

考量熱動力學的太陽光電模組完整模型設計與實驗量測驗證

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摘 要

本研究首先推導一種完整的太陽光電模型，可以適用於不同太陽能電池類型，同時這個太陽光電模型包含了電力子模組及熱動力學子模組，完整地描述太陽光電模組的電力輸出特性和熱動力學特性。本文所提出的太陽光電完整模型是用 Matlab/Simulink 套裝軟體實現及分析，考量日照強度和週遭環境條件對太陽能電池的影響，太陽能電池溫度可由日照輻射、週遭環境溫度和風速計算得到，有了電池溫度及日照強度，太陽光電模組的電力輸出特性如工作電壓、輸出電流及功率即可計算得到。最後我們以一組商品化太陽光電模組的電池溫度和輸出功率在真實的工作條件下經由實驗量測，把實驗結果和本文所建立的太陽光電完整模型的模擬結果做比對，比較結果可以證明所提出的模型非常接近實際太陽光電模組的輸出結果，驗證了太陽光電完整模型的仿真性。

關鍵詞：太陽光電完整模型，熱動力模型，電池溫度，Matlab/Simulink

The Design and Experimental Verification of a Complete Photovoltaic Module Model Considering its Thermodynamics

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ABSTRACT

This paper presents a novel complete model for a photovoltaic (PV) module of different cell types, which describes both electricity characteristics and thermal dynamics of PV completely. This study implements and analyzes the proposed model in the Matlab/Simulink environment. Considering the effects of sunlight irradiation and ambience conditions, the cell temperature is explicitly derived regarding sunlight irradiance, ambience temperature, and local wind speed. The cell temperatures and output powers of a commercial PV module are evaluated through a series of experiments in real working conditions. Comparing the experimental results with those simulated by the proposed model, the proposed model is validated and proven to be extremely close to a practical module.

Key Words: complete PV model, thermal model, cell temperature, Matlab/Simulink