic Power vs. Voltage curve. On the other hand, by optimize and simplified its algorithm by using Fuzzy Logic Controller (FLC) cum MATLAB software application.

Fuzzy Logic Controller (FLC) is one of the concepts by using MATLAB software application to structure the outline between conventional method and simplified method. Conventional Fuzzy Logic Controller (CFLC) had multiples inputs and outputs or multiples inputs and single output. Simplified Fuzzy Logic Controller (SFLC) had single input and single output. Inside the structure of the Fuzzy Logic Controller (FLC) consist of Fuzzification, Rule base and Defuzzification. Both fuzzification and defuzzification, consist of Membership Functions (MF) either input or output structured. Rule base is an instruction of the process progress between both fuzzification and defuzzification structure, such as "if.....and/or.....then.....". Output of the Fuzzy Logic Controller (FLC) will be sending duty cycles signals to the DC-DC Boost Converter circuit.

DC-DC Boost Converter circuit is to convert or boost minimum DC voltage level at input to maximum DC voltage level at output. In order for it to function, which a duty cycle's signals needed to input to the switching that an able to running the DC-DC Boost Converter circuit accordingly. So that, an able to obtain the suitable maximum DC voltage level as per requirement.

Lastly, it's to analyze the difference both of the Conventional and Simplified Fuzzy Logic Controller from output voltage and current of the simulation obtained. Hereby, both of the end result will shown the similar or/and alike performance for output DC voltage and current.

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