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USING jFUZZY LOGIC FOR ANALYSIS OF POWER SYSTEM BASED ON DYNAMIC SECURITY ASSESSMENT

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ABSTRACT

Power system and its security and analysis have been taken a major concern in day to day life. SECURITY evaluation is an important issue in planning and operation stages of an electric power system. This paper proposes a novel fuzzy logic Controller by using Jfuzzy Logic. A fuzzy logic-based classification method is developed to predict the security index of a given power system operating point. Jfuzzy Logic is Object Oriented approach together with the modular design In Addition the proposed system is tested by taking set of data sets. The comparison states the advantage of Jfuzzy Logic on the existing system.

Index: jfuzzy Logic, Pattern Discovery, Fuzzy Logic Controller, Dynamic Security Assessment

I INTRODUCTION

The term 'Security' as outlined by NERC (1997) is that the ability of electrical systems to face up to sharp disturbances like electric short-circuits or unlooked-for loss of system component . The most goal in security analysis is to extend the facility system's ability to run safely and operate among acceptable economic bounds. a collection of most probable contingencies is initial such that for security analysis. This set might embrace outage of a line/generator, eruption in load, three section fault within the system, etc.

1.1 Static Security Assessment

Static Security of power system is return its original state in operating point after a disturbances while not violating the system in operating constraints known as 'Security Constraints'. The Security Constraints provides the proof that the power in network is correctly balanced by the given equation (1) ,bus voltage magnitude and thermal limits of transmission lines are inside the suitable limits given by equation (2).If any of checks violates, the Power system might expertise disturbances that would lead to 'Black Out'.[2]

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$$\sum_{i=1}^{Ng} P_{Gi} = P_D + P_{Loss} \quad \text{where minimum } P_{Gi} \le P_{Gi} \le \text{maximum } P_{Gi} \qquad (1)$$

$$|V|_k^{min} \le |V|_k \le |V|_k^{max} \quad k=1,2...N_b \quad S_{km} \le S_{km}^{max} \quad \forall branch\ k-m \qquad (2)$$

Where P_{Gi} represents real power generation at *ith* bus, P_D is the total system demand; P_{loss} is the total real power loss in the transmission network; $|Vk|$ is the voltage magnitude at *kth* bus; S_{km} represents complex power flow in branch k-m; *Ng* is the number of generators.

1.2 Transient Security Assessment

Transient security is that the ability of the power system to work systematically within the limits bound obligatory by system stability phenomena. One in all the first needs of reliable service in electric power systems is to retain the synchronous machines running in parallel with adequate capability to satisfy the load. Transient security assessment consists of determining, whether or not the system oscillations, following the incidence of a fault or an oversized disturbance, can cause loss of synchrony among system generators [11].

Transient security assessment could be a set of transient stability of the ability system. Transient stability pertains to rotor angle stability, wherever the steadiness phenomena area unit characterised by the rotor oscillations beneath a severe perturbation. The goal of TSA is to unravel non-linear dynamic equations describing the transient behavior of the system beneath a collection of credible contingencies.

1.3 Pattern Recognition (PR) Approach.

Pattern Recognition (PR) is outlined as ‘the act of getting input as raw data and taking an giving an output based on the category of data’. It deals with the classification of information objects, referred as ‘Patterns’, into variety of classes or categories [11]. The essential elements of the PR system area unit pre-processing, feature choice and classifier style as shown in Figure 1. The role of pre-processing is to outline a the approach pattern ought to be conferred. The goal of feature choice is to pick out best feature set by computing numeric data and hard from observations. With the best feature vector designated, a classifier is designed that does the job of classifying observations, looking forward to extracted options.

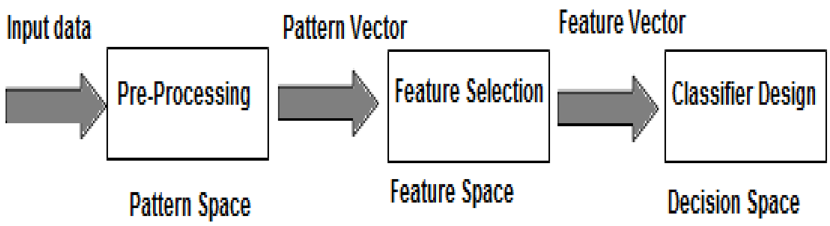


Figure.1 PR System

1.4 Jfuzzy Logic

In this paper, we have an open source Java library called jFuzzyLogic that permits us to style and to develop FLCs following the quality for FCL.[3] JFuzzyLogic offers a completely purposeful and complete implementation of a Fuzzy Inference system (FIS), and provides a programming interface (API)and an Eclipse plugin so as to create it easier to jot down and check FCL code. This library brings the advantages of open source code and standardization to the fuzzy systems community, that has many advantages:

- Standardization creates less programming work.
- This library extends the vary of doable users applying FLCs. This provides an entire implementation of FIS following the quality for FCL, reducing the amount of data and knowledge in fuzzy logic control needed of researchers. As a result researchers with less data are able to with success apply FLCs to their issues once mistreatment this library.
- The strict object-oriented approach, in conjunction with the standard style used for this library, permits developers to increase it simply.
- jFuzzyLogic follows a platform-independent approach that permits it to be developed and run on any hardware and software package configuration that supports Java.

II LITERATURE SURVEY

In this section we study some method for dynamic security assessment of Power system.

2.1 Application of Neural Network Based

Pattern Recognition approach to security assessment of Power system

KALYANI and K. SHANTI SWARUP in [11] gave the pattern recognition using neural network can be done by following steps:

a. Data generation

b. Feature Selection

c. Classifier Design

d. Performance evaluation of Classifier

2.2 Fuzzy based Sling Mode Control

LATHA.R,KANTHALAKSHMI.S,KANAGARAJ.J[6] have discussed The Fuzzy Sliding Mode Control (FSMC) technique. It is combination of variable Structure Control and Fuzzy Logic Controller. The conventional sliding surface is changed using a fuzzy rule set. This integration confers controller robustness and flexibility. Neutralization process and combining process are used to distinguish the performance of new controller to that of a conventional sliding mode controller and PID controller.

2.3 Support Vector Machine

Christian Andersson [8] discussed about Support vector machine.SVM classifier minimizes the generalization error by optimizing the trade-off between the number of training errors and the so-called Vapnik-Chervonenkis (VC) dimension, a new concept of complexity measure . SVMs are often found to provide better classification results that other widely used pattern recognition classifiers, such as the maximum likelihood and neural network classifiers. SVM performs the task of classification by first mapping the input data to a multidimensional feature space and then constructing an optimal hyperplane classifier separating the two classes with maximum margin. SVM performs minimization of error function by an iterative training algorithm to construct an optimal hyperplane.

III PROPOSED APPROACH- FRAMEWORK AND DESIGN

3.1 Problem Definition

To reduce the outage time and enhance service reliability and to remove the disturbance, it is essential to locate fault sections in a power system. Currently, past experiences are extensively used in fault diagnosis. These uncertainties occur due to failures of protective relays and breakers, errors of local acquisition and transmission, and inaccurate occurrence time, etc. An effective approach is thus necessary to deal with uncertainties in these expert systems.

Fault diagnosis in electric power system is a important operation. Every signal and step contain some uncertainties, which can be modelled by membership functions. Fuzzy set theory is used to determine fault sections in the approach. Membership functions of the possible fault sections are the most important factors in the inference procedures and decision making.

The system is useful for Modern power system. It is operated to maintain a unalterable conduct of electricity generation, transmission, and distribution. The operation of a power system is inevitably exposed to kinds of disturbances and faults, such as short-circuit of a transmission line or an unexpected generator outage, etc.

1. The given system examines the state of the system if it is in secure or insecure. For doing so it uses a mathematical algorithm in which it compares the system A with System B.
2. Where System A is defines the secure and insecure boundaries and System B defines the actual load of system.
3. After comparing the data of System A and System B, it generated the secure and insecure region of the system.

3.2 Structure of the Fault Diagnosis System

The fuzzy expert system structure is shown in Figure.2.Architecture consists of database, fault network identification, inference engine, dispatcher interface, fault determination.

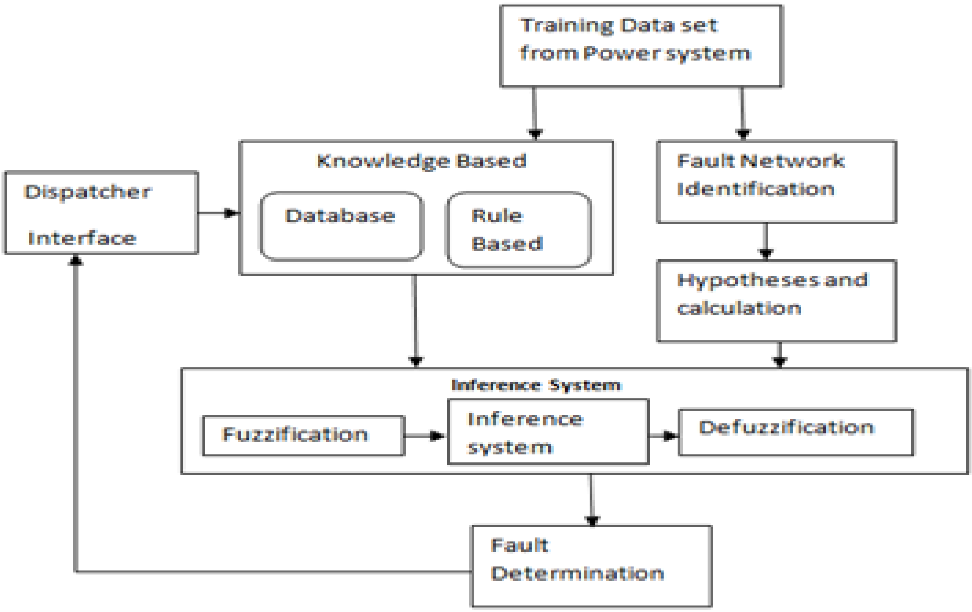


Figure 2.System Architecture

Database consists of training data sets of faults in power system ,whenever any fault is going to happen it will immediately compare with database and all hypothesis and calculation will be done and fault is determined. If any new fault is determined will get dispatch to database by dispatcher interface.

3.3 Improved Pattern Discovery Algorithm.

A. Basic Concept: Some of the basic conceptions of pattern discovery are shown below.

a. Event :An event E is a d-dimensional hyper-rectangle in a d-dimensional continuous sample space Rd

$$E=I_1 \text{ x } I_2 \text{ x.......x } I_d =\{X \text{ I } x_i \in I_i, 1< i<d\}$$

b. Volume*:* Let E be a d-dimensional event defined by the intervals { Ii }, i = 1 .....d; and Li be the length of the ith interval, then the volume of E is defined as

$$V =\Pi_{i=1}^{d} L_i$$

c. Observed Frequency: The observed frequency of event E_i, denoted as n_{oi}, is defined as the number of the sample points that fall inside of the volume occupied by $E_{i..}$

d. Virtual Frequency: Since Pattern Discovery aims to discover the patterns containing the organized information against the uniform random distribution, virtual frequency of an event E is formed to represent the uniform distribution frequency of the volume occupied by E.

$$N_{vi} = \frac{v_i \, n_+}{V_{TOT}}$$

B.*Residual Analysis:* The residual of the Event E_i is defined as

$$r_i = \frac{n_{oi}-n_{ni}}{\sqrt{\{n_{oi}+n_{ni}\}\{1-0.5\times\{n_{oi}+n_{ni}\}/n_+}}$$

The residual is used to detect the departure of the event frequency from the uniform distribution statistically.

a. Significant Event (Pattern): An event E_i is a significant event at the α X100 percent importance level if ri > Z 1-a/$_2$ .A significant event is also called a pattern.

b. Insignificant Event: An event E_i is an insignificant event at the α X 100 percent significance level if | ri |>$Z_{1-\alpha/2}$ The insignificant event indicates that the frequency of the event does not deviate from the uniformity.

c. Negative Significant Event: An event E_{i1} is a negative significant event at the α X 100 percent significance level if $r_i < Z\alpha/2$. The negative significant event indicates there is seldom or no sample points in the volume occupied by the event.

C. *Recursive Partition*: In order to seek the patterns in ad-dimensional subspace Ω , PD firstly partitions Ω into Q_d events by making each event contain equal number of sample points in each dimension (this is called equal frequency partition), where Q is the control parameter representing the number of events to be partitioned in each dimension.

D. *Centroid Deviation Analysis:* Although PD is powerful in discovering patterns of the data, we found that in some cases, PD will neglect some organized information of the data mistakenly. Thus we propose a centroid deviation analysis technique to enhance the pattern discovery ability of PD. When the number of the sample points contained inEi is not too small, if the distribution of the sample points follows the uniform distribution, then the centroid of E_i cannot deviates from its center significantly; otherwise, E probably contains organized information.

IV WORK FLOW OF FUZZY CONTROLLER

FLCs, as initiated by Mamdani and Assilian 15;16, are currently considered to be one of the most important applications of the fuzzy set theory proposed by Zadeh 17. This theory is based on the notion of the fuzzy set as a generalization of the ordinary set characterized by a membership function m that takes values from the interval [0, 1] representing degrees of membership in the set. FLCs typically define a non-linear mapping from the system's state space to the control space. Thus, it is possible to consider the output of a FLC as a non-linear control surface reflecting the process of the operator's prior knowledge.

An FIS is usually composed of one or more FBs. Every FUNCTION BLOCK has the following sections:

i) Input and Output variables are explain in the VAR INPUT and VAR OUTPUT sections respectively;

ii) Fuzzification and Defuzzification membership functions are explian in the FUZZIFY and DEFUZZIFY sections respectively;

iii) Fuzzy rules are written in the RULEBLOCK section. Variable definition sections are simple; the variable name, type and possibly a default value are specified.Membership functions either in FUZZIFY or DEFUZZIFY are explain for each linguistic term using the TERM statement followed by a function definition. Functions are defined as piece-wise linear functions using a series of points (x0;y0)(x1;y1):::(xn;yn), for instance, TERM jFuzzyLogic average := (10,0) (15,1) (20,0) defines a triangular membership function.

An FIS can contain one or more RULEBLOCK, in which fuzzy rules are defined. Since rules are intrinsically parallel, no execution order is implied or warranted by the specified order in the program. Each rule is defined using standard "IF condition THEN conclusion [WITH weight]" clauses. The optional WITH weight statement allows weighting factors for each rule. Conditions tested in each IF clause is of the form "variable IS [NOT] linguistic term". This tests the Membership of a variable to a linguistic term using the membership function defined in the corresponding FUZZIFY block. An optional NOT operand negates the membership function (i.e. m(x) = 1-m(x)). Obviously, several conditions can be combined using AND and OR connector

JFuzzyLogic

JFuzzyLogic's main goal is to facilitate and accelerate the development of fuzzy systems. We achieve this goal by:

i) Using standard programming language (FCL) that reduces learning curves

ii) Providing a fully functional and complete implementation of FIS;

iii) Creating API that developers can use or extend;

iv) Implementing an Eclipse plug-in to easily write an FCL code;

v) Making the software platform independent; and

vi) Distributing the software as open source. This allows us to significantly accelerate the development and testing of fuzzy systems in both industrial and academic environments.

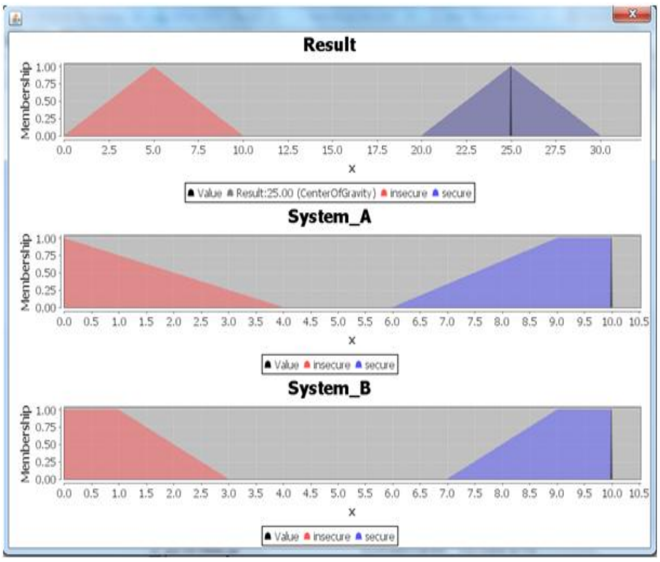
Algorithm used:

```
FUNCTION_BLOCK Resultper

VAR_INPUT
   System_A : REAL;
   System_B : REAL;
END_VAR

VAR_OUTPUT
   Result : REAL;
END_VAR

FUZZIFY System_A
   TERM insecure := (0, 1) (4, 0) ;
   TERM secure := (6, 0) (9, 1) (10,1);
END_FUZZIFY

FUZZIFY System_B
   TERM insecure := (0, 1) (1, 1) (3,0) ;
   TERM secure := (7,0) (9,1) (10,1);
```

```
END_FUZZIFY

DEFUZZIFY Result
   TERM insecure := (0,0) (5,1) (10,0);
   TERM secure := (20,0) (25,1) (30,0);
   METHOD : COG;
   DEFAULT := 0;
END_DEFUZZIFY

RULEBLOCK No1
   ACCU : MAX;
   AND : MIN;
   ACT : MIN;

   RULE 1 : IF System_A IS insecure OR System_B is      insecure THEN Result IS insecure;
   RULE 3 : IF System_A IS secure AND System_B IS     secure THEN Result is secure;
    END_RULEBLOCK

END_FUNCTION_BLOCK
```

V RESULT OF PRACTICAL WORK

Practical work done is as shown in figure given below. Following figure shows the graphical representation of security index of given power system operating points.



VI CONCLUSION AND FUTURE WORK

In this paper, we have improved pattern discovering algorithm by Jfuzzy Logic. This improvement can increase the performance when apply it to extract the patterns of data from a training data set of power system. Next, based on the results of the improved pattern discovery algorithm, a fuzzy logic-based classification method is developed to check the security index of a given power system operating point.

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