TEMPERATURE CONTROL OF TRANSFORMERS USING SOFT COMPUTING TECHNIQUES

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TEMPERATURE CONTROL OF TRANSFORMERS USING SOFT COMPUTING TECHNIQUES

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ABSTRACT

The adaptability of a transformer enables it to have a wide range of applications. One of the most important parameter that has an influence on the transformer insulation is the 'TEMPERATURE'. In a non oil transformer, temperature has more significance because the entire cooling medium is air. Hence, the parameter to be controlled is the fan speed that varies invariantly with the load. The conventional control technique fails to achieve this task .So to have all the intermediate values, we go for the predicate control which is possible by the use of fuzzy logic (Soft computing technique). Several studies were made with two parameters i.e. load and temperature. But this paper includes a variable "MOISTURE" also.

Key words: Non-oil transformers, Fuzzy control, MATLAB&SIMULINK

INTRODUCTION

Electric company high voltage transformers used in the utility grid are typically insulated by being immersed in a tank of oil, and cooled by natural convection (circulation) of the oil. A non oil transformer is not immersed in oil, and is cooled by air convection or by fans. Generally the oil immersed transformers are widely used because they have high efficiency and they offer better cooling ,but the usage of these type of transformers in mines and high rise buildings is risky, so a dry type transformer find its application and it is proved to be safe.

Advantages of non oil type transformer are as follows: It accommodates less place than any other. It does not catch a fire. The installation at any place is convenient. It is eco friendly and internal inspection is possible. There is no scope for corrosion. Side clearance is less. It is maintenance free (easy) .The limitation is, it cannot be used for more than 2000KVA.

The temperature control in a non oil transformer can be accomplished mainly in two ways, one is through reducing the load and other is increasing the fan speed[1]. Reducing the load needs to take the help of the circuit breaker, which is a most difficult process. Rather than this, the control of temperature in the prescribed limits is more important than anything else.

Thus, the control can be achieved by using the air blast cooling through a fan. The linear approximation causes inaccuracy in conventional systems. In this regard, Fuzzy logic shall be adopted, which can handle non linear systems, without approximations.

Fuzzy Logic

The Fuzzy rule based modeling is a qualitative modeling scheme where the system behavior is described using natural language.

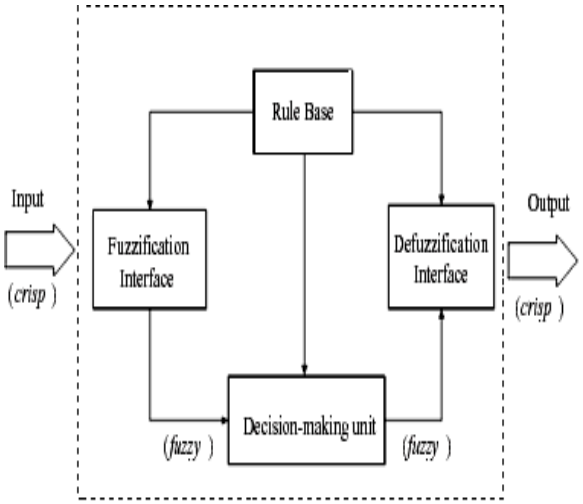

Fig 1 Basic Configuration of Fuzzy logic system

The fuzzy rule based approach was introduced by Zadeh and is being used in various fields of science and technology [2].

In order to obtain the control design for a nonlinear or complex dynamic system, there are four basic steps in designing a conventional fuzzy logic controller (FLC) for a physical system: 1) the definition of input/output fuzzy variables; 2) the decision making of fuzzy control rules; 3) fuzzy inference logic, and 4) defuzzification and aggregation. The inference operations upon fuzzy if-then rules performed by fuzzy inference systems are described as follows.

The input/output variables of a fuzzy controller can be divided into system variables, and linguistic variables. Most fuzzy controllers employ the error and error rate of system variables as the input and the force, voltage or another variable of the control law as the output.

The fuzzy control rule is important to the successful operation of the fuzzy control system. The rule base (knowledge base), containing a number of fuzzy if-then rules, is composed as follows:

$$R^{(m)}: IF\ x_1\ is\ A_1^m\ and \ldots and\ x_n\ is\ A_n^m \quad (1)$$
$$\text{THEN}\ \ y = K_m$$

where $x = (x_1, \ldots, x_n)^T$ and y are the input and the output of the fuzzy logic system, respectively. A_i^m is the label of the fuzzy set in i, for $m = 1,2,\ldots,M$, and K_m is the zero-order Sugeno parameter.

EFFECT OF MOISTURE ON TEMPERATURE

Non oil types can operate under all ambient conditions for commercial buildings and light manufacturing facilities. Non oil type transformer's enclosure will usually have louvers for ventilation. But these can be affected by hostile environments like **moisture**, corrosive fumes, dust etc.

Temperature does have a direct effect on moisture. If the air has 100 percent moisture, the actual temperature is high and if the moisture content is low, actual temperature is also low.

CONTROL OF TEMPERATURE

The easier way to control the fan speed is with the fuzzy control, which provides us with smaller and more efficient programs. With the wide scope of fuzzy logic, it enables us to consider the non-linearity. Therefore, based on the condition set, the fuzzy rules can be formulated. In addition to the extreme values of each and every parameter, all possible intermediate states have to be considered during the process of framing the rule set. First and foremost task is the formation of rule base.

Here the inputs are temperature, load, and moisture while fan speed is the output variable. To assign the degree to each membership function, few sample rules used are to comprehend these set of rules.

Based on the linguistic rules, these degrees are assigned to each membership function. This step enables us to convert the fuzzy triangle code for each membership function into the intermediate conditions well specified. These fuzzy triangles are nothing but a pictorial representation of the membership function, giving its limits and also the trueness of each linguistic rule.

IMPLEMENTATION

The implementation is done by the defuzzification process, and it is achieved through two ways. The first method is by manually and the second method is by using software. The manual process is tedious and time consuming, but the software method gives spontaneous and accurate results. Thus the Simulink model is as shown below. We consider three inputs while implementing this model. They are temperature, load and moisture content.

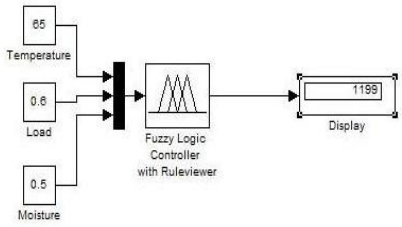

Fig: 2 Simulink model for three variables

Fig 3 The output in graphical form

The output can be obtained in text format also.

LIMITATION

1. The effect of pressure, change in dielectric constant of the insulated has been neglected.

CONCLUSION

The temperature control in a non oil transformer has been demonstrated so far, which results in the optimum usage of the transformers. Here, approximate real time values can be produced with the predicative methodology. For complete practical implementation, it would require to increase the number of inputs to suit the corresponding real time situation.

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