A Novel Passive Islanding Detection Method for Distributed Generation

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ABSTRACT- Off-grid and On-grid are two technologies that allow renewable energy sources to run continuously. The system can be networked in the first scenario, and it can operate independently or as a microgrid in the second. The decentralised generator (DG) can run in island mode even if there isn't an external power supply accessible. This circumstance may prohibit the equipment from correctly joining, endangering the auxiliary system. In order to find island patterns at particular times, this research suggests a passive method. There may be problems with island detection (ID) when using DG systems like P.V. Additionally, the identification accuracy will be impacted by the quantity of DG devices in the power distribution system. The suggested remedy has really been put into practise in a test example involving a network-connected DC power source operating at 415 V and 50 Hz. The MATLAB Simulink environment was used to assess the method's efficacy. This technique speeds up detection and improves the THD.

Keywords: Distribution Generation, Detection Time, Passive, Islanding Detection.

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1. INTRODUCTION

This Many advantages, including fewer carbon emissions, decreased transmission losses, and a more dependable power supply, will result from the widespread adoption of DG[1]. Isolation is a significant concern for utilities whose distribution systems, in part, are still active for DG. Effective techniques of identification categorize islanding episodes brought on by short circuits and other disruptions (such as load coupling) [2]. Except when they result in severe power quality issues [3] like overheating, islands are typically handled using passive technologies with huge dead bands [4]-[6]. Life insurance and property damage coverage. Everyone now wants the DG to be turned off more quickly following an islanding, or within 2000 milliseconds(ms) [7] of a power outage. Several techniques, including passive approaches, SCADA systems, power line transmission systems, and communication-based systems are employed [8].

In communications-based systems [9]-[10], the DG receives an activation signal from telecoms hardware in the case of an islanding event. Although more expensive, this approach is more effective. In contrast, parameters are measured and contrasted with thresholds in passive approaches [11]-[12].

This work employs a fuzzy adaptive rule-based technique [13]-[15] to quickly find islands. To implement the suggested method for system performance verification, a MATLAB/Simulink model was created. The Section 1 gives a brief introduction and next section provides proposed method. In Section 3 discussed about results and last section of this article is provided by conclusion.

2. PASSIVE ID METHOD

This paper proposes a passive ID, as seen in *figure 1*, the DC power source is coupled to a network of 415 V and 50 Hz. The detection time is lengthened by the suggested strategy. *Table 1* displays the test case's parameters.

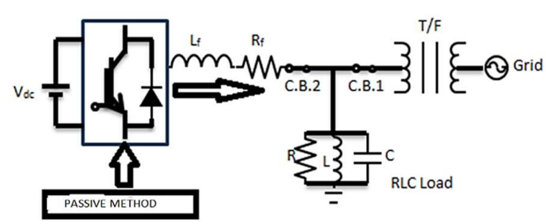

Figure 1: Recommended Test case

Table 1: Parameters for a Recommended Test Case

Parameter	Value
Inverter output Voltage	415 V
Grid Voltage	415 V
DC Link Voltage	600 V
Load	8 kW

The limitations of fuzzy spanning tree rules serve as the foundation for the idea of fuzzy membership.

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Think about the voltage and frequency variables that make this strategy effective. This method assumes a maximum voltage limit of 1.1pu, a minimum voltage limit of 0.88pu, and a maximum frequency limit of 50.50 Hz, a minimum frequency limit of 49.30 Hz. Above or below these voltage and frequency thresholds, decay might happen. The proposed method is schematically displayed in *figure 2*.

Numerical data and homogeneous sets are combined to create general rule-based fuzzy models. This setting offers very smooth brainwashing and low-level audio system description. The use of a common reorganization method is suggested to decrease the number of model sets. Comparative clauses make up dominant modal clauses, which eliminate other clauses from their formal ground. This group of initiatives could be strengthened to produce clear recommendations and hence fewer restrictions. The input and output membership functions are displayed in *figure 3*. In *table 2*, the fuzzy rule basis is displayed.

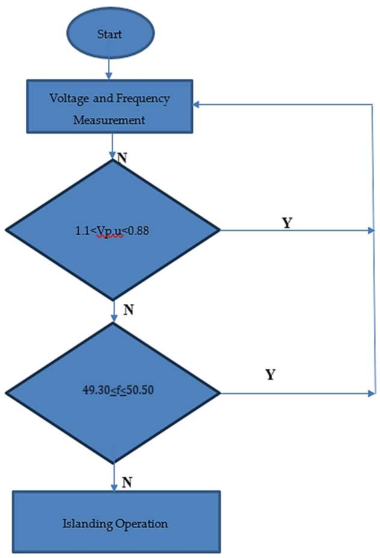

Figure 2: Proposals for adaptive algorithm

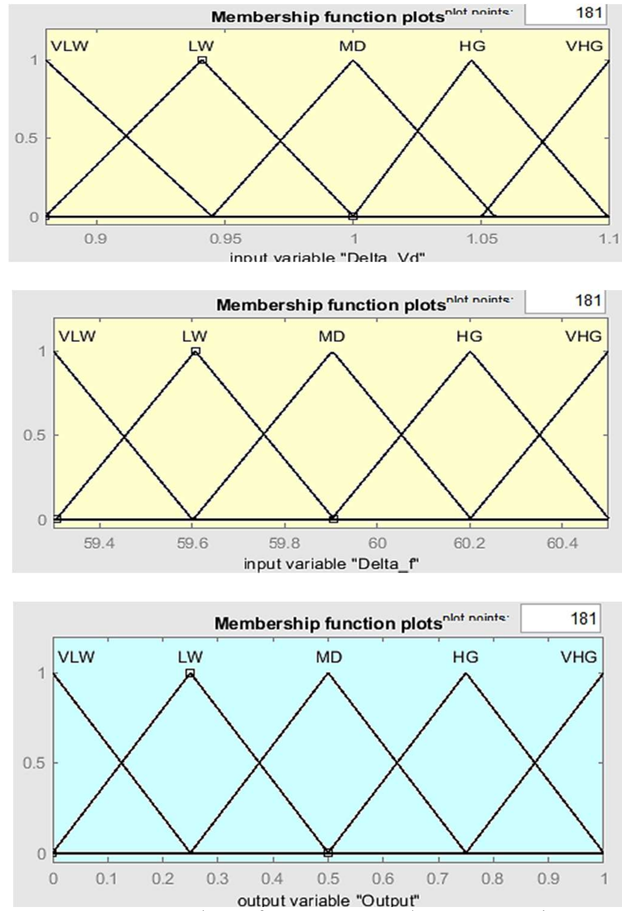

Figure 3: Members of Fuzzy Input and Output Functions

Table 2: Fuzzy Rule Base

Δf /ΔV	VLW	LW	MD	HG	VHG
VLW	VLW	LW	LW	MD	HG
LW	LW	LW	MD	MD	HG
MD	LW	LW	MD	HG	HG
VHG	MD	MD	HG	HG	VGH
HG	VLW	LW	LW	MD	HG

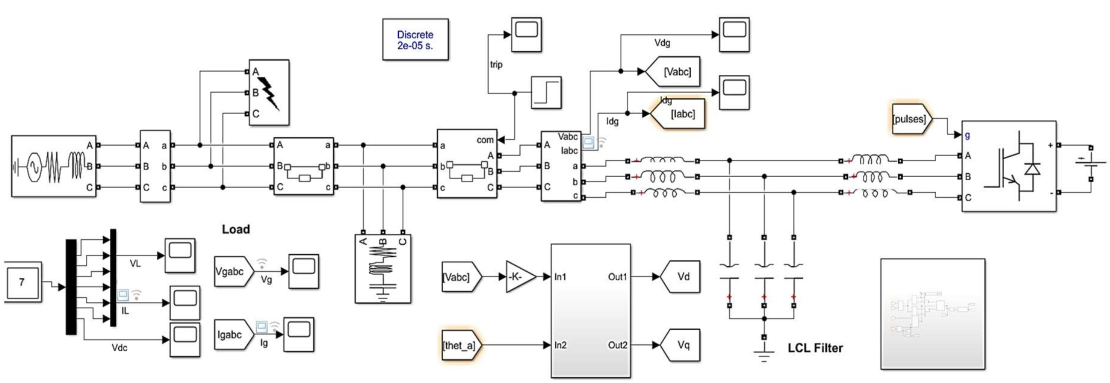

Figure 4: VSI-based MATLAB Simulink DG model

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The *figure 4* shows the simulation diagram of the proposed method.

3. RESULTS AND DISCUSSION

In the passive ID approach applied to the test case is shown in *figure 1*. grid current, grid voltage, DG inverter output current, DG inverter output voltage, load current and load voltage before disconnection are shown in *figure 5 to 10*.

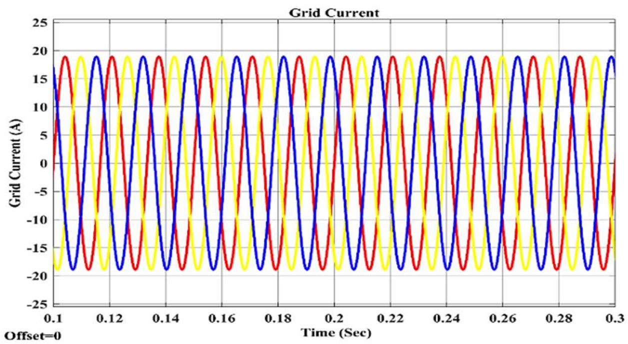

Figure 5: Grid Current just before an island

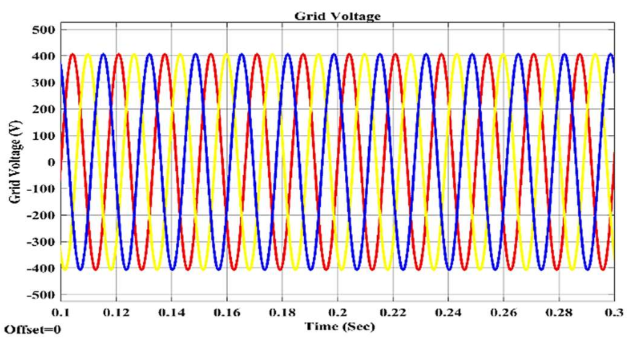

Figure 6: Grid Voltage just before an island

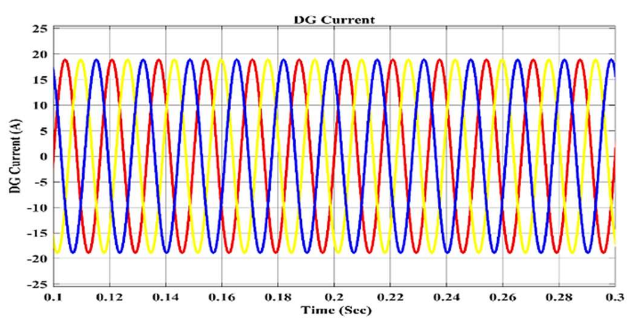

Figure 7: DG Inverter output current just before an island

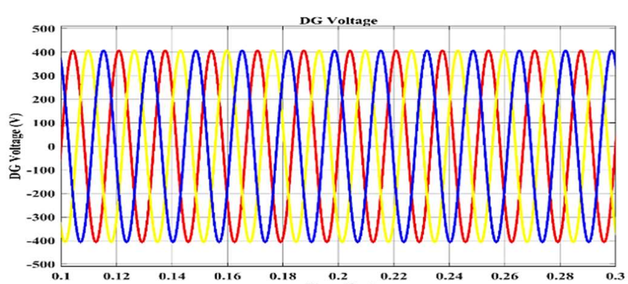

Figure 8: DG Inverter output voltage before islanding

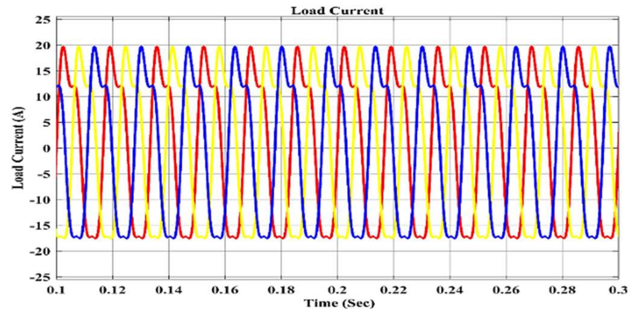

Figure 9: Load Current just before an island

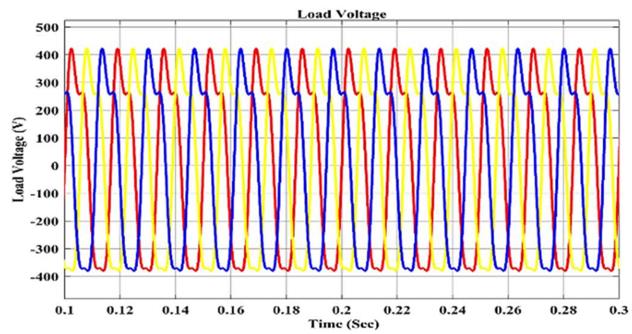

Figure 10: Load Voltage just before an island

All of the above waveforms maintain a constant amplitude. Opening the switch creates an island for 0.15 sec. The grid voltage after islanding and a voltage increases after 0.15 sec due to presence of inductor is shown in *figure 11*.

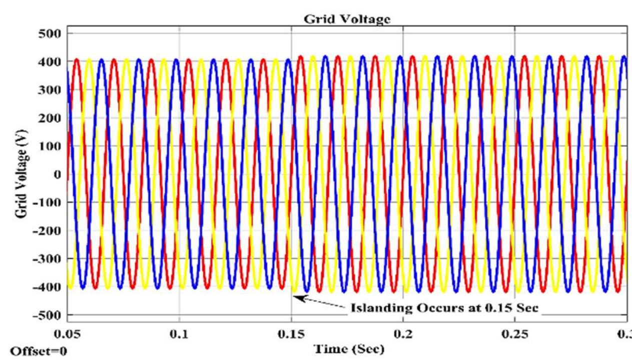

Figure 11: After islanding, the grid voltage

Figure 12 shows the grid current after isolation.

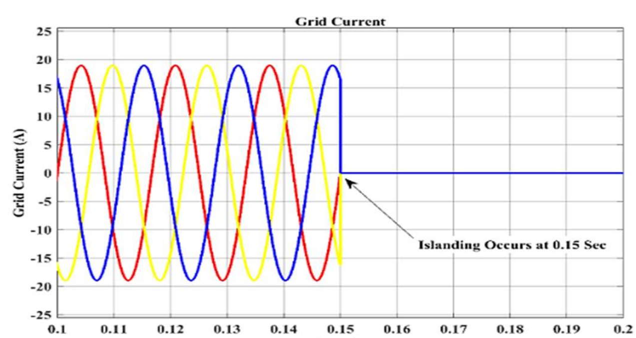

Figure 12: After islanding grid Current

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The output voltage of the DG Inverter after isolation is shown in *figure 13*. The DG provides supply to load up to 0.41sec after that DG is disconnected.

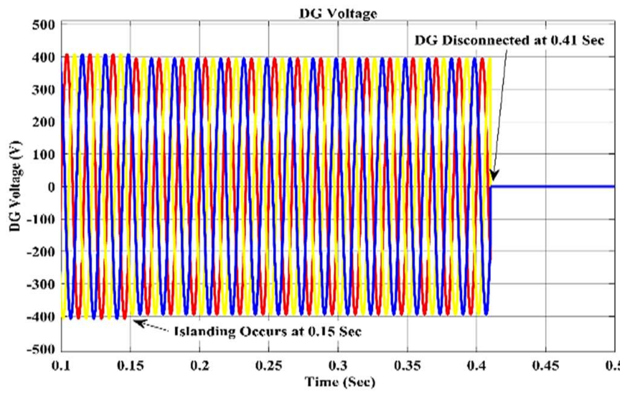

Figure 13: After islanding, the DG Inverter voltage

The output current of the DG Inverter after the island is shown in *figure 14*. There is a slight drop after islanding of 0.15sec, islanding is detected at 0.41 sec, and the ID time is 260ms.

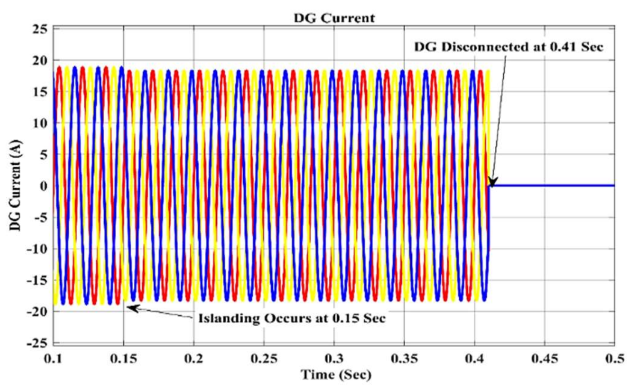

Figure 14: After islanding, the DG Inverter current

The load voltage after islanding is shown in *figure 15*. The load is received supply up to 0.41sec after that it becomes zero.

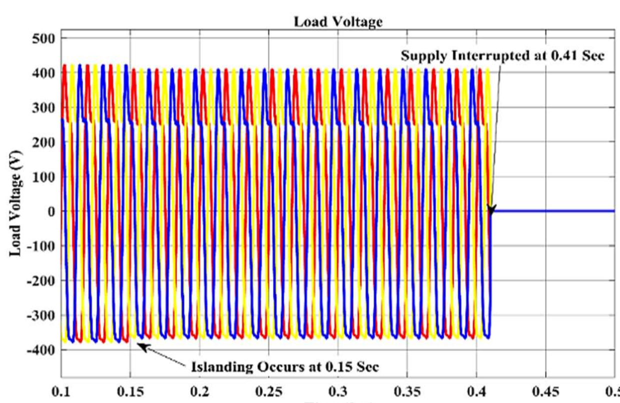

Figure 15: After islanding, the Load voltage

The load current after the island is shown in *figure 16*. The load is received supply up to 0.41sec after that it becomes zero.

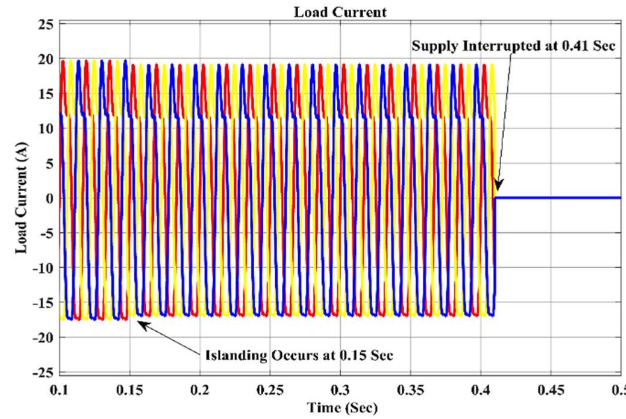

Figure 16: After islanding, the Load current

The grid and load current THD are shown in *figure 17* and *18*.

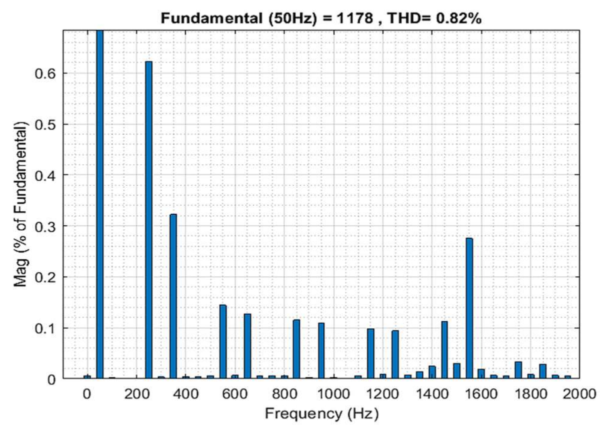

Figure 17: Grid current THD

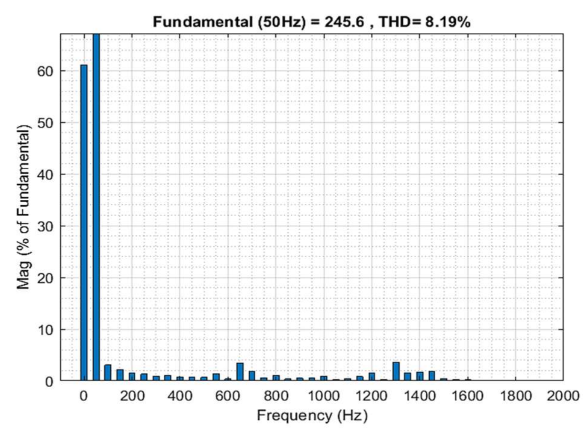

Figure 18: Load current THD

The THD of Load and grid current are 8.19 % and 0.82 %.

Table 3: Comparison Results

Parameter	Voltage Phase Angle [11]	Voltage Positive Feedback [7]	1.Change in Voltage 2.Change in Frequency [Proposed Method]
ID Time (ms)	2000	500	260
Grid Current THD	5.78%	5.14%	0.82%
Load Current THD	12.85%	10.81%	8.19%

The table above shows the comparison with existing passive methods in terms of detection time and THD.

4. CONCLUSION

The proposed a novel passive IDmethod is applied to a test scenario involving a DC power supply connected to a 415 V 50 Hz power supply from the public grid. The island was created using a circuit breaker at 0.15 sec. The passive method detects the island in 260 ms, disconnected the DG in 0.41 sec, and then shuts down the load. Compared with the existing passive methods, the THD of the grid and load currents are 0.82% and 8.19%. Complexity of the controllers improved by machine learning based techniques in future scope.

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