Design Simulation and Performance Analysis of Soft Computing Based Islanding Detection System

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Abstract— In recent years, worldwide energy demand has been exaggerated. In addition the lack of adequate transmission capacity, exaggerated transmission and distribution misfortunes and the release of power advertising have been turned into an inspirational power driving the concept, Distributed Generators (DGs). Dispersed age unit (DG) slash hack expansion and mainly regional units linked to distribution to power the system yet to be hundreds of locals[1]. Distributed generation (DG) provides numerous endowments; energy loss decrease throughout force transmission and reduction in the size and scope of electrical cables. Use of the DGs with the present force distribution arrangements may improve the intensity standard by reducing power quality and other issues. The electricity standard is a partner degree that increases concerns for electrical services and their customers during the recent deca. Quality of helpless force is recognised for the variety of aggravations such as diminution of voltage, swelling, imprudent and intermittent homelessness, numerous results, short interference, sounds and voltage shimmers, etc. Methods for locating the system include either moving the boundaries of the system to accept changes in voltage, recurrence that significantly spread throughout the grid removal, or detecting system boundary changes within the islanded DGs through the presentation of small aggravations within the grid activities (dynamic procedures). Current study involves the detection of soft computing classification based on fumbling logic design. In addition, a detection system is presented based on the method of recognition of neural network patterns. The proposed algorithm is superior to contemporary active and passive islanding conditions The proposed algorithm is also created with the help of the proposed algorithm.

Index term: DC-DC power converters, photovoltaic cells, maximum power point tracker, multilevel and single phase inverter, Wind Energy, Solar PV, Grid Connected Energy System

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I. INTRODUCTION

The new power generation sector is being driven today by technology technology, environmental policy and expansion in the financial and energy markets[9].

The generation of small electricity plants is possible with new technology. Furthermore, with the objective of reducing the environmental impact of power generation, renewable energy sources are increasingly used and new power supply solutions are developed and applied. This generation is not just a level 1 part of this new concept. Therefore, centralised generation provides some energy requirements, and distributed production generates another part of this. Power is produced near the customer.

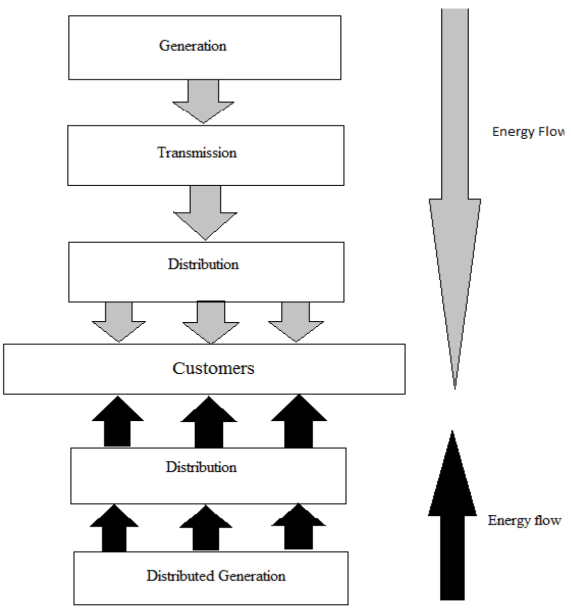

Figure 1.1 New industrial conception of the electrical energy supply

Distributed generation is a small power generation technology used in order to supply power at or near the loading site, either directly connected to the distribution system, or both connected directly to the customer's facility. Studies have shown that the power distribution capturing up to 20 new percent or 35 gigawatts (GW) of electricity in the next 20 possible years has. Small gas turbine generators (even a microturbine), interconnected internal combustion engines and generators, fuel cells, photovoltaic panels, are part of DG Technical Art. Other technologies include the conversion of solar thermal, stirling engine and biomass are considered DG. DG is confined to power units below 10 MW in this article. In this article

DG can offer to utilities and customers a range of services, including back-up power, peak capacities, peak allocation and base load or a combined heat and power supply on a particular website. Fewer obvious advantages include VAR support, voltage support, network stability, spin reserve and other economic advantages which eventually end up with simpler energy than expected loads. In order to significantly reduce one or more of the contaminants common to carbon-fired generation, the environmental benefit of DG technology art can be derived from real green electricity in Voltaic (ie the photos). For example, the DG natural gas emission of sulphur (So 2 turbine generator emissions, for example) is less than a quarter of a kind of a natural gas, of nitrogen oxides (of NOX 1 percent) or less (CO's2 carbon dioxide) and is 40 percent low in many new coal fired boiler power plants.

The following are some of the current DG technology art available: photovoltaic systems, wind turbines , fuel cells, micro-turbines, and generators.

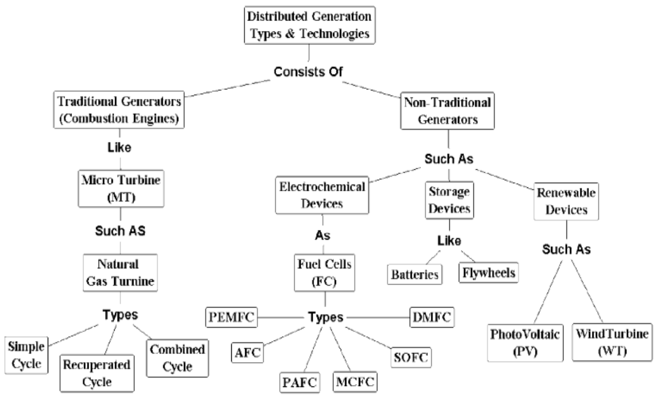

Figure 1.2. Distributed generation types and technologies

These types of DGs must help each other to make a more appropriate comparison of different situations. The converter is applied to convert a load of alternating current (AC) from the direct current (DC) generated by the solar panel. Today , numerous market investors rely on battery and network connexions. The magnitude of the expected power level to be processed needs to be determined by the investors and is compatible with network conditions. JS mounting systems, wired wiring, switches, disconnectors and system monitors are other components. These components were not thoroughly studied. At least high strength losses and costs should be maintained for the use of DC cables[39]. There is also a connecting box between the matrix and the converter fuse for the central inverter to protect against overload voltage. The grid itself is like an endless energy store in a network system. The grid may be supplied with excess energy.

II. ISLANDING

The islanding situation is the situation where a distribution system is being powered by DG and is isolated electrically from the rest of the power system. As Figure1.4 shows. In the case of a failure in the transmission line upstream, a distribution system traditionally has no active source of power, but DG is no longer valid for this assumption. Current practise is that in case of islanding, nearly every utility needs to disconnect DG from the grid as early as possible. The IEEE 929-1988 standard[24] requires that the DG be disconnected once it is is islanded. The shutdown of the utilities grid may cause generators to be insulated during maintenance on the utility grid. The loss of the grid is known to be voluntary. The accidental shutdown of the grid is of greater interest to unintentional islanding. As with unintentional islanding, there are various problems. In IEEE 1547-2003,[25] a maximum 2 seconds delay to detect unintended islands is set and the distribution system is ceased to be energy-intensive for all DGs.

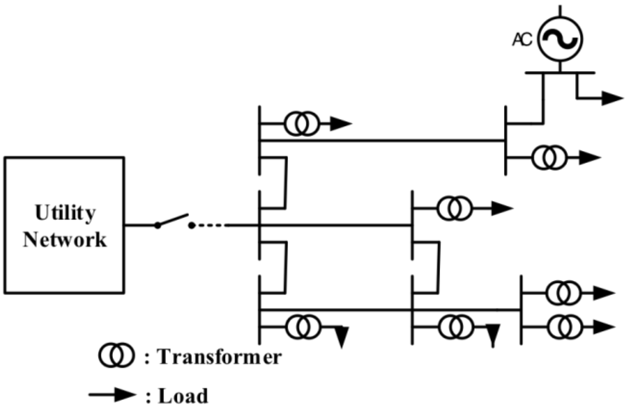

Figure 2.1 Scenario of Islanding Operation

Although the islanding operation has some advantages, there are also some disadvantages. Some of the following are:

• The safety of line workers may be jeopardised with the feeding of the system by DG sources following the initiation or tagging of primary sources.

• The voltage and frequency must not be kept at the permissible standard level. The DG interconnection may not be sufficiently based on the insulated system.

• Instant reclosure may lead to DG being reclosed out of phase. Due to large mechanical torques and streams which can damage generators or primary movers [26], transients that potentially damage the utilities or other customer equipment are developed. They are also generated. If a phase is re-secured, the crest overvoltage can approach 3-fold rated voltage when it occurs at a voltage peak, a very severe capacitive transient switching is generated.

• The degradation of electrical components as a result of voltage and frequency drifts are several risks resulting from this. It is important, because of these reasons, to quickly and precisely detect the islanding.

The principal philosophy for the detection of an insulated situation is to monitor the DG output parameters and system parameters and/or decide whether the change in these parameters caused an insulated situation or not. Islanding techniques can be broken down into local and remote techniques, as can local technology be divided into passive, active and hybrid techniques as shown in Figure 2.2.

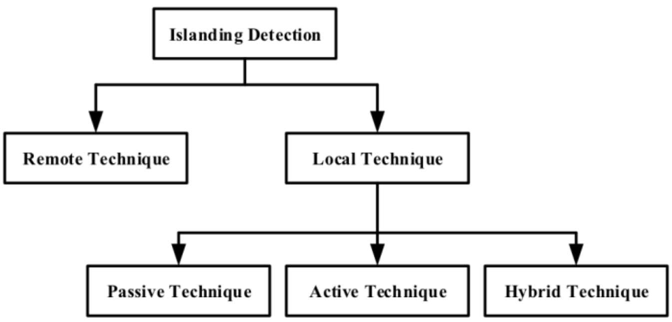

Figure 2.2 Islanding Detection Techniques

Remote detection methods for islanding are based on communication between utilities and DGs. Although these techniques may be more reliable than local techniques, the implementation of these techniques is costly and therefore uneconomic.

These techniques transmit isolated or uninsulated information on the power lines using the power line as a carrier of signals. The device comprises a signal generator (25 + kV) connected to the network where a signal as shown in the figure is continually broadcasting. Because of the low-pass philtre nature of an electricity system, signals must not interfere with other carrier technologies such as automated metre reading, close to or under the basic frequency. In order to receive this transmitted signal each DG will be equipped with a signal detector. The signal is received by DG and the system remains connected in normal operating conditions. However, if there is an island state, the signal transmitted is disconnected due to the opening of the substation breakers and the DG can not receive the signal indicating an island state.

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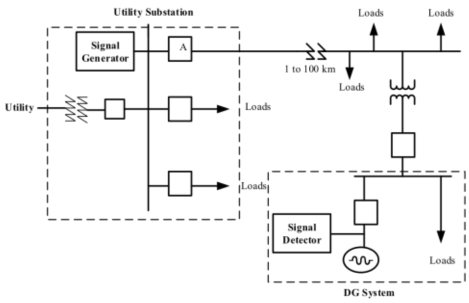

Figure 2.3: Distributed Generation power line Signalling Islanding Detection

The advantages of this method are their simplicity and reliability. Only one transmission generator is needed in a radial system, which can continuously transmit a message to many DGs in the network. When the connecting breaker has opened or a line failure is present that corrupts the signal transmission, the only time the message is not received. This method also has several major disadvantages, with the practical implementation as a priority. A high voltage transformer is required to connect the device to a substation. The cost barriers associated to a transformer of this voltage capacity can be particularly unwanted for the first DG system installed on the local network. Another drawback is the application of the signalling method in a non-radial system , which results in multiple signal generators being used.

III. PROPOSED METHODOLOGY

The strategy proposed constructs a fuzzy standard classifier that is tried to use highlights in a distributed generation for island location. The underlying grouping limits can be found using the selected tree (DT) in the created method. The fouzzy inscription capacity (MFs) is created from the DT order limits and the related rule base is foreseen in order to be insulated. However, a portion of the fuzzy MFs depend on comparability, which reduces fugty MFs and streamlines the fuzzy standard base, to make it ever simpler. The generated fuzzy principle based grade shows the strength of the proposed method of isolating the distributed generation in distribution network, using highlights up to a sign-to-clamor proportion of 20 dB, and gives arrangement results without misdetection.

Redundancy may exist in the form of similar fuzzy sets of compatible concepts in fuzzy, rule-based models acquired from numerical data. This leads to a complex and unnecessarily transparent system linguistic description. A method of simplification of the rule base that reduces the number of fuzzy sets in the model is being proposed using a measure of similarity. Similar fuzzy sets are fused into one common fuzzy set for the rule base substitution. When the re-dundancy within the model is high, fusing similar fuzzy sets could lead to the same rules which can also be fused, thus reducing the number of rules..

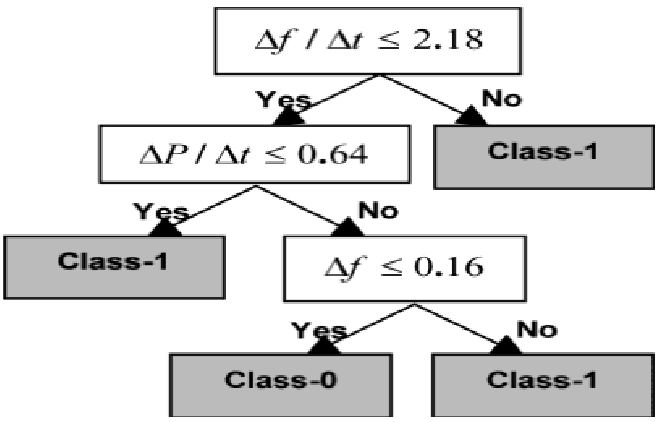

Figure 3.1 Decision Tree for Fuzzy Inference System

The proposed fuzzy guideline base is seen as precise and powerful for islanding identification for wide varieties in oper-ating boundaries of the distribution network. Despite the fact that the DT-fuzzy-based methodology gives comparative outcomes contrasted with DT just (for our considered database), the fuzzy change assists with improving the interpretability of information based clas-sifiers through its semantics that give knowledge in the classifier structure and dynamic procedure over fresh classifiers. If there should arise an occurrence of DT just utilized for the islanding location task, the plan depends on a disconnected dynamic procedure (an information mining approach) where last usage depends on the edge estimations of the relating highlights of DT yield. Be that as it may, in the proposed approach, DT is utilized for choosing most.

IV. SIMULATION & RESULTS

The we have simulated islanding detection system on feature extraction and fuzzy inference system for interconnected micro grid system. The simulation has been carried out on MATLAB 2011a software and the Simulink mathematical model and fuzzy system was developed on Sim power system toolbox. The overall description of results have been classified into following sub cases.

Description of Simulated Results-

- Simulation and design of micro grid system.
- Mathematical modelling of feature extraction from the micro grid.
- Design Simulation of fuzzy inference system for micro grid.
- Simulation of test cases for the analysis of accuracy of islanding detection system.
- Analysis of test cases through output of fuzzy inference system.
- Comparative assessment of proposed method with resepct to different operating conditions.

The first stage of simulation involves the modelling of grid connected system (microgrid) in matlab Simulink and creation of operating conditions leading to normal mode of operation and islanded mode of operation. The simulated mathematical model has been discussed in figure given below. The figure 4.1 to 4.6 explains the simulated mathematical model with various mode of operational conditions in grid connected system leading to normal mode of operation and islanded mode of operations. The detailed mode of operations and set of value is explained in table 4.1.

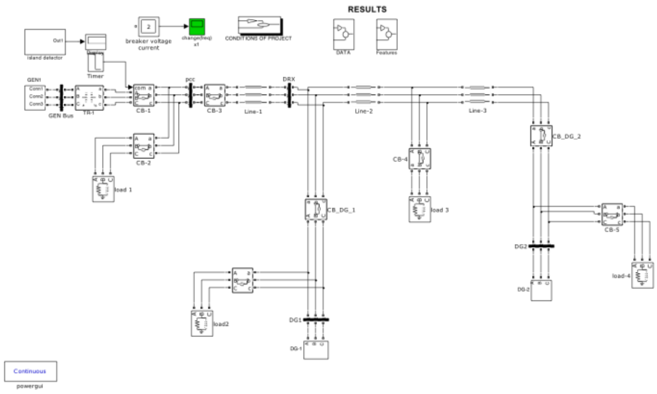

Figure 4.1: Detailed Simulation Diagram for Condition 1

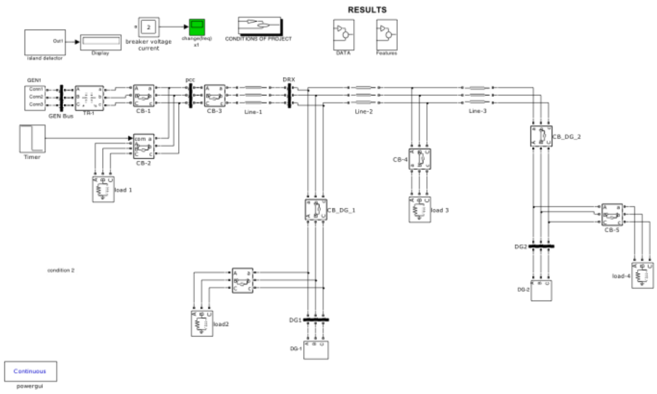

Figure 4.2: Detailed Simulation Diagram for Condition 2

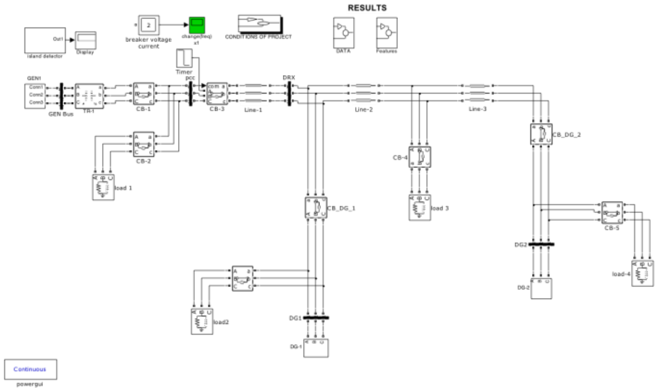

Figure 4.3: Detailed Simulation Diagram for Condition 3

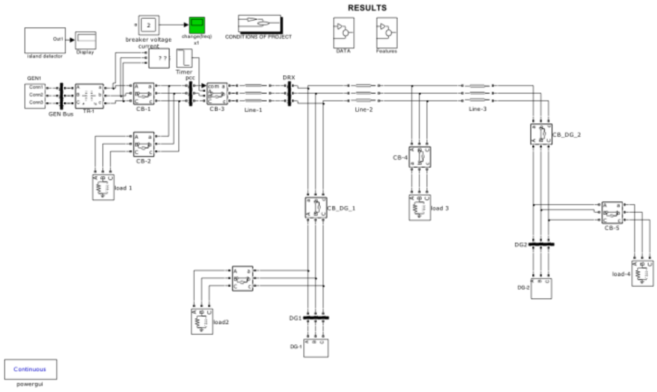

Figure 4.4: Detailed Simulation Diagram for Condition 4

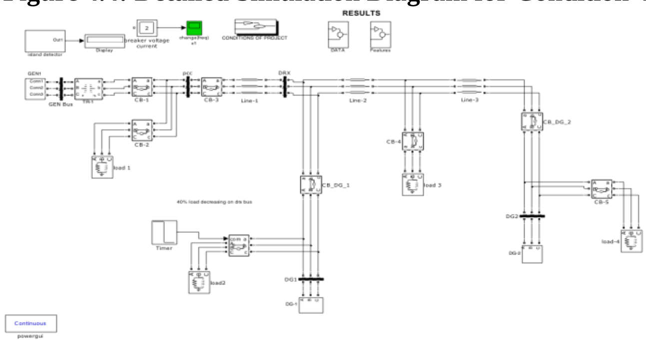

Figure 4.5: Detailed Simulation Diagram for Condition 5

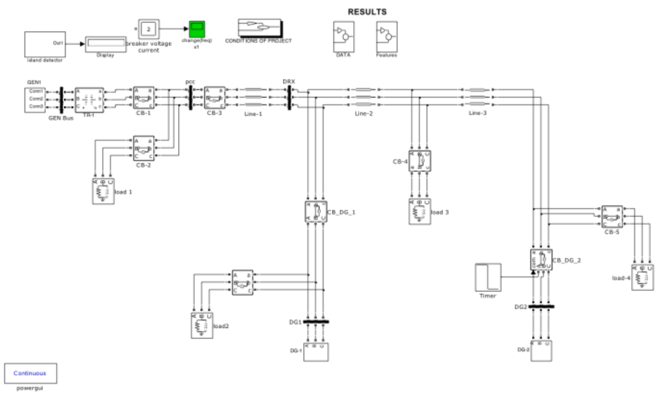

Figure 4.6: Detailed Simulation Diagram for Condition 6

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Table 4.1: Features Value

List of fuzzy variables		
S.NO	**Variable**	**Name**
1	X1	Change In Frequency (Hz)
2	X 2	Change In Voltage
3	X 3	Rate Of Change In Voltage
4	X 4	Rate Of Change In Power
5	X 5	Frequency Vs Power
6	X 6	Current Harmonics
7	X 7	Voltage Harmonics
8	X 8	Rate Of Change In Frequency
9	X 9	Power factor
10	X 10	Change in Power Factor
11	X 11	Rate of Change of Power Factor

Table 4.1 explains the list of feature vectors used in fuzzy inference system in order to detect islanding condition in distributed generation micro grid, The designed fuzzy logic controller is explained in figure 4.8. The change in frequency has been explained in figure 4.9. It is evident from the diagram that there is significant change in frequency when system ia operating in islanded mode of operation. Figure 6.10 explains the simulation diagram to measure frequency vectors used in fuzzy inference system in order to detect islanding condition in distributed generation micro grid, The designed fuzzy logic controller output is explained in figure 4.11. The islanding detection output has been explained in figure 4.12 It is evident from the proposed algorithm was able to detect the conditions related to normal mode of operation as well as islanded mode of operation depending on value of feature vectors and operating conditions.

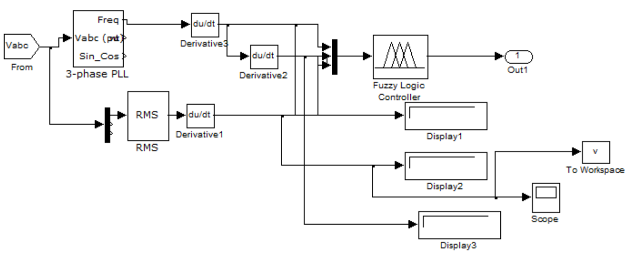

Figure 4.8: Design of Fuzzy Inference System

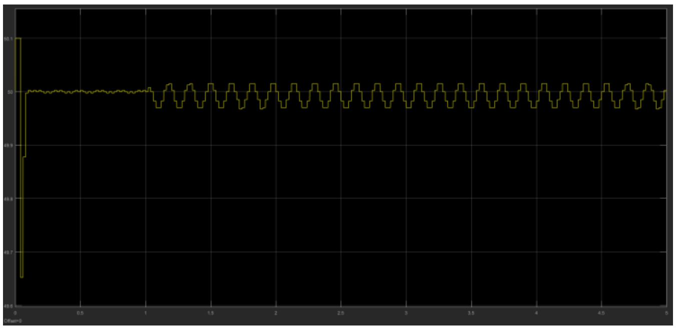

Fig4.9 Plot of Frequency in Normal Mode and Islanded Mode of Operation

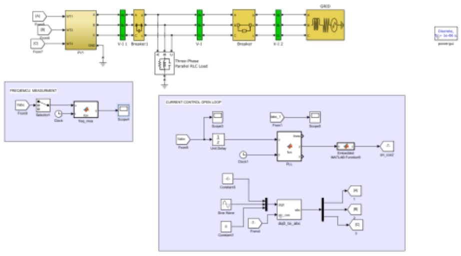

Fig 4.10 Feature Extraction from the Interconnected Grid System

A DT-initialized fuzzy rule base classifier is proposed for is- landing detection. The initial classification model is developed using DT which is a crisp decision tree algorithm. The DT is transformed into a fuzzy rule base by developing fuzzy MFs from the DT classification boundaries. The fuzzy MFs reduction and rule base simplification are performed using similarity measure.

Table 4.2 – Result Analysis

S.No	X1	X2	X3	Actual Condition	FIS Output
1	11.3	-0.14	0.44	Islanding	0.5
2	-7.6	-0.48	0.08	Islanding	0.5
3	1.9e-5	2.1	1e-4	Non Islanding	0
4	1.8e-5	6.0	1e-7	Non Islanding	0
5	3.3	-0.146	-0.015	Islanding	0.5
6	4.6	-0.19	-0.023	Islanding	0.5
7	31	11	-0.046	Islanding	0.5
8	-0.38	4.4	0.0015	Non Islanding	0
9	-0.40	4.06	0.002	Non Islanding	0
10	1.3	6.8	0.04	Non Islanding	0

The proposed method is tested on data with and without noise and found to provide 100% islanding detection. As the on- line implementation is easier with a fuzzy rule-based approach, it is thus suitable for developing real time relay for islanding de- tection in a large power network.

V. CONCLUSION

An innovative fuzzy rule base classifier is proposed for island detection. Use DT (a clear decision tree algorithm) to develop the initial classification model. By developing fuzzy MF from the DT classification boundary, DT is converted into a fuzzy rule base. Fuzzy MF reduction and rule base simplification are performed using similarity measures. The proposed method is tested on noisy and no-noise data, and it is found that it can provide 100% islanding detection. Because the method based on fuzzy rules is easier to implement online, it is suitable for developing real-time relays for island detection in large power grids.

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