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UPFC Using For The Congestion Management Lines In Electricity Market Restructured Using PSO and GA Algorithm

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Abstract: One of the most important issues related to restructured power systems is congestion transmission. The fundamental problem in dealing with various methods from the power industry researchers and practitioners are presented. In this paper, optimal positioning of UPFC based on PSO and genetic algorithm for Transmission congestion management in power systems using restructured review and the results are compared.

Key words: location optimization, GA, congestion management, UPFC, PSO.

INTRODUCTION

One of the most important issues restructured systems, network density is transferred. In dealing with this problem various methods from basic researchers and those involved give power industry. And include that the contract path method and critical factors, and cost transfer pricing method, method of using FACTS devices, etc. could be mentioned. The purpose of these procedures under the proposed congestion management are the first information to create mechanisms for attracting participation subscribers and prevent the occurrence of network congestion or density, and then resolve potential network densities using the methods are fair and transparent.

Restructuring of power systems in many countries following income had an important and has led to the use of common equipment to be more FACTS day. Since the power transmission network limitations essentially controlled flow removable or network is reduced, so use of these elements density for the management seems very useful. The application issues FACTS, a place for the true and accurate to maximize profits FACTS expensive equipment and management is optimum density lines.

The most important studies done in the field of FACTS devices for the management, density, UPFC can be used in different ways to manage the density. These methods based on market and generally are used in Europe. Based method, divided into geographic market and the use of FACTS elements between areas divided according to specific methods of density management. These methods include using mutual exchange, share market and auction market in the border area between the two is dense. But the most important issues in these field placement FACTS devices are optimized. Placement for problem solving many optimization methods FACTS devices such as linear and nonlinear programming, neural networks, fuzzy logic, steel plating and intelligent algorithms are used. Intelligent algorithms such as genetic algorithms (Saguan *et al*., 2004: Nabavi *et al*., 2006). and PSO algorithm due to the inherent characteristics of natural and simple to understand, be understood, using knowledge of human and living, etc. them to make appropriate problem solving discussion.

Algorithm PSO, for the first time in 1995 by Eberhart and Kennedy as an optimization method was introduced. This algorithm is a social search algorithm that models the social behavior of birds has clubs and governing in order to discover patterns and sudden change in flight path of birds at the same time they change and shape optimization is applied to categories. The work of PSO is based on the principle that every moment of each particle in your location search space the best place so far has been the best of his neighborhood where there is total, is set .

In Reference (Chen Zhang Shu 2005). of the PSO method for solving OPF market for shared congestion management is used. The main purpose of this reference for managing congestion at least cost and demand on active buying power with system reliability is preserved. In reference (Meena Selvi 2005). with the presence of TCSC, PSO algorithm for optimized playback on with the aim to minimize the congestion charge has been used. In this reference, TCSC in line performance and high-density installation of the two models (without the data-sharing market and bilateral market-sharing with mutual agreement) is analyzed. The results show that presented method can effectively change in density with the minimum production cost and minimum density, improve. The results also indicate that in some cases due to TCSC line installation cost, cost, density is increased.

Effective in congestion management, optimal placement FACTS devices in the network is the power of reference (Gitizadeh and Kalantar 2008). placement optimal TCSC and SVC in a IEEE 14 bus standard system evaluated the results shows the line density to eliminate condensation and voltage profile is improved. Also in Reference (Barati Ehsan Fotuhi-Firuzabad 2006). the optimal placement UPFC using genetic algorithm

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evaluated the results of UPFC placement showed reduced production cost, cost, density, improved density lines and Profiles is the voltage. The reference genetic algorithm placement UPFC for congestion management market is shared use. In reference (Kazemi Sharifi 2006). the optimal placement TCPS using criteria based on real power in the market for the management of shared and mutual density is taken into consideration. In this reference system as the standard IEEE 30 bus system used and studied by MATLAB7.0

Programming was conducted and the maximum social welfare for selecting the best location of TCPS is considered.

In reference (Saravanan and Mary Raja Slochanal 2006). one of the applications of PSO to identify the best location of FACTS devices to install minimum cost of FACTS devices has been paid. The temperature limit reference voltage lines and limit bus is considered. In reference 3 type FACTS devices the SVC, TCSC and UPFC used on the system and IEEE 30 bus, IEEE 118 bus and IEEE 6 bus tested is. The results show that UPFC capacity is on the system but the high installation costs. TCSC installed in the minimum cost recovery system load capacity is better.

In reference (Shaheen and Rashed Cheng 2008). the best location of UPFC with the optimization parameters is analyzed. The reference PSO and genetic algorithms for achieving this goal has been used. Simulation system for the IEEE 6 bus and IEEE 14 bus is used. The results show that both algorithms for solving the problem of high quality, specifications and performance integration constant calculation, well have. The results also show that the PSO technique at the beginning of GA optimization is faster, but with increased production, genetic algorithm, the PSO is better. In terms of computing time of the PSO technique is faster than GA.

The fact that, UPFC the most important and most widely used FACTS devices considered goes; this article placement optimal UPFC using PSO algorithm on the system IEEE 30 bus (Zimmermann and Gan 2005). Transmission congestion management for power systems restructured is used.

Algorithm Method Birds Community:

Birds in the community position algorithm to record the motion of particles and their neighbors will change. Each particle is a position that we show with $\vec{x}_i(t)$ Shows that this position P_i st particle is the time t. In this algorithm each particle addition to the speed of a location is required:

$$\vec{v}_i(t) = \vec{x}_i(t) - \vec{x}_i(t-1) \tag{1}$$

Algorithm community with a group of birds random answers to start, then answer the problem by optimization problem with space to make deals to search generations. Each particle as multidimensional with two values that x_{id} and v_{id} respectively Referrals location and speed to the situation after d_{st} of my i are particle is defined.

At each stage of the population moves every particle with two values is the best to date. The first value, the best answer so far is in terms of competence for each particle separately obtained and this value is called p_best . Another best value by the algorithm is obtained social birds; the best value so far by all particles in the population has obtained the best overall value and g_best is called. After p_best and g_best by the amount and speed of each particle according to its new location in relationship to that:

$$v_{id}(t+1) = w.v_{id}(t) + c_1.rand(p\_best_{id} - x_{id}) + c_2.rand(g\_best_d - x_{id}) \tag{2}$$

$$x_{id}(t+1) = x_{id}(t) + v_{id}(t+1) \tag{3}$$

Top w in the relationship, weight, c_1 and c_2 factors, learning, and $rand$ a random number in the range (1, 0) is. To prevent algorithm divergence, the final value of each particle velocity is limited.

$$v_{id} \in [-v_{\max} \ , v_{\min}] \tag{4}$$

w, c_1 and c_2 of the algorithm parameters are social birds. And convergence is dependent value for this parameter. Here, the procedure is usually equal to c_1 and c_2 and the number 2.05 is assumed. Convergence strongly depends on the amount of w is better dynamic and must be defined. Thus, the linear trend in the evolution of population 0.4 to 0.9 decreases. Initially this number must be large as possible by good answers to provide early and late stages Small w causes a better convergence. This reduction in the related form can be defined.

$$w = w_{max} - \frac{w_{max} - w_{min}}{iter_{max}} \times iter \quad (5)$$

This algorithm is the corresponding topology on. In this algorithm each particle movement relying on its experience and knowledge of all other particles is performed. Therefore, it is clear that the integrity of the community is many and complete communication is established between the particles.

The algorithm steps are:

1 - Basic population is formed randomly.
2 - Determine the competence of particles with their present position.
3 - Comparison of current competence and the best experiences of particles and their necessary replacement.
4 - Comparison of current competence of each particle's best previous result of all particles.
5 - Set the speed vector for each particle using the relationship 2.
6 - Move with their new positions related to particle 3.
7 - Return to step 2 and repeat the algorithm to reach convergence.

Genetic Algorithm:

A genetic algorithm GA searches technique in computer science to find the optimal solution and search problems. Genetic algorithms, evolutionary algorithms are one of the types of biological science such as inheritance, mutation, selection of sudden, natural selection and composition is inspired. Genetic algorithms on a set of solutions called the population, will work. A crowd of people, which are strings of numbers are called chromosomes, and contains information encoded parameters have to decide. Typically, 30 to 100 people including the person that in some matters, the number to about 10 individuals are also used. At the beginning of solving several random features to create the first generation are produced. During each generation, each attribute is evaluated fitness value (fitness) is measured by the fitness function. The next step is to create a second generation of community-based selection processes, production of selected characteristics on the genetic operators are: connecting chromosomes to each other and change over.

For each person, a parent pair is selected. Preferences are such that the appropriate elements to be selected, even the weakest elements also have the chance to choose from approaching the local response prevents. Connection creates two child chromosomes, which are added to the next generation. The next step is to change the new offspring. Genetic algorithms and prove a possibility that a small change. The degree of probability with the show P_m . P_m rates reflect mutations or mutations that is likely based on the number of mutant genes obtained. Based on this possibility, child chromosomes are randomly changed or find a mutation. This process led to a new generation of chromosomes is such that the previous generation is different. The whole process repeats for the next generation is, pairs are selected for the composition, the third generation of the population comes into existence and the process is repeated until we reach the last stage.

The proposed method problem solving:

FACTS devices include installation has two stages. First location in the network equipment should be specified and then control the device parameters for the desired goal should be optimal. Method first proposed standard system IEEE 30 bus (Figure 1) to test on it and share the load chosen regardless of UPFC on the values and passing power lines we calculated. Then the effect of UPFC in all different places, UPFC based on the desired sensitivity Replacement and doing calculations, density lines with and without UPFC gain. Calculations performed with UPFC Replacement in many different places and algorithm PSO (programming algorithm in MATLAB) continued and finally the most optimal location of UPFC installation, we manage specific density.

To determine the best relationship 6 is a multiple function and define it as we choose the objective function. Therefore, the aim of obtaining the minimum objective function and the implementation of the algorithm is to remove congestion.In this regard, V_i , $\cos t$, $loss$ and TCC , respectively, bus voltage, the production cost, total mortality is density and cost. Coefficients α , β and γ coefficients also are coordinating with the $\cos t$ so:

$$\alpha = 36000,\ \beta = 900,\ \gamma = 16$$

$$f = \alpha \sum_{i=2}^{i=14} \left| (1.05 - V_i) - (0.95 - V_i) \right| + \cos t + \beta.loss + \gamma.TCC \quad (6)$$

$$C_i = \sum_{i=1}^{N_g} C_{gi}.P_{gi} \quad (7)$$

$$TCC = \sum_{i-1}^{Nb} P_i^D \lambda_i - \sum_{i=1}^{Nb} P_i^G \lambda_i \quad (8)$$

Ties 7 and 8 respectively to relations of production and total cost of congestion costs are (Barati and Ehsan Fotuhi-Firuzabad 2006). In addition to the above relations, limitations and constraints related to the bus voltage and active power productions as well as nine are defined relationship.

$$P_{gi}^{\min} \le P_{gi} \le P_{gi}^{\max} \ , \ V_i^{\min} \le V_i \le V_i^{\max} \qquad (9)$$

The constraints and limitations of the UPFC control parameters are considered as follows:

$$\begin{aligned} &V_{se}^{\min} \le V_{se} \le V_{se}^{\max} \ , \quad \delta_{se}^{\min} \le \delta_{se} \le \delta_{se}^{\max} \\ &V_{sh}^{\min} \le V_{sh} \le V_{sh}^{\max} \ , \quad \delta_{sh}^{\min} \le \delta_{sh} \le \delta_{sh}^{\max} \end{aligned} \qquad (10)$$

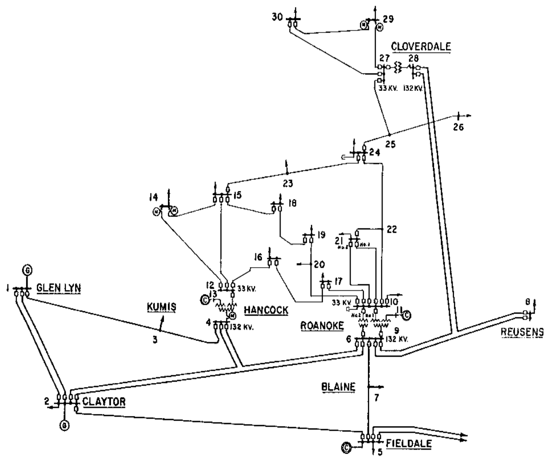

Fig. 1: Sample system used (IEEE 30 bus).

UPFC model used in the algorithm implementation:

The UPFC power injection model shown in Figure 2 has been widely used in research and studies on the impact of UPFC system. Therefore this model for simulation and implementation of the algorithm is used.

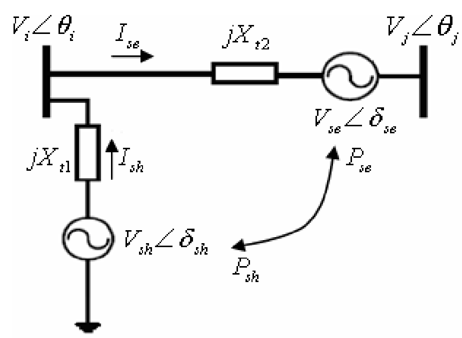

Fig. 2: UPFC power injection model.

Relations used in the model according to Figure 2 are:

$$P_{sh} = -V_i V_{sh} \sin(\theta_i - \delta_{sh}) / X_{t1} \qquad (11)$$

$$Q_{sh} = V_i \left(V_{sh} \cos(\theta_i - \delta_{sh}) - V_i\right) / X_{t1} \qquad (13)$$

$$P_{to} = V_j \left(V_{se} \sin(\theta_j - \delta_{se}) - V_i \sin(\theta_j - \theta_i)\right) / X_{t2} \qquad (14)$$

$$Q_{to} = -V_j \left(V_j - V_i \cos(\theta_j - \theta_i)\right) + V_{se} \cos(\theta_j - \delta_{se}) / X_{t2} \qquad (15)$$

Any population structure in the implementation of the PSO algorithm is shown in Figure 3. Based on the length of a population that is 6 Location UPFC placement represent and also show parameters UPFC.

bus_i	bus_j	V_{sh}	V_{se}	δ_1	δ_2

Fig. 3: Structure of each population.

LMP in the calculation to this point is that the buses that the generator is installed if the cost is $P^{\min}\langle P\langle P^{\max}$ generators operating in the proposed set of LMP but when $P \geq P^{\max}$ or $P \leq P^{\min}$ is LMP is determined by the system.

Now considering the above relations, distribution of samples on the system and results based on the power lines crossing between then obtained by considering the density values using the algorithm lines PSO, placement optimal UPFC and optimized for playback on obtaining the best location of UPFC in terms of density delete lines continued.

Results and discussions on the system studied:

Method presented in three cases has been reviewed:

In the first case: the system without UPFC and the line density isn't limited.

Second case: In this mode density limit for 60MW lines there. Using genetic algorithms and positioning UPFC, problem is solved.

Third case: In this mode density limit for 60MW lines there. Using PSO algorithms and positioning UPFC, problem is solved.

Cost function coefficients and proposed sale of energy is shown in Table 1. Value of each generator power production is given in Table 2 is noted as being expensive because of any purchase of generator 2 has been done. The UPFC and linear parameters in Table 3 for all buses is given which must be exposed is shown. In Table 4 of the algorithm implemented general information shown is.

Table 1: Cost function coefficients and proposed energy sales.

Bus No.	α	β	γ	Bid ($/MWh)	P_{max}	P_{min}
1	100	2	0.02	4	0	90
2	100	10.75	0.0175	10	0	90
13	100	3	0.025	4	0	40
22	100	1	0.0625	6	0	50
23	100	3	0.025	4	0	30
27	100	3.25	0.00834	5	0	55

Table 2: The rate of production power generators.

Bus No.	The active powers generators in case 1	The active powers generators in case 2	The active powers generators in case 3
1	85.00	86.440	86.580
2	0	0	0
13	40.00	40.00	40.00
22	45.980	49.320	49.550
23	30.00	28.650	27.00
27	55.00	55.00	55.00

Table 3: parameters UPFC.

algorithm	GA	PSO
UPFC installed	Line 8-6	Line 28-6
V_{sh}	0.06	0.22
V_{se}	0.16	0.24
δ_{sh}	-129	-8.58
δ_{se}	-56	-142.73

Table 4: General Information results from algorithm implementation.

General Information	Case 1	Case 2	Case 3
Total loss	5.026	6.741	5.592
Total generation	250.984	259.45	252.54
Total congestion charge	384	315	309
Total generation cost	1469.3	1409.5	1389.1
Numeric value function f	5788	5780	5698
Power flow in line 1-2	62.965	52.053	41.998

According to Table 4 in-line density value of 1-2 in both algorithms amounts less than 60 MW has come fix the line density show. In line with the rest passing ability is normal Listen.

Total amount of congestion costs in the second mode 315$/h and mode 3 309$/h is derived. Also, the total amount of production costs in the second case, d is set in 1409$/h but that amount in case 3, obtained in 1389$/h indicate that a better performance than the PSO algorithm and genetic algorithm further increase social welfare in the third mode is. The best place to install the UPFC on line 8-6 of genetic algorithm and PSO algorithm, lines 28-6 is set.

Conclusion:

Results for the three cases studied show that the PSO algorithm to solve the genetic algorithm and increased density has better social welfare. The results also indicate that the convergence speed of PSO algorithm is higher than the genetic algorithm.

As a result, the congestion management method using FACTS devices, despite being expensive, these elements, given that the optimal use of these elements in terms of what type of equipment used and what the best location in terms of installation, eventually reduced cost to the consumer is. So it seems that the use of UPFC and the PSO algorithm for fast convergence to more congestion management costs and reduce production cost and density compared to other similar methods including genetic algorithm is more priority.Read phonetically.

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