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A controlling method for charging photovoltaic generation power obtained by a MPPT control method to series connected ultraelectric double layer capacitors

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Abstract

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Abstract:
A photovoltaic (PV) generation system which can efficiently acquire the electric energy irrespective of the weather is described. The PV generation system is characterized by two controllers, namely, a maximum power point tracking (MPPT) controller which makes it possible to take the maximum power which solar arrays can generate at any time irrespective of the weather, and a controller which quickly charges the maximum power obtained by the MPPT control to series connected ultraelectric double layer capacitors (ultraEDLCs) while maintaining the electric capacity which solar arrays can generate at that time. The MPPT controller controls the output current of the solar arrays so that the output power converges on the maximum power in the prediction line previously determined based on the linearity between the maximum output power and the optimal current. The MPPT controller is characterized by having the ability to enlarge the controllable range of the output power to lower solar radiation in comparison with the conventional hill-climbing method. The charging controller controls the current and voltage so as to be charged at around the power generated at that time while supervising the maximum voltage and allowable temperature of each series connected EDLC, The combined control method makes it possible to charge with the maximum power generation from solar arrays into ultraEDLCs. Effectiveness of the methods is verified by simulations and experiments.

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Contents

I. Introduction

Studies of photovoltaic (PV) generation systems are actively being promoted in order to mitigate environment issues such as the green house effect and air pollution. PV generation systems have two big problems that the efficiency of electric power generation is very low, especially under low irradiation states and the amount of the electric power generated by solar arrays is always changing with weather conditions, i.e., the intensity of the solar radiation (irradiation). A maximum power point tracking (MPPT) method which has quick response characteristics and is able to make good use of the electric power generated in any weather is needed to solve the former problem. Many MPPT control methods have been proposed that search for the maximum operating conditions from the output power and voltage characteristics of solar arrays using differential techniques like the hill-climbing method or fuzzy rules. However, methods to make the output power generated from the installed solar arrays quickly arrive at its peak value have not been discussed. Although an enhanced hill-climbing method was recently reported [1]–[4], there are difficulties in the algorithms because various parameters are needed during the tracking process. This leads to a larger time to reach the maximum power. A method to refine the response characteristics of the output power was also proposed [2] that searches for the maximum point so that the derivative of the output power with respect to the output voltage of solar arrays becomes zero. However, there are problems in controllability to search for the maximum point at lower irradiation because the derivative of the output power with respect to the output voltage also drops as the irradiation decreases.

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