Designing of Efficient Controlling for Star Configured H-Bridge Cascaded STATCOM using Fuzzy Approach

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Abstract - The controlling of different electrical applications is first and foremost task to maintain the stability as well as reliability of that circuit in various situations. These situations can be any one. This work discussing and working on the h-bridge converter with cascaded STATCOM and star configuration. The following configuration is proposed to control the reactive and compensating currents while controlling different voltage controlling with startup and stopping process of grid. Here to improve the controlling fuzzy approach is utilized and the simulation outcomes are shown in the results. After comparison with the previous controlling method this work is has better voltage and current results.

Keywords - H-bridge, STATCOM, Fuzzy, Cascaded.

I. INTRODUCTION

A STATCOM operates as a controlled reactive power source. It provides voltage support by generating or absorbing reactive power at the point of common coupling (PCC) and it has a charged DC voltage capacitor connected to the converter which enables a controllable three-phase output voltage. By changing the output voltage the reactive power exchange between the converter and the AC system can be controlled. If the output voltage of the converter is raised to be higher than that of the AC system, then a leading current is produced by the STATCOM, that is to say, the STATCOM will operate in capacitive mode, which means that it will supply reactive power to the power grid.

If, on the other hand, the output voltage is decreased below that of the AC system than a lagging current is produced, which is to say that the STATCOM will operate in inductive mode, and reactive power will be consumed. The general representation of a STATCOM system is provided in Figure 1.1. The STATCOMs adaptability, flexibility and controllability, provide new opportunities to utilize this technology in order to replace old generation resources, The implementation of a STATCOM in this case will allow for the voltage profile along the line to be maintained, for reactive compensation and for fast recovery in the eventuality of a voltage dip.

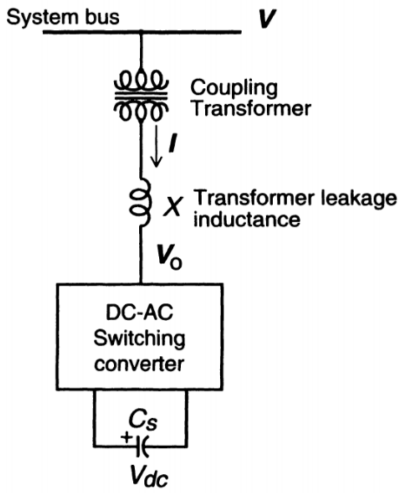

Figure 1.1 STATCOM

II. PROPOSED SYSTEM

Figure:2.1 shows the main circuit of cascaded H-bridge STATCOM in this work. It is composed of three-phase clusters. Each phase cluster consists of three H-bridge cells. The dc capacitor voltages are set to *Vc, 2Vc, 4Vc* in a phase cluster. Fig. shows an example of output waveform. Voltage level from -7 to +7 can be generated by combining the capacitor voltages. The level is decided according to the calculation flow shown in Fig.. Then the cluster outputs the nearest voltage level to reference v^{*}_{a}. Conventional cascaded H-bridge multilevel converter may require high number of H-bridge cells for low current distortion.

But the proposed circuit configuration can output 15-level voltage in spite of only three cells. So, lower conduction losses of semiconductor devices are expected. For dc voltage balancing in each phase cluster, the control method proposed here uses the fact that several switching patterns are available when a phase cluster outputs particular voltage levels. An example is shown in Fig.. When a phase cluster outputs voltage, there exists three operational pattern "V_C", "$2V_C - V_C$", "$4V_C - 2V_C - V_C$" and charged or discharged capacitors are different.

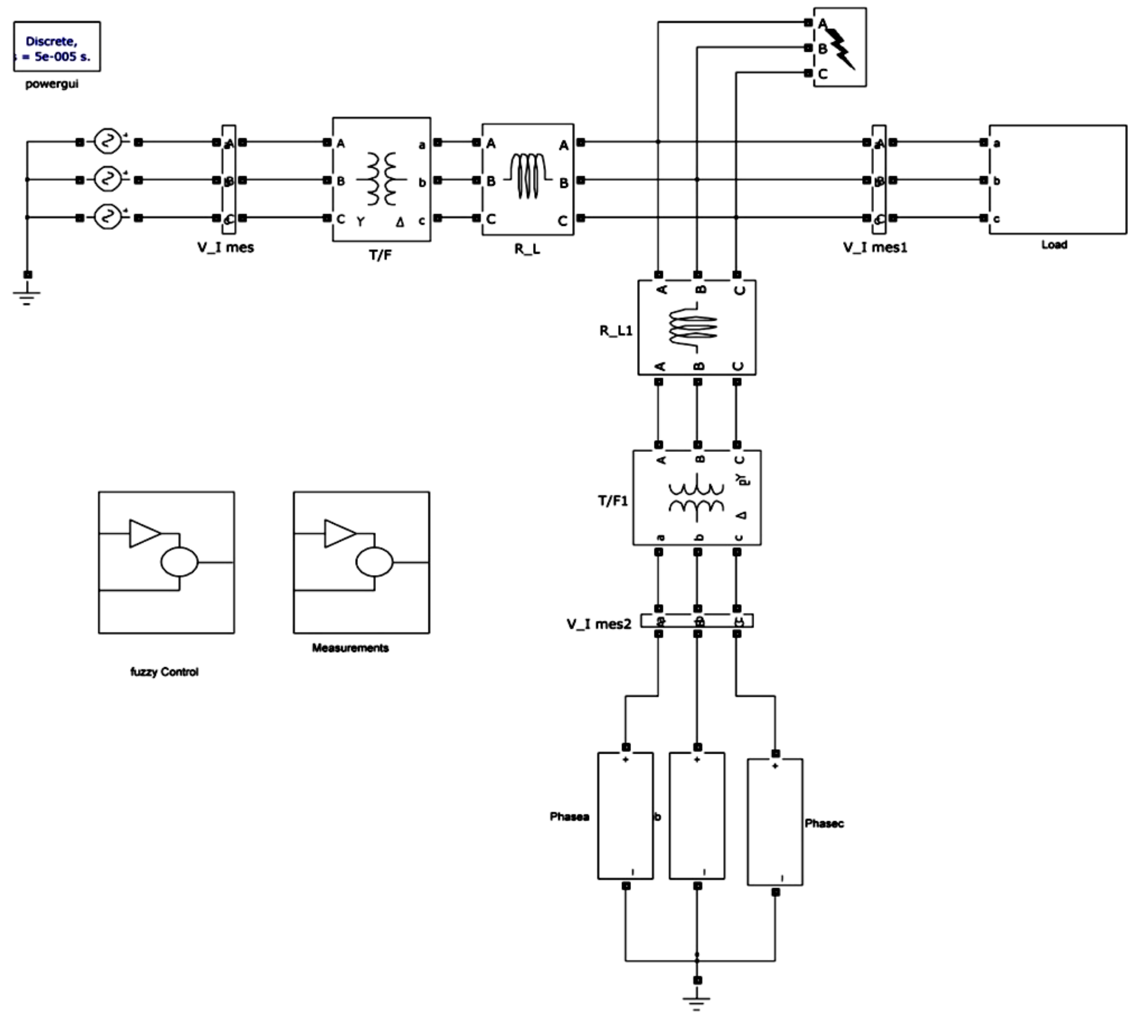

Figure:2.1 Proposed Model of the Work

Control Scheme for STATCOM

Figure:2.2 shows the control block of the STATCOM shown in Figure 2.1 The STATCOM is designed to control the positive sequence voltage at the grid connection point to reference by -axis current . The average capacitor voltage is controlled to reference V_C^* by -axis current . Where, is from and (2). The dc voltage is varied according to the STATCOM output voltage shown in Fig. The reason why this method is adopted is to use as many voltage levels of the cascade H-bridge multilevel converter as possible, regardless of the peak of STATCOM output voltage. In addition, the control element " 7/6.5" shown in Fig. acts to set the peak of reference , , in the middle of output level 6 and 7. The zero-sequence voltage shown or the negative sequence current , shown in Fig. are used for capacitor voltage balancing between phase clusters. The feature of this method is that the appropriate values of are obtained in about 1/4 cycle even if sudden change of , occurs by power system faults. After transformation of , and low pass filtering, the positive sequence voltage , are obtained as dc components. On the other hand, are once rotated to reverse direction of transformation.

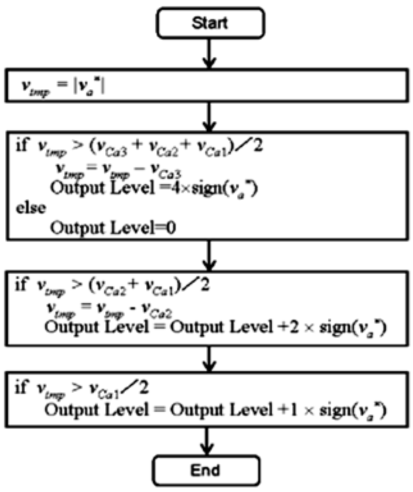

Figure:2.2 Flow Chart of Operation

Here, the negative-sequence voltage is also obtained as dc components. After low pass filtering, the output values are rotated two times to forward direction of transformation and the negative-sequence voltage , are obtained accurately. The time constant of low pass filter does not have to be long, ie. the delay time of low pass filter is not long, because the filter is requested to eliminate only harmonic component of ac side voltage. As a result, the STATCOM can respond to power system faults quickly, and the error of capacitor voltage between phase clusters is expected to be small even in the transient state by the faults. In addition, , are used for PLL, shown in Fig. to synchronize the phase angle to positive sequence of the grid voltage. And the positive sequence voltage at grid point I also obtained by this control block diagram.

Fuzzy Controlling

Fuzzy logic is all about the relative importance of precision. You can use Fuzzy Logic Toolbox software with MATLAB technical computing software as a tool for solving problems with fuzzy logic.

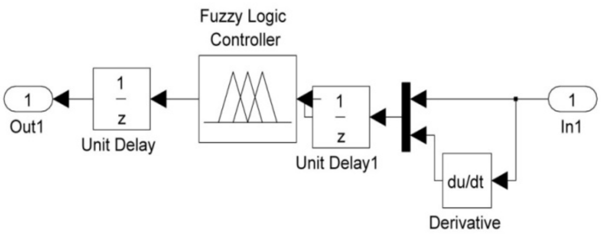

Figure:2.3 Fuzzy Logic Block of Proposed

Fuzzy logic is a fascinating area of research because it does a good job of trading off between significance and precision—something that humans have been managing for a very long time.

In this sense, fuzzy logic is both old and new because, although the modern and methodical science of fuzzy logic is still young, the concept of fuzzy logic relies on age-old skills of human reasoning.

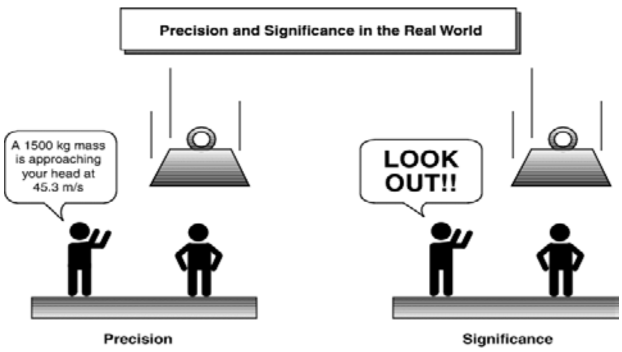

Figure 2.4 Precision And Significance.

III. SIMULATION OUTCOMES

The controlling mechanism for the Cascaded H-Bridge Converter using STATCOM with Star Configuration is explained in this work. The fuzzy controlling approach is integrated with the system to improve the controlling of reactive and compensating current in dynamic conditions and the simulation waveforms of currents and voltages are shown in the below figures.

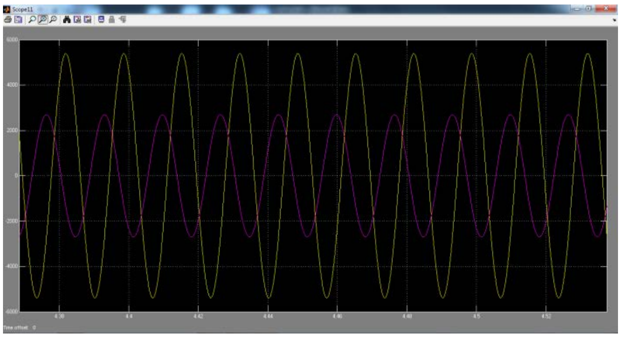

Figure:3.1 Reactive current and Compensating current.

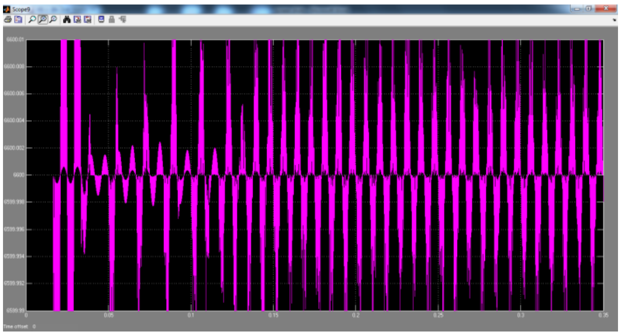

Figure:3.2 DC mean voltage of all converter cells.

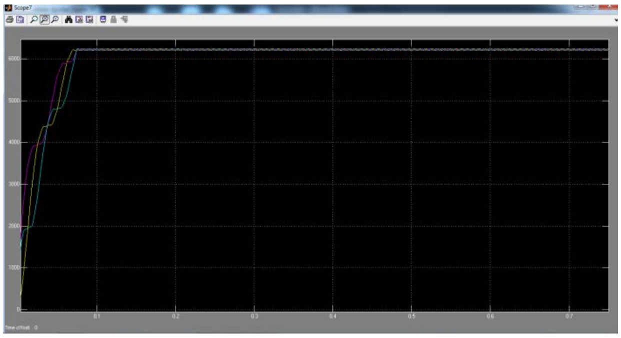

Figure: 3.3 DC mean voltage of all converter cells.

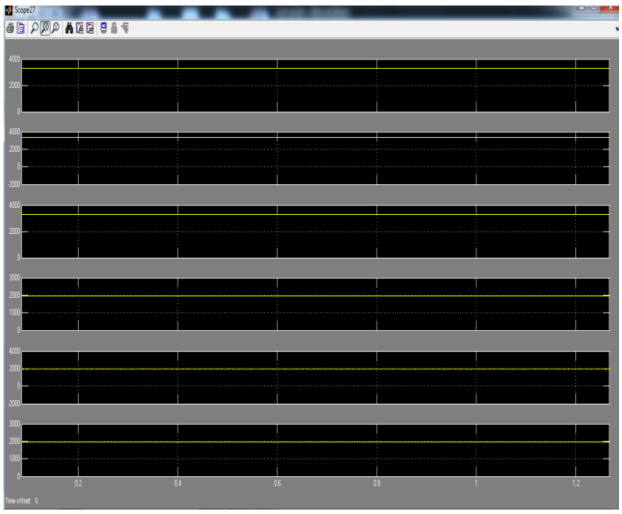

Figure: 3.4 waveforms of cells in a-phase cluster for testing individual balancing control in the steady-state process.

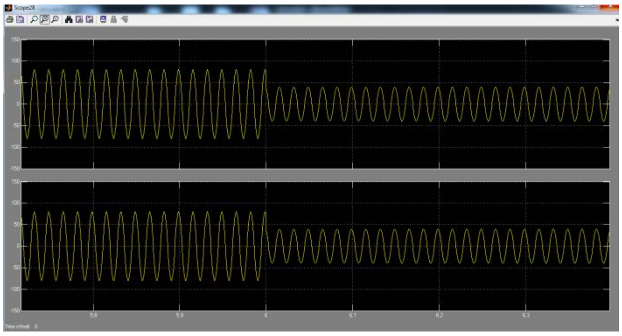

Figure: 3.5 Dynamic performance of STATCOM in the dynamic process. Reactive current and compensating current.

IV. CONCLUSION AND FUTURE SCOPE

The above analyzed controlling system is having fundamentals of STATCOM based on H-bridge converter with star configuration. The proposed work having different facts first is fuzzy controlling technique is used for overall improvements which is proved in the simulation results and second is balancing of reactive and compensating currents dynamically. The simulations results have shown that the proposed fuzzy based approach is feasible and more effective for multilevel voltage source converter integrated with cascaded structure. The explained work utilizes new soft computing technique for controlling of different currents and voltages for H-bridge cascaded converters which can be further utilize for the steady state currents and voltages and dynamic state also.

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