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DPFC CONTROLLING BY COORDINATION OF FACTS DEVICES USING GENETIC ALGORITHM

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Abstract: For the change of force frameworks different FACT gadgets are utilized yet the lumped gadgets dependably confront issue of higher appraisals and upkeep cost henceforth a recently create framework is proposed called DPFC (circulated Power Flow Controller) which comprises one shunt control converter and a few arrangement control converter this paper particularly manages coordination of dispersed units and controlling of every unit utilizing a concentrated controller taking into account hereditary calculation. The paper likewise demonstrates the reenactment consequences of the proposed calculation utilizing MATLAB/SIMULINK.
Keywords: DPFC (distributed power flow controller), Genetic Algorithm.

I. INTRODUCTION

The Distributed Power Flow Controller (DPFC) newly developed efficient FACT device, which provides much lower cost and higher reliability than conventional FACTS devices. It is a modified form of the UPFC and has the same capability of simultaneously adjusting impedance, transmission angle, and bus voltage magnitude of the power system. There is a basic need for all electrical system is to provide smooth supply to consumer, however the increased demand of electrical power makes the electrical network very complex and hence makes it difficult to control the power system, from recent times the FACT devices are employed for stabilization of power systems but the devices based on semiconductor technology are not excellent of perform under very high voltage and current conditions so the designing of a single semiconductor device operateble under such conditions is difficult and also it significantly reduces the life of device, this is why a reliable and low maintenance is always researched by engineers, the recently developed DPFC is a great proposal towards it. A DPFC is a kind of UPFC where a series converter is replace by some low rating series converters connected at some distance from each other. Since DPFC needs relatively small rating devices hence it decreases the cost of the devices used in FACTs and also it increases the reliability of the system as failure of one unit will not cause the system to fail. But the controlling and coordination of distributed units of DPFC is difficult because improper coordination between units can cause uneven distribution of power in units and fluctuations in transmission lines. The basic improvement performed over UPFC for the development of DPFC is the DPFC eliminates the common dc link between the shunt and series converters, instead it uses the transmission line to exchange active power between converters at the 3rd harmonic frequency, and as we have already discussed in previous paragraph Instead of one large three-phase converter, the DPFC employs multiple single phase converters (D-FACTS) as the series compensator. This concept reduces the rating of the components and provides a high reliability. Another significant preferred standpoint of DPFC over UPFC is that it can control every stage dynamic and responsive power stream and the voltage size independently in light of the fact that it uses the three single stage converters rather than one three stage converter, it gives the capacity normalizing the unequal current.

II. DPFC ARCHITECTURE & IMPLEMENTATION

The engineering of DPFC is like UPFC it contains a shunt converter gadget which is fundamentally a STATCOM this is appropriated rather the arrangement compensator is disseminated by various single stage converter the advancement of DPFC through UPFC is appeared in figure 1.

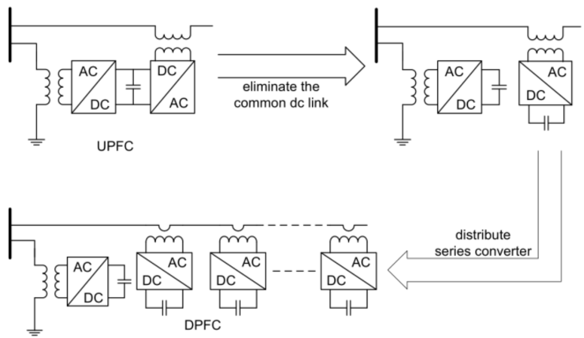

Figure 1: Evolution of DPFC from UPFC.

The analysis of figure shows 1. A UPFC contains a DC link between series and shunt compensators 2. Separation of common DC link by exchanging the power through transmission line 3. Division of series compensator into multiple single phase compensators. In addition of these modifications DPFC involve a high pass filter at the loading of line to provide return path for harmonic current produced by shunt converter figure 2.

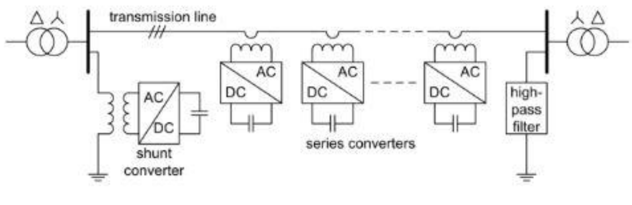

Figure 2: Complete diagram of DPFC.

The operating principle of the DPFC firstly contains the power exchange between FACT devices through AC transmission line instead of direct DC link as used with UPFC. The principal of exchanging the power is hidden in the principle of orthogonality of sine waves, as we all knows that sine wave and their integer multiples (also called harmonics) are orthogonal to each others, and according to theory we know that any one orthogonal component from their set can never affect any other orthogonal component of the set, hence we can say that the power generated at one frequency can be transmitted through transmission line without disturbing it integer multiple or harmonics the same conclusion is followed by the DPFC in which shunt converter takes the power from line at fundamental frequency and transmits the power for series converters at 3^{ed} harmonic.

III. STANDARD CONTROLLING OF DPFC

Because the DPFC contains two types of converters series and shunt it requires at least two separate controller but for operating the device efficiently it require a coordinated controlling between each device which is performed by centralized controller. Hence it requires three controllers as shown in figure 3.

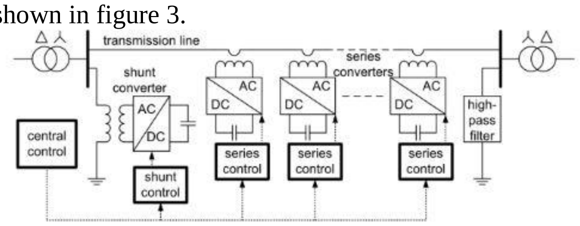

Figure 3: DPFC with series shunt and centralized controllers.

The two basic (shunt and series) controllers are dedicated controllers for each converter it contains all the control outputs required to control converter but some control inputs are externally feeded based on external controllability required or the controlling signals available from central controller. For the proper controlling of DPFC central controller has to be carefully designed because functionality of complete system depends upon it, conventional designs of controller contains analog controller based on system equations and dynamics.

IV. GENETIC ALGORITHM

Genetic algorithm is a mathematical model of natural evolution for searching of optimal solutions. In engineering many problems are faced where it is not possible to find exact solution from given data and relations hence an optimization technique is needed the genetic algorithm helps in quickly searching the solution even in very large domain. The basic of genetic algorithm is based on the rule of survival of the fittest, here the initial arbitrarily selected values of variables is evolved and promoted on the basis of their survival on fitness function, and the evolution is performed by selection, crossover and mutation as happened with natural process.

The algorithm is required following preprocessing:

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

The evolution usually starts from a population of randomly generated individuals and happens in generations. In each generation, the fitness of every individual in the population is evaluated, multiple individuals are stochastically selected from the current population (based on their fitness), and modified (recombined and possibly randomly mutated) to form a new population. The new population is then used in the next iteration of the algorithm. Commonly, the algorithm terminates when either a maximum number of generations has been produced, or a satisfactory fitness level has been reached for the population. If the algorithm has terminated due to a maximum number of generations, a satisfactory solution may or may not have been reached. The fitness function is defined over the genetic representation and measures the quality of the represented solution. The fitness function is always problem dependent. If the variables values not evolving towards solution in may be directed to local minima to avoid such conditions a mutation (random variation in variables binary string) could be performed generally mutation is performed after 100 to 1000 crossovers.

Simple generational genetic algorithm procedure:

1. Choose the initial population of individuals
2. Evaluate the fitness of each individual in that population
3. Repeat on this generation until termination

(time limit, sufficient fitness achieved, etc.):

1. Select the best-fit individuals for reproduction
2. Breed new individuals through crossover and mutation operations to give birth to offspring
3. Evaluate the individual fitness of new individuals
4. Replace least-fit population with new individuals
5. Proposed Algorithm

The proposed estimation uses genetic computation for central control unit and produces the control signals for each and every other unit. Since the estimation and controlling is performed from central unit all data is traded to that unit by some correspondence system in our work we are tolerating dedicated correspondence associate. It is expected that every single other unit contain some detecting gadgets which can detect the present, voltage and stage edge of the associated terminal, and they can send that information to the focal unit by the accessible correspondence interface. The genetic algorithm is used to calculate the optimum values for $V_{se,i}\angle\theta_i$ (where $V_{se,I}$ represents the voltage generated by ith series compensator and θ_i is the angle of generated voltage) which gives the required $V_o \angle\theta_o$, subject to $P_{sh,3} = P_{se,3}$ (where $P_{sh,3}$ is the power generated by the shunt compensator at 3rd harmonic and $P_{se,3}$ is the power required by series compensator at 3rd harmonic to generate desired compensation voltage.). In proposed system five course of action compensators are used and each has capacity of injecting the 0.1 voltage (PU), in this manner the amount of variable for the given structure is six, the basic masses for the qualities is decided to eight, the change to half and half extent is decided to 0.001 and the target resistance is set to 1 percent.

V. SIMULATION RESULTS

In proposed system five course of action compensators are used and each has capacity of imbuing the 0.1 voltage (PU), along these lines the amount of variable for the given structure is six, the fundamental masses for the qualities is decided to eight, the change to mixture extent is decided to

0.001 and the target resistance is set to 1 percent. The system shown below and the performance of the proposed system is measured for the switching load. The load is switched from 100MVA to 200MVA at t = 2 sec. and switched back to 100MVA at t = 3 sec.

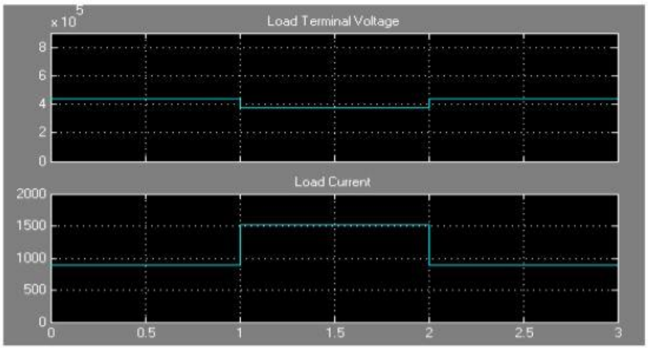

Figure 5: voltage and current at load when DPFC is turned off.

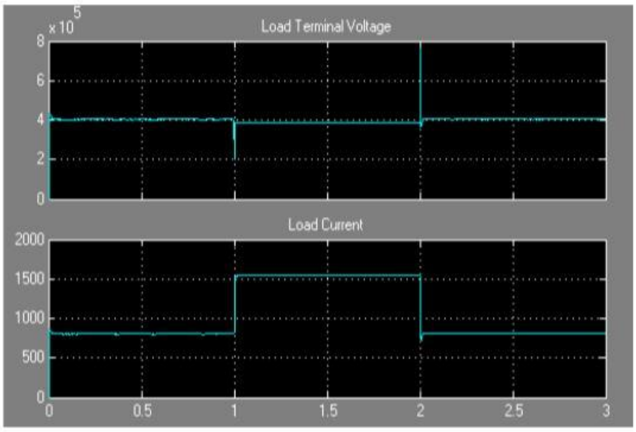

Figure 6: voltage and current at load when DPFC is turned on.

The reenactment comes about demonstrates what the DPFC is shunted the yield voltage flactuate from 440KV to 380KV amid the heap exchanging while for working DPFC the voltage fluctuates from 400KV to 390KV this shows extraordinary change in direction of framework with DPFC.

VI. CONCLUSION

The point of the paper is to utilize the hereditary calculation as incorporated controller for the change of the execution of DPFC and the reproduction comes about demonstrates that the proposed calculation functions admirably and enhances the heap direction from 15 percent to 2.5 rate. The proposed can be effortlessly changed to work properly even with disappointment of one of the arrangement converters. The execution of the proposed framework demonstrates that the advancement calculation can fill in as brought together controller for the DPFC subsequently in future other streamlining calculation like (PSO (Particle Swarm Optimization), Differential Evolution and so forth.) can likewise be utilized.

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