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研　究　主　論　文　抄　録

論文題目

ANN-POLAR COORDINATED FUZZY CONTROLLER BASED REAL-TIME MAXIMUM POWER POINT TRACKING CONTROL OF PHOTOVOLTAIC SYSTEM

ニューロ・ファジィ制御による太陽光発電システムの実時間最大出力追従制御

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主論文要旨

It is crucial to improve the photovoltaic (PV) system efficiency and to develop the reliability of PV generation control systems. There are two ways to increase the efficiency of PV power generation system. The first is to develop materials offering high conversion efficiency at low cost. The second is to operate PV systems optimally. However, the PV system can be optimally operated only at a specific output voltage and its output power fluctuates under intermittent weather conditions. Moreover, it is very difficult to test the performance of a maximum power point tracking (MPPT) controller under the same weather condition during the development process and also the field testing is costly and time consuming.

This thesis presents a novel real-time simulation technique of PV generation system by using dSPACE real-time interface system. The proposed system includes artificial neural network (ANN) and fuzzy logic controller scheme using polar information. A three layer feed-forward ANN is trained once for different scenarios to determine the global MPP voltage and power. The fuzzy logic with polar information controller uses the global MPP voltage as a reference voltage to generate the required control signal for the power converter. This type of fuzzy logic rules is implemented for the first time to operate the PV module at optimum operating point. The proposed method has been tested using different solar cell technologies such as monocrystalline silicon, thin-film cadmium telluride and triple junction amorphous silicon solar cells. The verification of availability and stability of the proposed system through the real-time simulator shows that the proposed system can respond accurately for different scenarios and different solar cell technologies.

One of the main causes of reducing energy yield of photovoltaic systems is the partially shaded condition. Although the conventional MPPT control algorithms operate well in a uniform solar irradiance, they do not operate well in non-uniform solar irradiance conditions. The

non-uniform conditions cause multiple local maximum power points on the power-voltage curve. The conventional MPPT methods can not distinguish between the global and local peaks. Since the global power point may change within a large voltage window and also its position depends on shading patterns, it is very difficult to recognize the global operating point under partially shaded conditions. From these view points, the effectiveness of the proposed method is demonstrated to solve the partially shaded conditions under the experimental real-time simulation technique based dSPACE real-time interface system for different size of PV arrays, such as 3x3(0.5kW) and 20x3(3.3kW) and different interconnected PV arrays, for instance series-parallel (SP), bridge link (BL) and total cross tied (TCT) configurations.