VOLUME-7, ISSUE-12, DECEMBER-2018 • PRINT ISSN No 2277 - 8160

GLOBAL JOURNAL FOR RESEARCH ANALYSIS International

Original Research Paper

Engineering

REACTIVE POWER COMPENSATION USING FUZZY LOGIC TECHNIQUE

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ABSTRACT In this paper we proposes an automated solution based on fuzzy controller to STATCOM in which all the decisions are based on the actual data points such as load, voltage levels and current in the systems. Additionally the proposed solutions helps maintain voltage levels, control voltage fluctuations, improve power factor and minimize human intervention resulting in the improved and efficient system. We also provide the result analysis.

KEYWORDS : Fuzzy controller , membership function.

INTRODUCTION

After studying several research works in the field of Reactive Power Compensation, the demand for controllable reactive power source has gone up mainly for efficient and reliable operation of ac electric power system . VAR compensators should be controlled to provide rapid and continuous reactive power supports during static and dynamic power system operating conditions . Flexible AC Transmission systems (FACTS) controllers are emerging as an effective alternative to increases or enhance power transfer capability and stability of the network by redistributing the line flow and regulating the bus voltages. Static VAR compensator (SVC) andSTATCOM are some of the commonly used FACTS controllers . Power System Stability is the ability of the system to regain its original operating conditions after a disturbance to the system . Power system transient stability analysis is considered with large disturbances like sudden change in load, generation or transmission system

configuration due to fault or switching. It is very important to stable the voltage supply, so that the performance is increases and because of the stability the loss is reduces.

STATCOM

A Static Compensator (STATCOM) is a device that can provide reactive support to a bus. It consists of voltage sourced converters connected to an energy storage device on one side and to the system on the other. The use of facts (flexible AC transmission system) devices in a power system can potentially overcome limitations of the present mechanically controlled transmission systems. By facilitating bulk power transfers, these interconnected networks help minimize the need to enlarge power plants and enable neighboring utilities and regions to exchange. The stature of FACTS devices within the bulk power system will continually increase as the industry moves toward more competitive posture .

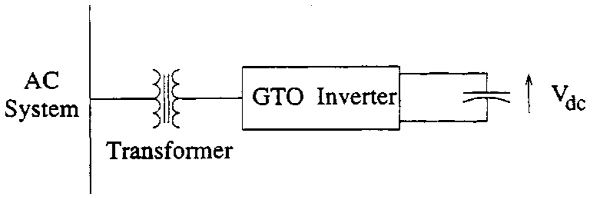


FIG :GTO Inverter

The use of facts (flexible AC transmission system) devices in a power system can potentially overcome limitations of the present mechanically controlled transmission systems. By facilitating bulk power transfers, these interconnected networks help minimize the need to enlarge power plants and enable neighboring utilities and regions to exchange power. The stature of FACTS devices within the bulk power system will continually increase as the industry moves toward a more competitive posture in which power is bought and sold as a commodity. As power wheeling becomes increasingly prevalent, power electronic devices will be utilized more frequently to insure system reliability and stability and to increase maximum power transmission along various transmission corridors. static synchronous compensator, or STATCOM, is a shunt connected FACTS device. It generates a balanced set of three phase sinusoidal voltages at the fundamental frequency, with rapidly controllable amplitude and phase angle. This type of controller can be implemented using various topologies. How-ever, the voltage-sourced inverter, using GTO thyristor in appropriate multi-phase circuit configurations, is presently considered the most practical for high power utility applications.

FUZZY LOGIC

Fuzzy logic system is the process of formulating the mapping from a given input to an output using fuzzy logic. The mapping then provides a basis from which decisions can be made, or patterns discerned. In recent years, fuzzy system application has received increased attention in various areas such as automatic control, data classification, decision analysis, expert systems, and computer vision. Because of its multidisciplinary nature, fuzzy inference systems are associated with a number of names, such as fuzzy-rule-based systems, fuzzy expert systems, fuzzy modeling, fuzzy associative memory, fuzzy logic controllers, and simply (and ambiguously) fuzzy systems. In conventional controller, the system or process to be controlled, where as in a fuzzy logic controller the focus is on human operator's behavior and hand on experience. First, the system is modeled analytically by a set of differential equations from which control parameters are adjusted to satisfy controller specification.

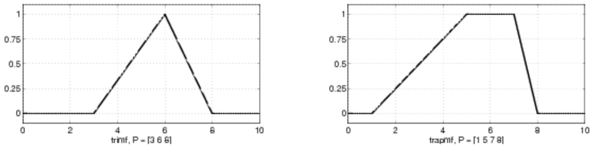
MEMBERSHIP FUNCTION

The only condition a membership function must really satisfy is that it must vary between 0 and 1. The function itself can be an arbitrary curve whose shape we can define as a function that suits us from the point of view of simplicity, convenience, speed, and efficiency .The toolbox includes 11 built-in membership function types. These 11 functions are, in turn, built from several basic functions:

- piece-wise linear functions
- the Gaussian distribution function
- the sigmoid curve
- quadratic and cubic polynomial curves

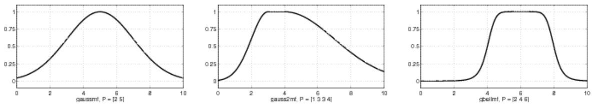
For detailed information on any of the membership functions mentioned next, see the corresponding reference page. By convention, all membership functions have the letters mf at the end of their names.The simplest membership functions are formed using straight lines. Of these, the simplest is the triangular membership function, and it has the function name trimf.

This function is nothing more than a collection of three points forming a triangle. The trapezoidal membership function, trapmf, has a flat top and really is just a truncated triangle curve. These straight line membership functions have the advantage of simplicity.



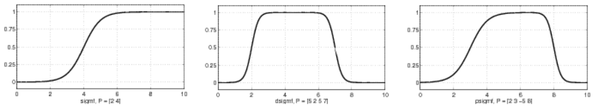
trimf trapmf

Two membership functions are built on the *Gaussian* distribution curve: a simple Gaussian curve and a two-sided composite of two different Gaussian curves. The two functions are gaussmf and gauss2mf. The *generalized bell* membership function is specified by three parameters and has the function name gbellmf. The bell membership function has one more parameter than the Gaussian membership function, so it can approach a non-fuzzy set if the free parameter is tuned. Because of their smoothness and concise notation, Gaussian and bell membership functions are popular methods for specifying fuzzy sets. Both of these curves have the advantage of being smooth and nonzero at all points.



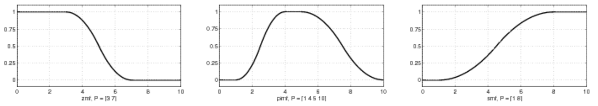
gaussmf gauss2mf gbellmf

Although the Gaussian membership functions and bell membership functions achieve smoothness, they are unable to specify asymmetric membership functions, which are important in certain applications. Next, you define the sigmoidal membership function, which is either open left or right. Asymmetric and closed (i.e. not open to the left or right) membership functions can be synthesized using two sigmoidal functions, so in addition to the basic sigmf, you also have the difference between two sigmoidal functions, dsigmf, and the product of two sigmoidal functions psigmf.



sigmf dsigmf psigmf

Polynomial based curves account for several of the membership functions in the toolbox. Three related membership functions are the Z, S, andPi curves, all named because of their shape. The function zmf is the asymmetrical polynomial curve open to the left, smf is the mirror-image function that opens to the right, and pimf is zero on both extremes with a rise in the middle.



zmf pimf smf

There is a very wide selection to choose from when you're selecting a membership function. You can also create your own membership functions with the toolbox. However, if a list based on expanded membership functions seems too complicated, just remember that you could probably get along very well with just one or two types of membership functions, for example the triangle and trapezoid functions. The selection is wide for those who want to explore the possibilities, but expansive membership functions are not necessary for good fuzzy inference systems. Finally, remember that more details are available on all these functions in the reference section. In fuzzy logic controller, these adjustments are handled by a fuzzy rule based expert system developed on the knowledge gained by the human process operator. After choosing proper variable as input and output of the fuzzy controller, it is required to decide on the linguistic variables. These variables transform the numerical value of the input of the fuzzy controller, to fuzzy quantities. The number of this linguistic variable specifies the quality of the control which can be achieved by using the fuzzy logic controller. As the number of linguistic variable increases computational time increases but the quality of the controller improves. Therefore, a compromise between the quality of control and computational time is needed to choose the number of linguistic variable.

FUZZY RULES

Human beings make descisions based on rules. Although, we may not be aware of it, all the descisions we make are all based on computer like if-then statements. If the weather is fine, then we may decide to go out. If the forecast says the weather will be bad today, but fine tommorow, then we make a descision not to go today, and postpone it till tommorow. Rules associate ideas and relate one event to another.Fuzzy machines, which always tend to mimic the behaviour of man, work the same way.

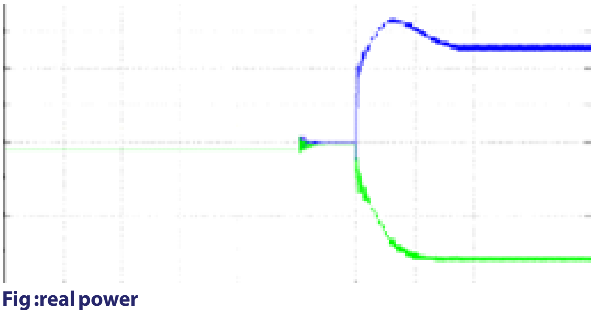


Fig :real power

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