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Topic of Research: Fault Tolerant Converter of Multiple Inverter based Photovoltaic System

FINDINGS

The findings from this PhD thesis on the development of fault tolerant converter for photovoltaic system emphasize over the enhanced reliability, and robustness of the system. To improve the system reliability, it is imperative to have a *Fault Tolerant Mechanism* that is capable of handling and mitigating such fault conditions. It is desired that this fault tolerant mechanism must ensure continuity of supply even in the fault events. Conventionally, the fault tolerant technique can be applied either at the converter or component level, with regards to grid-connected PV systems. The proposed technique considers the inverter output data for conversion to 2D image form sothat it can be provided as input to the proposed AlexNet based CNN. Along with AlexNet basedCNN, this thesis explores techniques like ResNet based CNN, and SVDD based fault diagnostic technique.

This thesis also explores the reliability parameters associated with the PV inverter system. A significant component affecting the system reliability is the PV mission profile. As such, it is crucial to understand the guidelines associated with these systems, and defining directions forcalculating the overall lifetime of a grid-tied PV system. Further, a multi-agent twin delayed deep deterministic policy gradient (MATD3PG) technique is implemented for intelligent parallel inverter management, fault diagnostics, and fault-tolerant operation in a grid-tied PV system. Using the multi-agent reinforcement learning (RL) framework, optimal control of theparallel inverter may be obtained, including fault-tolerant operation. The main benefit of the presented approach is that it performs optimal fault-tolerant action without triggering system de-rating. The presented technique enables exact tracking of reference currents, faster responsetimes, uninterrupted supply to the loads, and a seamless transition to the post-fault operation mode.

Collectively, numerical simulations and experimental analysis are performed at the component and systemlevels of the grid-connected PV system to evaluate the applicability of the proposed methods. The concluded findings demonstrate that the suggested fault-tolerant model based on RL approach can make the system more reliable, efficient, flexible and self-healing.

Keywords: Fault detection, Reliability, Fault Tolerant Converter, Power modules, Grid-connected PV system, Condition monitoring, Parallel Inverter control