TRANSMISSION POWER LOSS MINIMIZATION IN POWER SYSTEM BY SVC USING FIREFLY ALGORITHM

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ABSTRACT

Power losses are the major problem in present power system scenario. It is possible to reduce the transmission line real & imaginary power losses using FACTS Controller. The location of placement of FACTS devices should be proper for loss reduction.

The SVC FACTS device can reduces the real & reactive power losses in transmission lines. The optimal placement of SVC is a challenging task . The accurate load flows is required for optimal placement of SVC in the transmission lines. The newton Raphson method is adopted for solving the power flows.

Our main objectives are to minimize the real & reactive power loss in transmission lines. The FACTS device SVC is used for economic operation and reduction of power losses.

In this paper I suggested Heuristic method of Firefly Algorithm (FF) for optimal placement of SVC for reduction of power losses. The result is compared with another standard method of optimization technique like Particle Swarm Optimization (PSO).

Keywords: NR Load flow, SVC, FACTS, Firefly.

I.INTRODUCTION

Now a days electrical power demand has been increased day by day while the expansion of power generation and transmission is limited due to restriction on resources and environment The construction and re modification of new transmission network is very difficult and it is uneconomical. Due to Continuous increase demand on power system, the major problem occurs to drop the voltage and increases transmission losses, Which may tends to loose the stability and reduces the efficiency of the power system.

The major technical losses depend upon the load. The load is increasing continuously which reduces the voltage profile and losses. To increase the voltage profile and reduces the losses in transmission system by reactive power compensation. To increase the voltage profile and reduces the transmission losses by injecting the reactive power at weak nodes.

The capacitance placement is one of the reactive power injection device. Power flow through AC transmission line is a function of line impedance, the magnitude and the phase angle between sending end and the receiving end voltages. While rapid development of power electronics , the FACTS devices such as SVC, TCSC, STATCOM, SSSC & UPFC etc. are being used.

In this paper we dealt with the SVC controllers to enhance the power flow and reduces the real and reactive losses in the transmission system. The action & reliability of SVC is faster than capacitors. I have proposed the Firefly Algorithm to minimize the losses in transmission system using FACTS device SVC.

II. PROBLEM FORMULATION

2.1 NR Method Flow:

The methods of calculating Load Flow are extremely important in assessing the state of power system. The Newton Raphson method is a powerful tools of solving nonlinear algebraic solutions. The convergence is sure as compare to GS method .

2.2 SVC Models:

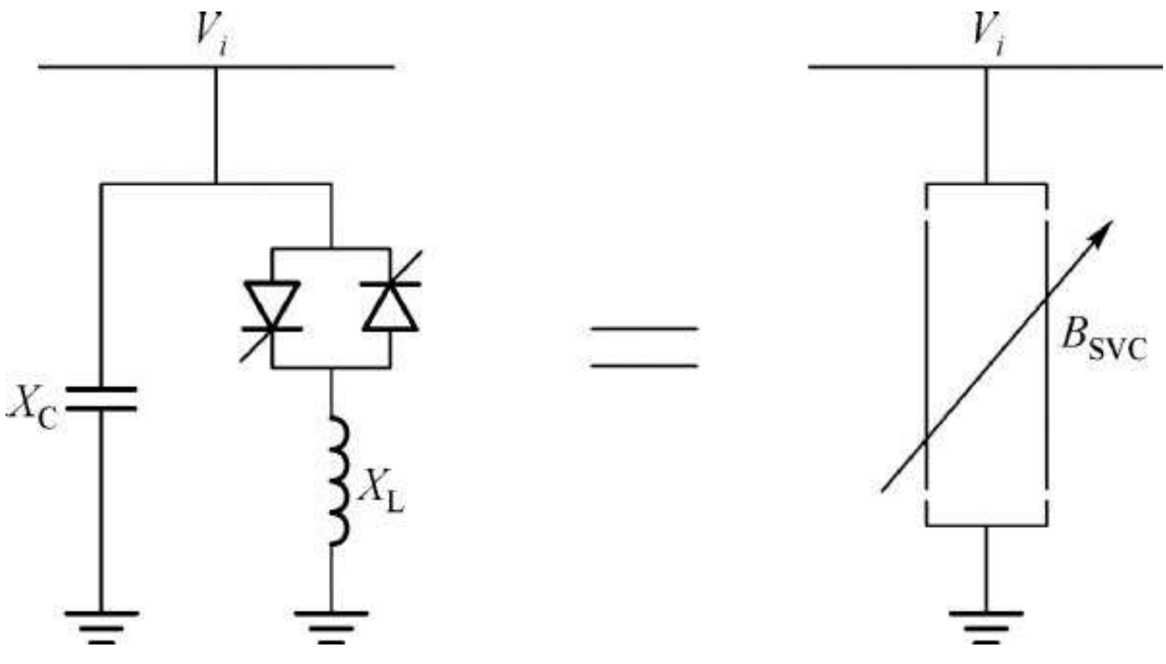

Fig 2.1 SVC Structure and variable shunt susceptance.

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The SVC has adjustable reactance with reactance limits. The SVC can be generate or absorb reactive power by synchronously switching capacitor and reactor banks . Te capacitor and reactor is " in " or " out " according to requirements of reactive power.

The normalization of the resistance of the line is obtained by relating it to a calculated basic resistance by means of the voltage (V_{Base}) and the power (S_{Base}). If the base voltage is given in kV and the power in kVA then, this resistance is given by:

$$R_B = \frac{10^3 V_{Base}^2}{S_{Base}} \quad (2.1)$$

The normalized resistance is then:

$$R = \frac{r}{R_B} \quad (2.2)$$

Standardized load ratings are obtained by:

$$\begin{cases} Pl = \frac{Pl}{S_{Base}} \\ Ql = \frac{Ql}{S_{Base}} \end{cases} \quad (2.3)$$

2.3 Reduction of Active Power Losses

The reduction of the power losses due to a battery "k" is equal to the difference of the losses of active power in the network before and after the installation of the said capacitor bank. It is given by:

$$\Delta P_k = P_{av_k} - P_{ap_k} \quad (4.10)$$

Where,

P_{av_k}: are the active power losses in line before compensation.

P_{ap_k}: are active power losses in line after compensation.

2.4 Reduction of Reactive Power Losses

The reduction of the reactive power losses due to a battery installed at node "k" of the distribution line is defined by the difference between the losses before and after the installation of batteries in question of capacitors. It is given by:

$$\Delta Q_k = Q_{av_k} - Q_{ap_k} \quad (4.11)$$

Where,

Q_{av_k}: are the losses of reactive power in line before compensation.

Q_{ap_k}: are the losses of reactive power in line after compen

III.FIREFLY ALGORITHM

Heuristic methods may be used to solve complex optimization problems. In mathematical optimization, the firefly algorithm is a metaheuristic proposed by Xin-She Yang and inspired by the flashing behavior of fireflies.

In pseudocode the algorithm can be stated as:

Begin,

1) Objective function:

2) Generate an initial population of fireflies ;.

3) Formulate light intensity *I* so that it is associated with

(for example, for maximization problems, or simply ;)

4) Define absorption coefficient γ

```
        While (t < MaxGeneration)
          for i = 1 : n (all n fireflies)
            while (t< MaxGeneration)
              for i = 1 : n (all n fireflies)
                for j = 1 : n (n fireflies)

                    if (        ),

                    Vary attractiveness with distance r via         ;
                     move firefly i towards j;
                    Evaluate new solutions and update light intensity;
                  end if
                end for j
        end for i
      Rank fireflies and find the current best;
    end while
  Post-processing the results and visualization;
end
```

The flowchart of firefly algorithm is given below.

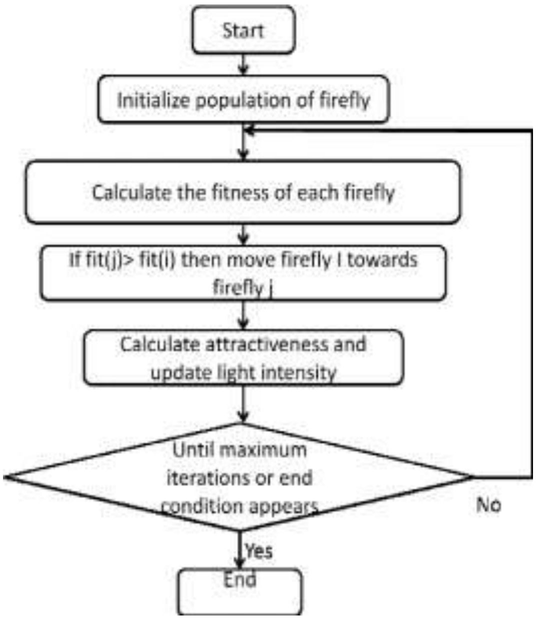

Fig 3.1 Firefly Algorithm flowchart

IV.DEVELOPMENT OF THE PROPOSED METHOD

Algorithm for the proposed work

Step1: IEEE bus network data must be collected.

Step2: To Carried out Newton Raphson load flow. Here maximum iteration permitted to 100.

To calculate real & reactive power loss.

Step3: Now initialize the firefly algorithm. and calculate the fitness value. The FF results in proper compensation range of SVC to reduce the power loss in the system.

Step4: At the end of load flow , the losses in the systems will be minimized.

V.RESULTS & DISCUSSION:

A MATLAB coding is developed for Firefly algorithm. The test is carried out on IEEE 14 bus system. The number of iterations is permitted 100 and swarm size is 20. Compare the results with Heuristic Methods of Particle Swarm Optimization (PSO) and Cultural Algorithm (CA).

5.1 IEEE 14 Bus system:

Tabulation of Results:

Table: 1 Comparison of power losses with PSO,CA & FF

	IEEE 14 Bus			
Heuristic Methods	**Active Power (MW)**		**Reactive Power (MVar)**	
	Without	With	Without	With

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	compensation	Compensation	compensation	Compensation
PSO_SVC	**13.7214**	**13.7063**	**56.5404**	**55.5803**
CA_SVC	**13.7214**	**13.6997**	**56.5404**	**55.4893**
FF_SVC	**13.7214**	**13.6882**	**56.5404**	**55.5522**

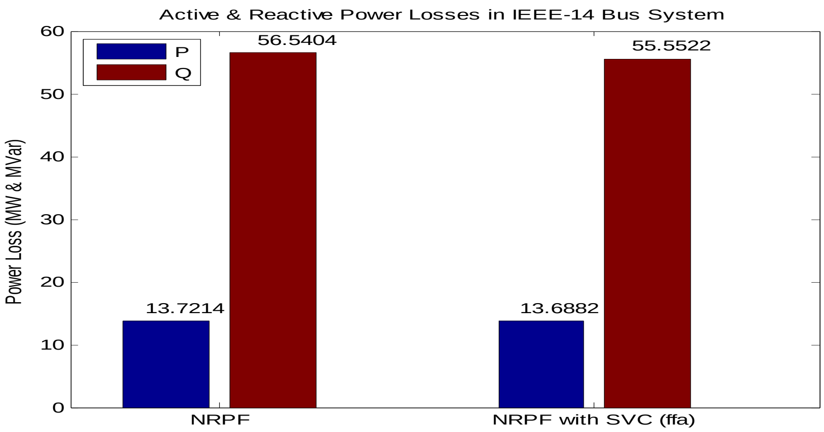

Fig.5.1 Active and Reactive Power Losses in IEEE 14 Bus system by SVC using FF

VI.CONCLUSION

The performance of FF is better than PSO and CA. The Firefly Algorithm is carried out on IEEE 14 Bus system. The reactive power compensation and reduction of losses in transmission system is a need for rapid development of nation. The electronics devices such as FACTS is more sensitive, reliable and rapid action devices than others. The SVC could help to increase the voltage profile and reduce the power losses in the system.

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