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AN INTELLIGENT PASSIVE ISLANDING DETECTION AND CLASSIFICATION SCHEME FOR A RADIAL DISTRIBUTION SYSTEM

by

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Abstract

Distributed generation (DG) provides users with a dependable and cost-effective source of electricity. These are directly connected to the distribution system at customer load locations. Integration of DG units into an existing system has significantly high importance due to its innumerable advantages. The high penetration level of distributed generation (DG) provides vast techno-economic and environmental benefits, such as high reliability, reduced total system losses, efficiency, low capital cost, abundant in nature, and low carbon emissions. However, one of the most challenges in microgrids (MG) is the island mode operations of DGs. the effective detection of islanding and rapid DG disconnection is essential to prevent safety problems and equipment damage. The most prevalent islanding protection scheme is based on passive techniques that cause no disruption to the system but have extensive nondetection zones. As a result, the thesis tries to design a simple and effective intelligent passive islanding detection approach using a CatBoost classifier, as well as features collected from three-phase voltages and instantaneous power per phase visible at the DG terminal. This approach enables initial features to be extracted using the Gabor transform (GT) technique. This signal processing (SP) technique illustrates the time-frequency representation of the signal, revealing several hidden features of the processed signals to be the input of the intelligent classifier. A radial distribution system with two DG units was utilized to evaluate the effectiveness of the proposed islanding detection method. The effectiveness of the proposed islanding detection method was verified by comparing its results to those of other methods that use a random forest (RF) or a basic artificial neural network (ANN) as a classifier. This was accomplished through extensive simulations using the DIgSILENT Power Factory® software. Several measures are available, including accuracy (F1 Score), area under curve (AUC), and training time. The suggested technique has a classification accuracy of 97.1 percent for both islanded and non-islanded events. However, the RF and ANN classifiers' accuracies for islanding and non-islanding events, respectively, are proven to be 94.23 and 54.8 percent, respectively. In terms of the training time, the ANN, RF, and CatBoost classifiers have training times of 1.4 seconds, 1.21 seconds, and 0.88 seconds, respectively. The detection time for all methods was less than one cycle. These metrics demonstrate that the suggested strategy is robust and capable of distinguishing between the islanding event and other system disruptions.

Keywords: Distributed Generation, Inverters, Micro-grids, Islanding Detection, Gabor transform