

# Power System Transient Stability Enhancement by a Controlled (STATCOM) Using Intelligent Techniques

Dr. Azher Alfahady<sup>1</sup>, Ayman Alkhafaf<sup>2</sup>

<sup>1</sup>Electrical Engineering Department, Mosul University, Iraq

<sup>2</sup>Electrical Engineering Department, Mosul University, Iraq

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## ABSTRACT

Because of increasing demand and restrictions on load day by day due to industrial development rapidly, AC Transmission lines become more stressed. One of the stressed system is losing stability after disturbance happened. Therefore, Flexible ac transmission system (FACTS) devices are used in transmission lines to get desired stability. Synchronous generator must be in balance with loads for all time. When the power generation less than loads, drops in voltage and frequency will happened. Improving transient stability of system by controlling on the excitation of generator when the faults or disturbance occur for short time, But that not sufficient to maintain the system stability when big fault or disturbance occur near the generator terminals for long time. The STATCOM regulates voltage at its terminal by controlling the amount of reactive power generated in power system, the benefit of STATCOM used to improve the system transient stability during disturbance or fault.

**Keywords:** FACTS , STATCOM , Transient Stability .

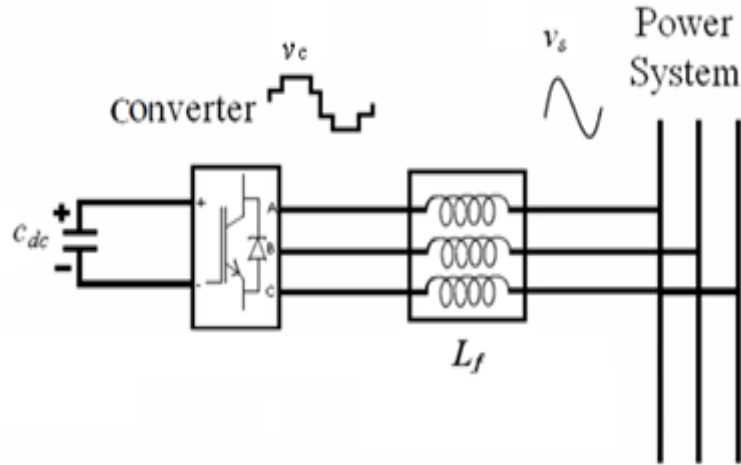
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## INTRODUCTION

The electrical load in most countries of the world was growing. This rapid growth in electrical load offset by building electric power stations of different sources of fuel. But this increase is not offset by the construction of new lines for power transmission. There are certain lines will suffer momentum prevents the achievement of the required electric power exchange. To solve this problem, there are two ways: first strengthen the system of electrical adding new transmission lines, as the construction of new electric transmission lines, especially in densely populated areas is a solution impractical for various reasons, including environmental, economic and others, while the second is to add AC transport system flexible equipment to increase the portability and control of the power flow, so the addition of this equipment is a suitable alternative[1].The concept of alternating flexible Lord transportation system for the first time in 1986 in the patrols Foundation Electric Power Research, and then followed by a speech at the summer conference of the sector of electric power in the Institution of Electrical Engineers and Electronics in 1987. This was followed by a speech at the US Conference of ability and then followed by a series of research and systems after that. Equipment provides flexible AC transmission system variables possibility of the transfer of power, such as the real power and reactive power control lines, respectively, and the reluctance of parallelism, the value and the angle of voltages at any public.

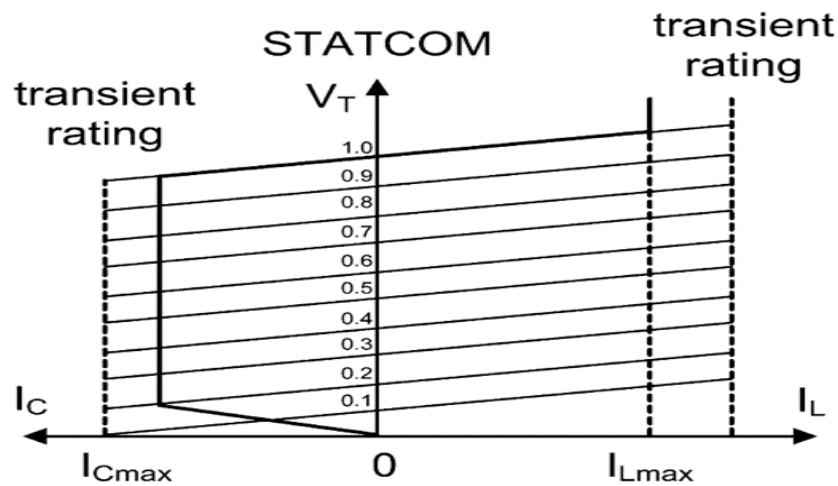
## STATIC SYNCHRONOUS COMPENSATOR (STATCOM)

The figure shows (1) functional model of the system static synchronous compensator (STATCOM). Where compensator consists (STATCOM) mainly from a widening represents a source of voltage (DC voltage) equipped voltages for changer source voltages (VSI), consisting of transistors group type field effect (MOSFET) (MOS Field Effect Transistor) or bipolar with a gate isolated (IGBT) (Insulated Gate Bipolar Transistor) or other types of power electronics keys. Directed modulator connects the system through the ability to leverage a converted voltage [2].



**Fig. 1: Model of statcom**

When the value  $V_i$  equal to the value of the  $V_s$ , the ability interacting mutual equal to zero, and when the value of  $V_i$  be greater than the value of  $V_s$ . then becomes the current  $I$  advanced for voltages  $V_s$ . angle 900 and thereby give compensator system interactive and advanced capability (-Q) to the power system, and this represents a capacitive pattern, where it is compensator system represents a lamb hitched to the power system. When the value of  $V_i$  be less than the value of  $V_s$ . then pulls compensator system and the interactive ability of late (+ Q) the ability of the system and this represents the Hittite style. (Figure 2) shows the voltage and current for inductance non-effective power characteristics (STATCOM), compared with inductance (SVC) thyristor control, where portrays us figure that self-compensator suppressions (STATCOM) provides support voltage and improve the preprocessing Trans-system capacity by processing ineffective power at voltages in other words, few compensator gives the greatest stream even when few voltages of the system capacity. Because of the lack of wide or large inductance to generate non-effective capacity, the effective capacity of others inductance Resume suppressions gives faster and better stability of response when a change in the system impedances.



**Fig. 2: Voltage-current characteristics of STATCOM**

**POWER SYSTEM**

It was used consisting of two generating circuit and three feeders and two transformer for transmission line connecting to the pregnancy. Since the pull-born first (G1) worth (13.8 KV, 1000 MVA) and the second generator (G2) worth (13.8 KV, 5000 MVA) Each station contains a set of generators and each generator contains a control system by raising the generator (Excitation System) and system the rotor speed control system Turban (Hydraulic Turbine and Governor). Been linked to these stations to two transformer for cranes for voltage (Step up Transformer) first converted Capacity (1000MVA) and VDC (13.8kv / 500kv), either converted second capacity (5000MVA) and VDC (13.8kv / 500kv), has been linked to two transformer for to a length of transmission line (700 km) and the carrying value (5000MW) and this pregnancy connects on one side (G2), and (Figure 3) shows the outline of the electrical system used in the search[3].

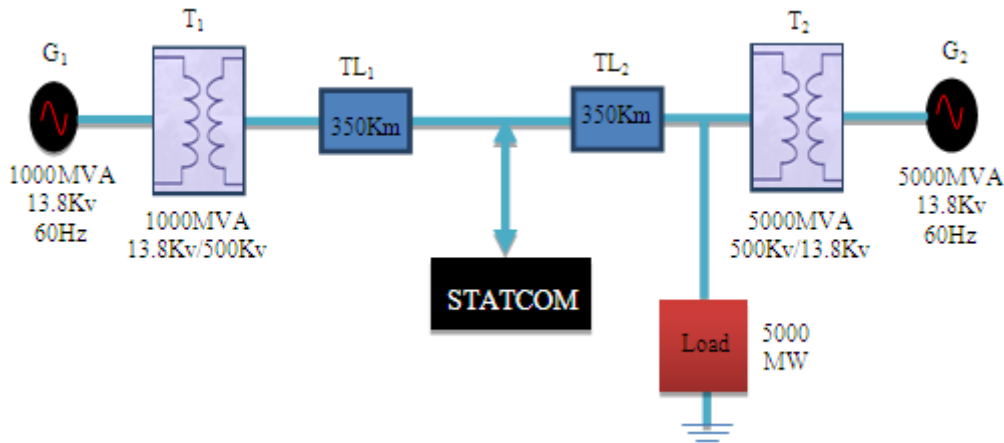


Fig. (3) Power System with STATCOM

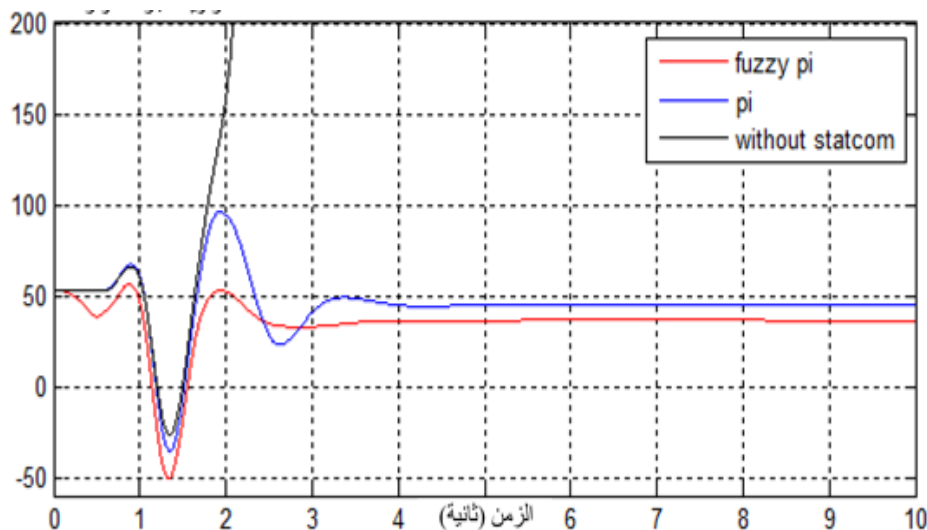
Method of synthesis of Ziegler-Nichols method of extension. Proposed by John G. Ziegler and Nichols in the forties of the last century. Where it is making the value of the complementary element (integral) ( $K_i$ ) differential element ( $K_d$ ) (derivative) equal to zero. The value of the proportional component ( $K_p$ ) (proportional) change from zero to be obtained on the wave pull microcontroller be volatile (in a manner trial and error), and are then calculate the  $K_u$  value, which represents the value of the wave output, as well as calculate the oscillation period ( $T_u$ ), and then be depending on the type of user controlled values  $K_p$  elements account,  $K_i$ ,  $K_d$  [4]. this method is used to estimate the components of the controller used in the STATCOM.

### FUZZY PI CONTROLLER

Dominant (PI) is used widely in industrial applications, since the function element (P) is used to adjust the pull-controlled according to the size of the error, while the function of (I) used to determine the amendment to the steady-state. It must be the values (P, I) after synthesized. Dominant (FLC) is used for complex systems and focuses on the basic understanding of the system in order to design a set of rules. So use the dominant Type (Fuzzy PI) for tuning of the constants (P, I) according to the operating conditions [5].

### COMPARISON BETWEEN THE DOMINANT AND THE DOMINANT PI FUZZY PI SYSTEM STATCOM

The improved capacity system using reactive power synchronous static (STATCOM) through the traditional dominant (PI), where the system did not go out for work during the exposure to the sudden disruption of pregnancy (Load Disturbance) and sometimes up to expose her to a three-error phase (Three Phase Fault) sometimes other, and thus the ability system became unstable and did not come out of any generator work. For further improvement of the stability of power system has been used dominant (Fuzzy PI) to control the compensator (STATCOM) for the same conditions experienced by the system in the case of the use of the traditional dominant PI. Figure (4) (5) shows a comparison between the dominant and the dominant PI Fuzzy PI system when subjected to suddenly load.



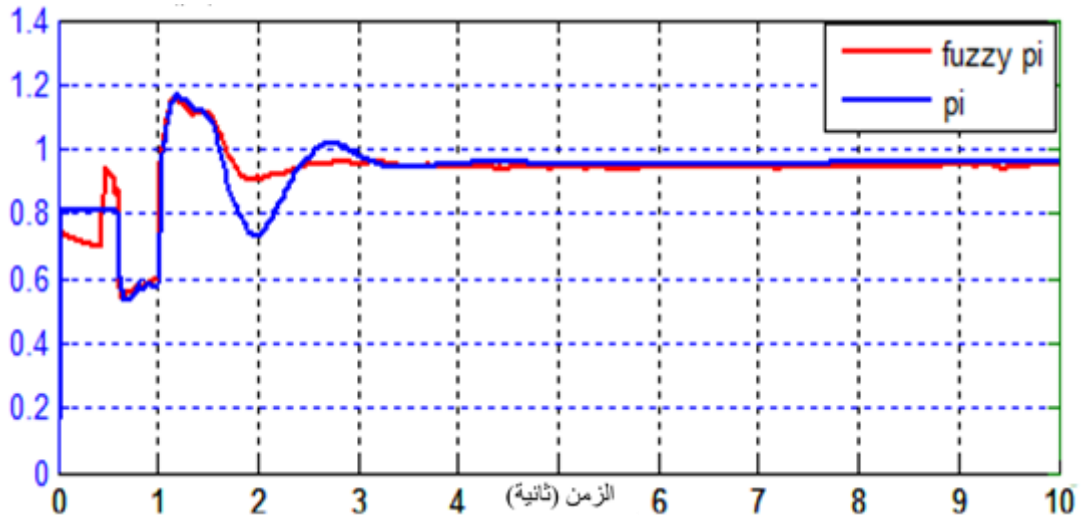


Figure (4)(5) is compare between PI and Fuzzy Pi when the The system offers to a three-phase fault.

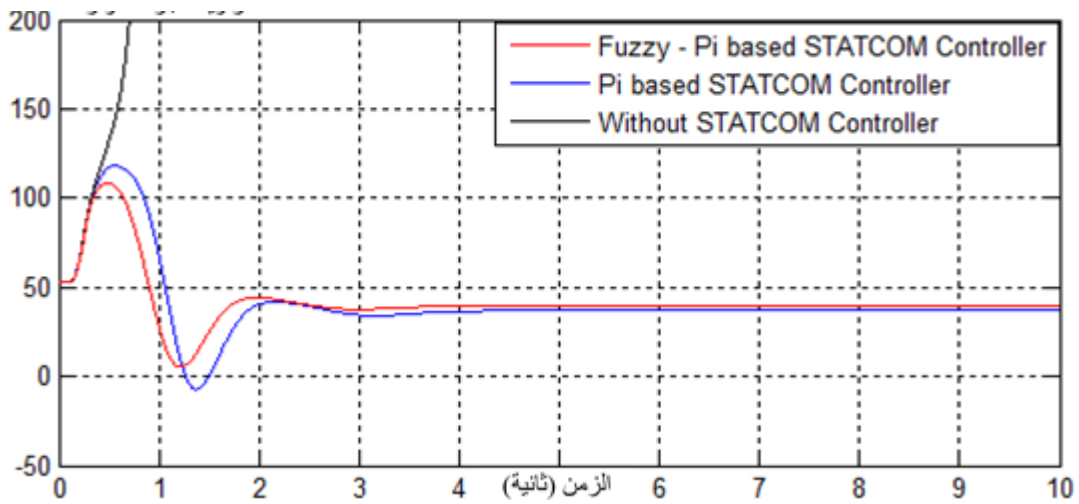


Figure (6)

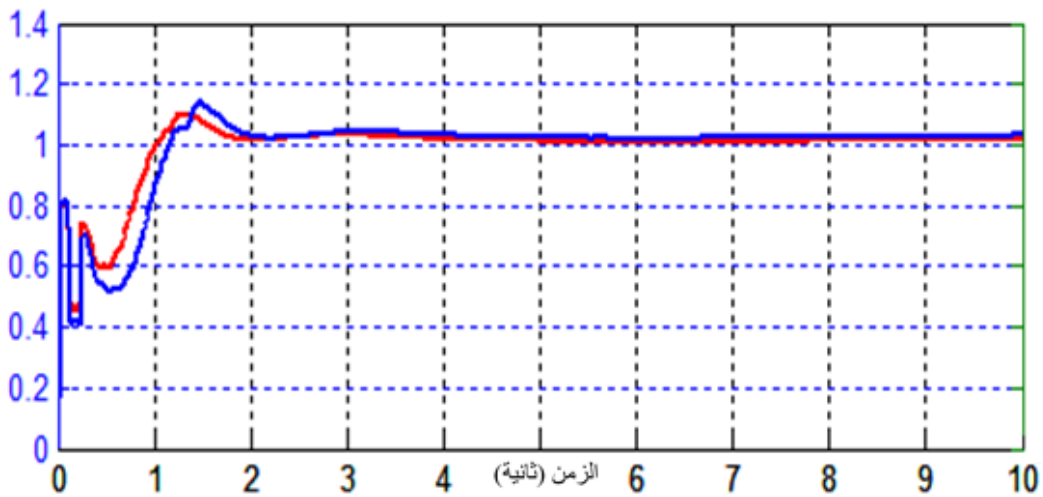


Figure (7)

The shapes (4) (5) shows that the use of Controlling Fuzzy PI be more successful to quell the angle of the rotor of Controlling PI due to disorder in pregnancy and three-phase error, respectively. As well as the case for the line voltage and described in the forms (6) (7), where Controlling Fuzzy PI has proved its effectiveness in the control voltage line over Controlling PI.

## CONCLUSION

Usually the load system electric power either download inductive or capacitive, and this leads to the entry into force of the interactive capability that works not to exploit the electric power system fully because of the move away power factor for one, moreover, the improvement of the stability of the cross case is of the most important problems facing the power systems, so it was used inductance power reactor synchronous static (STATCOM) to compensate for reactive power and also used a dominant conventional PI type and sometimes dominant Fuzzy-PI at other times were obtained the following conclusion:

Close happen (Exodus synchronous generator from work) for the electric power system when exposed to the disorder of pregnancy or sudden three-phase fault, been linked system compensator (STATCOM) the ability to containing two machine system. Were analyzed the two machine behavior after a sudden disruption of pregnancy as well as the work of a three-error phase, has control of the compensator (STATCOM) using traditional PI controlled to improve the stability of the cross case, use the dominant Fuzzy-PI with STATCOM for the best improvement of the stability of the cross case, it has been compared to dominant Fuzzy-PI with the traditional dominant PI results were obtained best to improve the stability of the cross using the dominant Fuzzy-PI status, it was achieved not out power system working after exposure to the disorder sudden and error Three phase, in this research was performed power system and system compensator STATCOM and controlling relying on MATLAB / Simulink software.

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