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Methods, Algorithms and Circuits for Photovoltaic Systems Diagnosis and Control

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In modern photovoltaic systems, there is an ever-increasing need to improve the system efficiency, to detect internal faults and to guarantee service continuity. The only way to meet these objectives is to utilize and create synergies between diagnostic techniques and control algorithms. Diagnostic methods can be implemented through module-dedicated electronics, by running on real-time embedded systems or by using a huge database on the cloud, profiting from artificial intelligence, machine learning, and classifiers. Model-based diagnostic approaches and data-driven methods are attracting the interest of the scientific community for the automatic detection of phenomena like the occurrence of hot spots, the increase of the ohmic losses, the degradation due to unexpected potentials (PID), switch failures in power electronic converters, and also the reduction of the power production due to soiling or partial shadowing. The detection of malfunctioning or even faults affecting the whole power conversion chain, from the photovoltaic modules to the power conversion stages, allows to perform proper control actions, also in terms of MPPT. Control algorithms, running on an embedded system, are optimized, e.g., through the online adaptation of their own parameters, by suitably processing data coming from the diagnostic algorithms.

This book presents recent and original results about the diagnostic approaches to photovoltaic modules and related power electronics and control strategies with the aim to maximize the photovoltaic output power, to increase the whole system efficiency and to guarantee service continuity.

