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# Voltage Regulation Improvement through Genetic Algorithm based DPFC in Power Transmission System

**Pankaj Tripathi*, Prof. Govind Prasad Pandiya**
M. Tech Research Scholar, Department of Electrical & Electronics, BITS Bhopal MP, India
Head of Department, Department of Electrical & Electronics, BITS Bhopal MP, India

## ABSTRACT

Huge truths gadgets have been demonstrated valuable for the different working in the power frameworks like arrangement and shunt pay through SSSC, STATCOM and UPFC .yet because of their high evaluations and support cost another conveyed control stream controller is produced called DPFC, in this paper a reproduction model is made of a transmission line which comprises of one shunt control converter and four arrangement control converter associated with high loads. The coordination of various fragments is enhanced and midway controlled utilizing the approach of hereditary calculations and results are re-enacted with and without hereditary through MATLAB.

**Keywords:** DPFC, Genetic algorithms, Transmission line.

## I. INTRODUCTION

Control stream is controlled by conforming the parameters of a framework, for example, voltage size, line impedance and transmission point. The gadget that endeavours to fluctuate framework parameters to control the power stream can be portrayed as a Power Flow Controlling Device(PFCD).Depending on how gadgets are associated in frameworks, PFCDs can be partitioned into shunt gadgets, arrangement gadgets, and consolidated gadgets (both in shunt and arrangement with the framework)

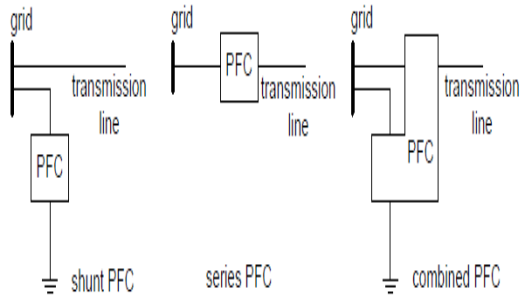


**Figure 1.** Simplifie Diagram of Shunt, Series and Combined Devices

A shunt contraption is a device that interfaces between the cross section and the ground. Shunt devices create or hold open power at the reason for relationship in this way controlling the voltage estimate. Since the vehicle voltage significance must be vacillated inside particular purposes of repression, controlling the power stream thusly is obliged and shunt contraptions fundamentally fill diverse requirements. A device that is related in course of action with the transmission line is implied as a series device.

By extending the inductive impedance of the line, plan contraptions are in like manner used to confine the present coursing through particular lines to deflect overheating. A joined gadget is a two-port gadget that is associated with the lattice, both as a shunt and in an arrangement, to empower dynamic power trade between the shunt and arrangement parts. Joined gadgets are appropriate for power stream control since they can at the same time shift different framework parameters, for example, the transmission point, the transport voltage size and the line impedance. In spite of the fact that the UPFC and the IPFC have better capacity than control stream, there is no business application at present. The primary reasons are: The main worry with consolidated FACTS is cost. Commonly, a FACTS cost around 120-150 $ per kVA, contrasted with 15-20 $ per kVA for static capacitors. Oneof the purposes behind the high cost is that the appraisals of FACTS gadgets are regularly in 100 MVA, with the framework voltage from 100 kV to 500 kV. This requires an extensive number of energy electronic switches in arrangement and parallel association Secondly, as the FACTS gadgets are introduced at various areas for various purposes, each of them is extraordinary. Therefore, every FACTS gadget requires hand craft and assembling, which prompts a long building cycle and high Cost. In conclusion, A FACT is a perplexing framework, and requires an expansive territory for establishment and furthermore very much prepared specialists for upkeep. The second concern is conceivable failure sin the combined FACTS and two issues are considered. The reliability of the device itself. Due to the set major drawbacks, the UPFC and IPFC are not widely applied in practice. Even when there is a large demand of power flow

control within the network, the UPFC and IPFC are not currently the industry first choice.

## II. EVOLUTION OF DPFC

The new idea displayed in this theory is called Distributed Power Flow Controller (DPFC). It is a consolidated FACTS gadget, which has taken an UPFC as its beginning stage.

### A. DPFC

The DPFC has a similar control capacity as the UPFC; autonomous modification of the line impedance, the transmission edge and the transport voltage. The DPFC dispenses with the regular DC interface that is utilized to associate the shunt and arrangement converter consecutive inside the UPFC. By utilizing the Distributed FACTS idea as the arrangement converter of the DPFC, the cost is significantly decreased because of the little evaluating of the parts in the arrangement converters. Additionally, the unwavering quality of the DPFC is enhanced on account of the excess gave by the numerous arrangement converters. The underneath figure specifies the changed working of a DPFC control with alternate FACTS gadgets.

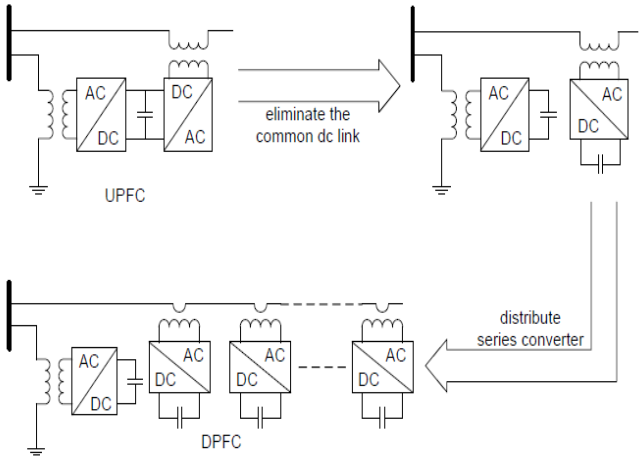


**Figure 2.** Evolution of DPFC from UPFC

### B. DPFC Control system

To control multiple converters, a DPFC consists of three types of controller's control, shunt control and series control, The DPFC can be considered a UPFC that employs the D-FACTS concept and the concept of exchanging power through the 3rd harmonic.

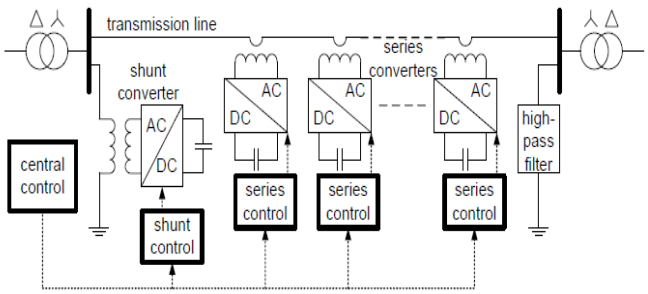


**Figure 3.** DPFC with Series shunts and centralized Controllers

In this way, the DPFC in their advantages High controllability, high reliability, low cost.

## III. GENETIC ALGORITHM

All Genetic calculation is a numerical model of normal development for looking of ideal arrangements. In designing numerous issues are confronted where it is impractical to discover correct arrangement from given information and relations subsequently a streamlining strategy is required the hereditary calculation helps in rapidly looking the arrangement even in expansive space. The basic of genetic algorithm is based on the rule of survival of the fittest, here the initial arbitrarily selected value so variables is evolved and promoted on the basis of their survival on fitness function, and the evolution is performed by-election, crossover and mutations happened with natural process.

The algorithm is required following preprocessing:

- Define the limits of variable.
- Convert the variable to binary string.
- Form a fitness function which minimize when solution found.

The advancement as a general rule starts from a masses of subjectively delivered individuals and happens in times. In each period, the health of every individual in the masses misevaluated, various individuals are stochastically browsed the present people (in light of their wellbeing), and adjusted (recombined and maybe discretionarily changed) to shape another masses. The new person is then used as a piece of the next iteration of the count. Ordinarily, the figuring closes when either a most extraordinary number of periods have been made, or an alluring health level has been pursued the masses. In case the estimation has finished in light of a most outrageous number of times, an alluring game plan director won't not have been come to. The wellbeing limit is described over the genetic depiction and measures the way of the addressed game plan. The health limit is constantly issue subordinate. In case the components values not developing towards arrangement in may be directed to nearby minima to stay away from such conditions a Mutation (random variety in factors double string) could be performed by and large change

is performed after 100 to 1000 Crossovers. Straightforward generational hereditary calculation system:

- Choose the underlying populace of people
- Evaluate the wellness of every person in that populace
- Repeat on this era until end (time constrain, adequate)

## IV. PROPOSED METHODOLOGY

In proposed system five series compensators are used and each has capability of injecting the 0.1 voltage(PU), hence the number of variable for the given system is six, the initial population for the genesis selected to eight, the mutation to cross over ratio is selected to0.001and the goal tolerance is set to1percent.The genetic algorithm is used to calculate the optimum values for $V_{se}$, $i\angle\theta_i$ (where Vse,I represents the voltage generated by $i^{th}$ series compensator and $\theta_i$ is the angle of generated voltage) which gives the required Vo $\angle\theta_o$, the calculation and controlling is performed from central unit where the signals are generated from all other units and are controlled and monitored by the genetic algorithm at the centre.

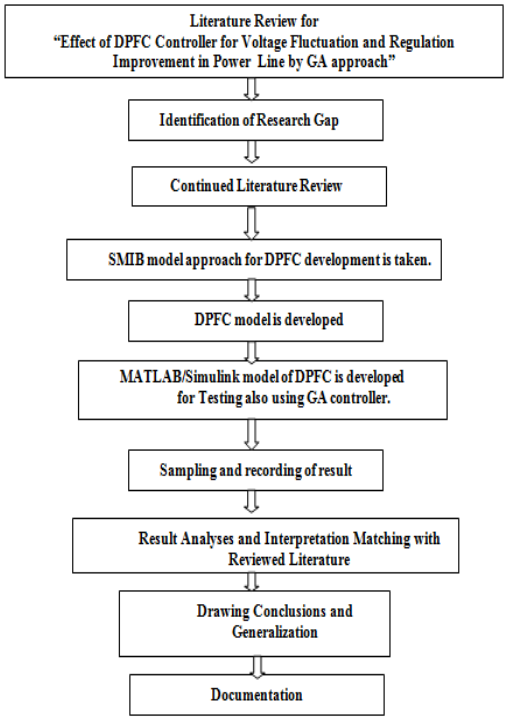


**Figure 4:** Flowchart for Research Undertaken

## V. SIMULATION & RESULT

The model of transmission framework is reproduced utilizing MATLAB. The Model of recreated system contains a 500KV power source which supplies the ability to a 100 MVA stack through a 500km long transmission line, for controlling five SSSC (20MVA) controllers are set at a few interims of line and a STATCOM of 100MVA is put close to the source.

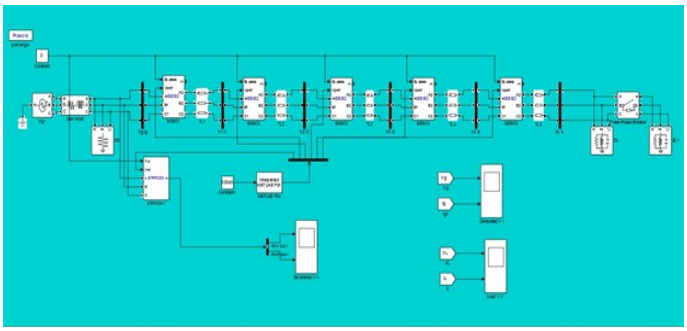

**Figure 5.** Diagram of the Simulated Model designed in Simulink

The model of dissertation work is shown above data of various components taken for result evaluation of 500KV transmission line is as follows.

**Table 1** Model Components Specification

| S.NO. | PARAMETER | SPECIFICATION | COMPONENT |
|---|---|---|---|
| 1 | Length | 500 km | Transmission line |
| 2 | Voltage | 500 KV | Transmission Voltage |
| 3 | Rating | 20 MVA, 500 KV | SSSC, of each |
| 4 | Rating | 100 MVA, 500KV | STATCOM |
| 5 | Rating | 100 MW | Load |

Reactive power is the amount of energy given to the system to create magnetic field, inside the system, it is very essential in electromechanical energy conversion devices. If any device is switched on first reactive power flows then creates necessary magnetic field after, this active power follows for work done.In general +Q is the convention which shows reactive power absorption in the power line here as shown by the plotted graph shown in Figure 7.1. Where –Q is the convention which shows reactive power injection in the power line also uncompensated line reactive power is shown in the plot.

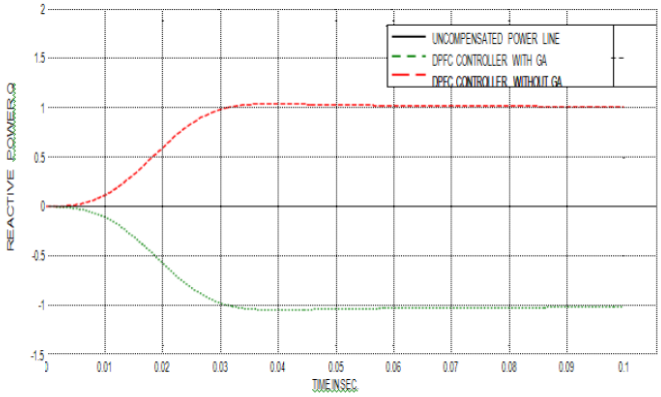


**Figure 6.** Reactive Power Compensation

In the Fig 7 voltage comparison plot of uncompensated power line and compensated power Line is shown. Here uncompensated lines are prone to voltage flickers (fluctuations), where from the graph it is clearly deduced that the compensated knower lines are not having fluctuation of voltages. From the fig 7 it is also cleared that DPFC controller damp the system oscillations whereas the response of DPFC controller with genetic algorithm as central controller is improved at generator bus side. The scope at the generator side measures the receptive energy to be infused by the FACT as voltage control. In the figure specified beneath it can be seen that there is an exponential ascent in Q (receptive power) without hereditary calculation control, while with the genetic algorithm control there is an exponential decay in the reactive power.

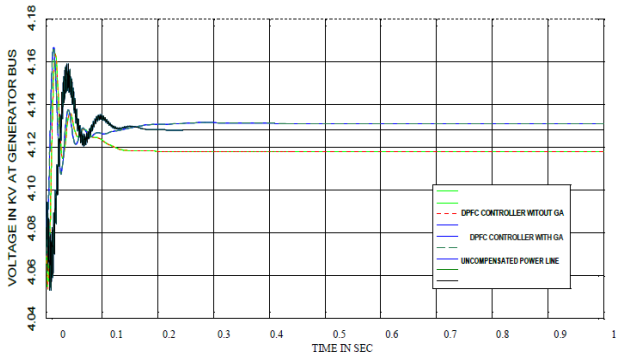


**Figure 7.** Voltage comparison plot at generator bus

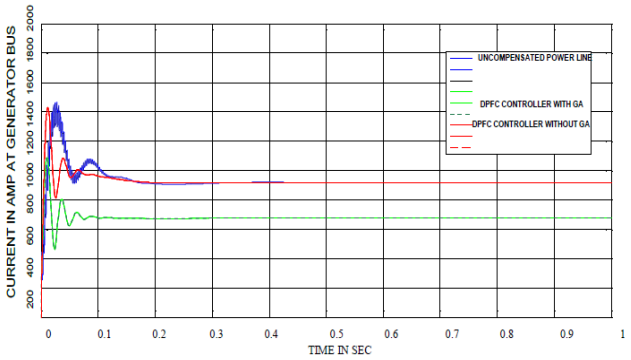


**Figure 8.** Current comparison plot at generator bus

As the generator transport voltage variances are diminished and framework turn out to be more steady by remunerated controllers conduct is additionally comprehend by the present examination plot as appeared in Fig 8.

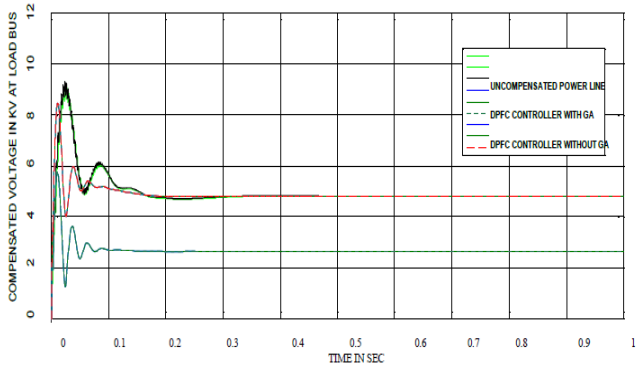


**Figure 9.** Compensated Voltage injection comparison plot at load bus

This decay of receptive power diminishes the infused voltage from 550 kv to 270 kv at load end as appeared in Fig 9.

As the generator bus voltage fluctuations are reduced and system become more stable by compensated controllers behavior is also understand by the current comparison plot as shown in Fig 9. As by the utilization of compensated controller DPFC improves the thermal loading of the power line, which is predicted by the current comparison plot.

Here in this dissertation work reduction of Voltage fluctuation and regulation improvement is shown. The Fig 9 expresses that the voltage to be injected is reduced from 490 kv to 290 kv which protects the system from achieving leading power factor and conclusively improves the voltage profile and regulation through STATCOM. Also power enhancement is achieved from the series FACT devices.

The fig 10 expresses the verification to the results i.e when voltage reduces the current increases due to short. circuit but here in this case with decrease in voltage current also decreases decreasing reactive power compensation, the current reduces from 90 amp to 55 amps.

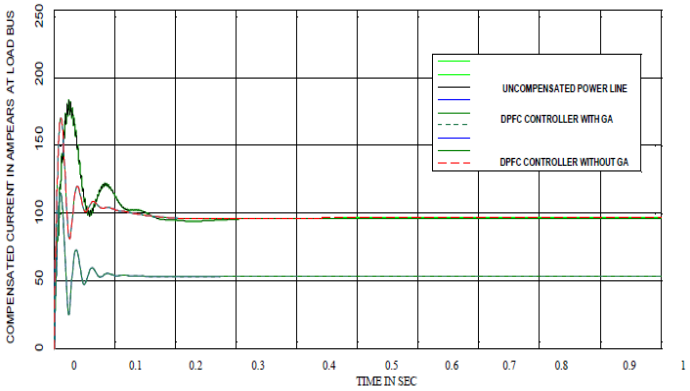


**Figure 10.** Compensated Current comparison plot at load bus

In this DPFC controller MATLAB/SIMULINK based model is that with the help of a total monitoring control of Vref of the FACTS devices via genetic algorithm control at one common bus the injection of voltage is controlled and reduced. This finally improves the voltage regulation and fluctuations in the system. Thermal loading limits of power line are also improved by the use of DPFC controller which improves the system response at the time of transient in the system. The model approach can be stably used for the smart grids and electrical power stations.

## VI. CONCLUSION

In this research Paper DPFC controller with Genetic Algorithm based central controller is implemented, which enhance the capability of controller and reduce the extra injection of compensation, voltage and current to the power line. This shows that genetic algorithm as Centralized

controller for the improvement of the performance of DPFC & the simulation results shows that the proposed algorithm works well and improves the load regulation and fluctuations by 19 percent from previous value. As due to reduction of voltage flickers and improvement of voltage regulation, power quality of power flow will also improve in power lines. This type of compensation system is need of future smart power lines as they have to transfer maximum power within thermal limits. DPFC controller possess three degree of freedom for controlling parameter and its distributed nature led to its effective power compensation then other controllers, thus it is having more utilization probability for smart system compensations. Thermal limit of power line is also improved by employing this controller which is also beneficial for power lines.

## VII. FUTURE SCOPE

It is aimed that the future of power system network will not be unidirectional else it will be bidirectional depending upon the consumption of power. so the need of distributed power system is necessary in the formation of smart grid and electric vehicles system which is the near stable future for power system. Hence these places will need more optimization in their work were work can be ahead carried above the approaches of genetic algorithms.

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