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# Fault-tolerant power extraction strategy for photovoltaic energy systems

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**Abstract:** Photovoltaic (PV) arrays are subject to various types of environmental disturbances and component-related faults that affect their normal operation and result in a considerable energy loss. The nonlinear current-voltage (I-V) characteristic curve of the PV array prevents the detection and isolation of the faults and also makes the tracking of the maximum power operating point (MPP) more difficult. Fault detection and identification (FDI) techniques have been proposed to detect the presence of faults and isolate them. Many maximum power point tracking (MPPT) methods have been proposed to find the best operating point in the presence of disturbed environmental conditions. However, existing FDI methods do not consider the tracking of the MPP in faulted operating conditions, and available MPP tracking methods do not consider the occurrence of faults in the PV system. The objective of this study is to propose a fault-tolerant control (FTC) strategy to detect the presence of abnormal operating conditions and reconfigure the MPPT procedure to search for the new suboptimal operating point. The FDI method is based on monitoring the PV panel generated power for the presence of abrupt changes; the MPPT reconfiguration is based on a combination between Incremental Conductance (IncCond) Algorithm and an Improved Current-based Particle Swarm Optimization (ICPSO) tracking technique. Simulation and experimental results show an excellent performance of the proposed FTC method in the presence of various types of faults.

**Keywords :** Fault-tolerant control (FTC), Particle swarm optimisation (PSO), Photovoltaic (PV) arrays, Line-Ground fault, Line-line fault, Partial shading, Maximum Power Point Tracking (MPPT)