Australian Journal of Basic and Applied Sciences, 10(15) October 2016, Pages: 183-193

AUSTRALIAN JOURNAL OF BASIC AND APPLIED SCIENCES

ISSN:1991-8178 EISSN: 2309-8414
Journal home page: www.ajbasweb.com

Sensitivity Based Optimal Real Power Rescheduling For Congestion Management Using Black Hole Algorithm

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ARTICLE INFO

Article history:
Received 26 August 2016
Accepted 10 October 2016
Published 18 October 2016

Keywords:
Congestion management; sensitivity factor; real power rescheduling; deregulated power system; black hole algorithm.

ABSTRACT

Transmission congestion management is critical issue in the operation of deregulated power markets. Ensuring sufficient transmission capacity is vital to realize all power transactions. Optimal power schedule corresponding to market clearing price may cause overloading of transmission lines in competitive markets. Optimal real power schedule related to minimum cost needs to be rescheduled for avoiding line overloading. In this paper, transmission congestion alleviation is done by changing the pattern of real power generation from the different generators. The objective of this work is to minimize the cost involving in rescheduling of real power for managing transmission congestion. Transmission congestion cost is the objective and the control variables in this problem are the real power output from different generators of the system. The generators that are more sensitive to the power flow in the congested lines are identified with the help of real power sensitivity index. The generators that are more responsible for the congestion in a line are given more priority in this rescheduling problem. A new optimization method based on the recently proposed black hole algorithm (BHA) is used for identifying the optimal generation pattern for avoiding congestion. The algorithm mimics the existence of black hole in the space and easy to be implemented for any optimization problem. The effectiveness of the algorithm is validated by testing it on the modified IEEE-30 bus system. The results obtained are compared with that of particle swarm optimization (PSO) and big bang big crunch (BBBC) algorithms. The obtained numerical results are much encouraging and validated.

INTRODUCTION

In general, deregulated power markets are with limited resources of power transferring capability because of environmental, right-of-way (ROW) and socio-economic reasons. Generation schedule corresponding to marketing clearing price results mostly in increased power loss and poses threat to the security of the power system networks (De Vries, 2001) and (Lommerdal and Soder, 2003).Congestion relief is necessary and various congestion management approaches applicable for different power markets are discussed in the literatures (Lo *et al*., 2000) and (Rajesh and Jacob Raglend, 2015). Still the necessity for new approaches for solving congestion management problem continues forever (Shirmohammadi *et al*., 1998). In (Verma and Mukherjee, 2016), optimal real power re-dispatch is suggested for transmission congestion management. Social welfare maximization based transmission congestion method is discussed in Masoud and Aref (2011). Distributed power generators are discussed for congestion relief in power systems (Sarwar and Siddiqui, 2015). An alternative approach based on topology change is presented in Han and Papavasiliou (2015) as an efficient way of congestion mitigation. A coordinated approach between generating companies and system operator for congestion management using Benders cuts is discussed by Yamina and Shahidehpour (2003).

To Cite This Article: Ramachandran R and Arun M., Sensitivity Based Optimal Real Power Rescheduling For Congestion Management Using Black Hole Algorithm. ***Aust. J. Basic & Appl. Sci.,*** *10(15): 183-193, 2016*

Locational Marginal Price (LMP) is used as a signal for congestion management (Kumar and Mohan, 2016) by adjusting the generator power output. Flexible AC transmission systems (FACTS) devices are used for congestion management by changing the power flow pattern in a power system network. This approach is suitable only when the level of congestion is small. Some of the FACTS devices used for transmission congestion alleviation are: Thyristor-Controlled Series Compensator (TCSC) and Thyristor Controlled Phase Angle Regulator (TCPAR) (Patel and Paliwal, 2015) and (Hooshmand *et al*., 2015). Congestion caused by voltage instability and thermal overload is taken in (Suganthi *et al*., 2015). Real power rescheduling based on relative electrical distance is adopted to alleviate line overload in (Yesuratnam and Thukaram, 2007). This method does not take into account the optimization of cost when the generators have different cost functions. Srivastava and Kumar (2000) followed load curtailment method for managing congestion in a network.

Recently, evolutionary algorithms are proposed to optimize the rescheduling cost of real power output from synchronous generators. Evolutionary Programming (EP) algorithm is used for rescheduling of real power generation for congestion management is presented Ramasubramanian *et al*. (2012). Optimal congestion management in an electricity market using bacterial foraging optimization (BFA) is done by Panigrahi and Pandi (2009). Visalakshi and Baskar (2011) used a modified NSGA II algorithm based model for the decentralized congestion management problem in the deregulated forward power market. Bio geography algorithm based loadability limit enhancement is presented in (Arunachalam and Logamani, 2015) for congestion alleviation.

In the present work, the recently developed nature inspired simple and efficient technique of BHA is taken for minimizing total congestion cost by the rescheduling of real power for congestion management. In this congestion management scheme by real power rescheduling in a generator, the amount of rescheduling of power is decided by the sensitivity of that generator to the power flow in the congested line. Pattern of changing the real power schedule is not done in a random manner only the participating generators are taken. This minimizes the total congestion cost. The algorithm is easy to implement and with less number of parameters to be tuned in obtaining the nearly global best solutions.

Black Hole Phenomenon:

John Michell and Pierre Laplace identified the absence of star by integrating Newton's law but the absence of star was not called as black hole in those days. John Wheeler, an American physicist first named the phenomenon of mass collapsing or absence of star as a black hole. A black hole in the space is left when a star or massive sized planet gets collapsed. Black hole swallows and vanishes any object that comes nearer to its boundary. The sphere-shaped boundary of a black hole is called as the event horizon whose radius is named as the Schwarzschild radius. The Schwarzschild radius is calculated by the following equation:

$$R = \frac{2GM}{C^2} \tag{1}$$

Where, G is the gravitational constant, M is the mass of the black hole, and C is the velocity of light.

Black Hole Algorithm (BHA) Hatamlou, (2013):

Like the other meta-heuristics algorithms, a population of randomly distributed candidate solutions are created in the problem space. Population-based algorithms use different techniques to move the individuals towards the global best solution by a certain technique. For instance, mutation and crossover are the techniques used in GA. PSO takes the individual best and global best solutions for moving the initial solution to the global best solutions.

In BHA, the evolution of the population is achieved by moving all the candidates towards the best candidate in each iteration namely, the black hole and replacing those candidates that enter within the range of the black hole by newly generated candidates in the solution space. In BHA the best candidate among all the candidates at each iteration is selected as a black hole. Then, all the candidates are moved towards the black hole based on their current location and a random number. The searching mechanism of BHA is as under:

A randomly generated population of solutions is taken as the initialization process. Then the fitness values of the population are evaluated and the best solution whose fitness value is the best one is the black hole. After initializing the black hole and stars, the black hole starts absorbing the stars around it and all the stars start moving towards the black hole. The absorption of stars by the black hole is mathematically formulated as follows:

$$x_i(t) = x_i(t-1) + rand(0,1)(x_{BH} -, x_i(t-1)) \tag{2}$$

Where, $x_i(t)$ and $x_i(t-1)$ are the locations of the i^{th} star at iterations t and $t-1$, respectively. x_{BH} is the location of the black hole in the search space. rand is a random number in the interval (0, 1). N is the number of stars (candidate solutions).While moving towards the black hole, a star may reach a location with lower cost than the black hole. In such a case, the black hole moves to the location of that star and vice versa. Then the BHA will continue with the black hole in the new location and then stars start moving towards this new location. In addition, there is the probability of crossing the event horizon during moving stars towards the black hole. Every candidate solution that crosses the event horizon of the black hole will be sucked by the black hole. Every time a candidate star dies and another candidate solution is born and distributed randomly in the search space and starts for a new search. This is done to keep the number of population size constant. The next iteration takes place after all the stars have been moved. The radius of the event horizon in the black hole algorithm is calculated using the following equation:

$$R = \frac{f_{BH}}{\sum_{i=1}^{N} f_i} \tag{3}$$

Where, f_{BH} is the fitness value of the black hole and f_i is the fitness value of the i^{th} star. N is the number of candidate solutions. When the distance between a candidate solution and the black hole is less than R, that candidate is collapsed and a new candidate is created and distributed randomly in the search space. Based on the above description the flow chart for BHA is shown in figure (1)

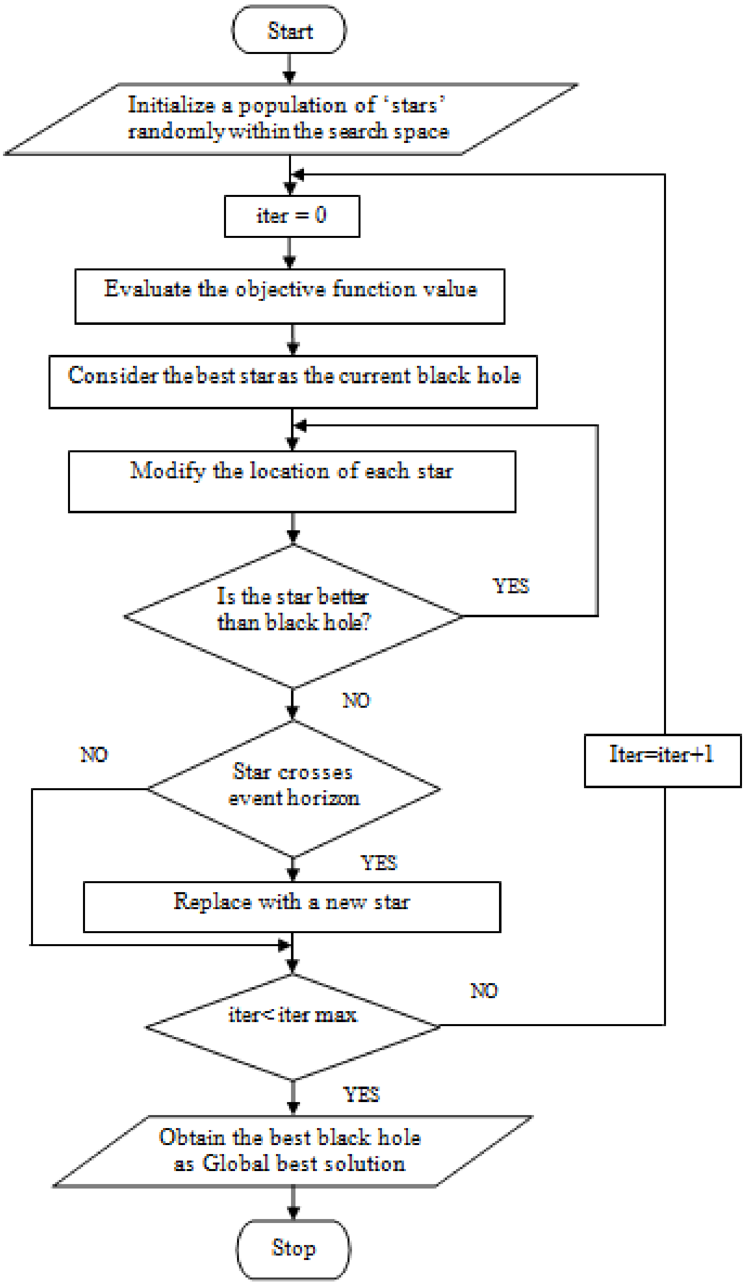

Fig. 1: flow chart for Black Hole Algorithm

2.2 Implementation of BHA for congestion management:

Step 1: Initialize the algorithm parameters like population size, maximum number of iterations and black hole.

Step 2: Each individual is a vector of the control variables. i.e. $X_i = [P_{g1,} P_{g2,} P_{g3,} \cdots P_{gN}]$. Nis the number of agents are generated by respecting the limits of control parameters.

Step 3: Calculate the fitness function values of all candidate solution by running the NR load flow.

Step 4: Determine the center of mass which has global best fitness using equation (3).

Step 5: Generate new candidates using the center of mass, particle best and global best by adding/subtracting a normal random number according to equation (2).

Step 6: Repeat steps step 2 to step 5 until stopping criteria has not been achieved.

Mathematical Problem Formulation:

2.1 *Formulation of generator sensitivity index:*

The generators in the system have different sensitivities to the power flow through the congested line. A change in real power flow in a transmission line *k* connected between buses i and j due to change in real power generation by generator g can be termed as generator sensitivity to congested line (GS) which can be written mathematically as (Dutta and Singh, 2008) and (Venkaiah and Kumar, 2011).

$$GS_g = \frac{\Delta P_{ij}}{\Delta P_{Gg}} \tag{4}$$

Where P_{ij} is the real power flow on congested line-*k*;

P_{Gg} is the real power generated by the g^{th} generator.

The real power flow through the congested line can be written as:

$$P_{ij} = -V_i^2 G_{ij} + V_i V_j G_{ij}\cos(\theta_i - \theta_j) + V_i V_j B_{ij}\sin(\theta_i - \theta_j) \tag{5}$$

The first terms of the two products in (6) are obtained by differentiating (5) as follows:

$$GS_g = \frac{\partial P_{ij}}{\partial \theta_i}\cdot\frac{\partial \theta_i}{\partial P_{Gg}} + \frac{\partial P_{ij}}{\partial \theta_j}\cdot\frac{\partial \theta_j}{\partial P_{Gg}} \tag{6}$$

$$\frac{\partial P_{ij}}{\partial \theta_i} = -V_i V_j G_{ij}\sin(\theta_i - \theta_j) + V_i V_j B_{ij}\cos(\theta_i - \theta_j) \tag{7}$$

$$\frac{\partial P_{ij}}{\partial \theta_j} = +V_i V_j G_{ij}\sin(\theta_i - \theta_j) - V_i V_j B_{ij}\cos(\theta_i - \theta_j) \tag{8}$$

$$= -\frac{\partial P_{ij}}{\partial \theta_i} \tag{9}$$

The active power injected at a bus-s can be represented as:

$$P_S = P_{GS} - P_{DS} \tag{10}$$

Where P_{DS} is the active load at bus-s. P_S can be expressed as

$$P_S = |V_s|\sum_{t=1}^{n}((G_{st}\cos(\theta_s - \theta_t) + B_{st}\sin(\theta_s - \theta_t))|V_t|)$$

$$= |V_s|^2 G_{ss} + |V_s|\sum_{\substack{t=1 \\ t\neq 1}}^{n}\{(G_{st}\cos(\theta_s - \theta_t) + B_{st}\sin(\theta_s - \theta_t))|V_t|\} \tag{11}$$

Where, n is the number of buses in the system.

Differentiating (11) w.r.t. θ_S and θ_t, the following relations can be obtained:

$$\frac{\partial P_s}{\partial \theta_t} = |V_s||V_t|\{G_{st}\sin(\theta_s - \theta_t) - B_{st}\cos(\theta_s - \theta_t)\} \tag{12}$$

$$\frac{\partial P_s}{\partial \theta_s} = |V_s| \sum_{\substack{t=1 \\ t \neq s}}^{n} \{(-G_{st}\sin(\theta_s - \theta_t) + B_{st}\cos(\theta_s - \theta_t))|V_t|\} \tag{13}$$

Neglecting P-V coupling, the relation between incremental change in active power at system buses and the phase angles of voltages can be written in matrix form as:

$$\underset{n\times 1}{[\Delta P]} = \underset{n\times n}{[H]}\underset{n\times 1}{[\Delta\theta]} \tag{14}$$

Where,

$$\underset{n\times n}{[H]} = \underset{n \times n}{\begin{bmatrix} \frac{\partial P_1}{\partial \theta_1} & \frac{\partial P_1}{\partial \theta_2} & \cdot\ \cdot\ \cdot & \frac{\partial P_1}{\partial \theta_n} \\ \frac{\partial P_2}{\partial \theta_1} & \frac{\partial P_2}{\partial \theta_2} & \cdot\ \cdot\ \cdot & \frac{\partial P_n}{\partial \theta_n} \\ \cdot & & & \cdot \\ & & & \cdot \\ \cdot & & & \cdot \\ \frac{\partial P_n}{\partial \theta_1} & \frac{\partial P_n}{\partial \theta_2} & \cdot\ \cdot\ \cdot & \frac{\partial P_n}{\partial \theta_n} \end{bmatrix}} \tag{15}$$

Thus,

$$[\Delta\theta] = [H]^{-1}[\Delta P] \tag{16}$$

$$= [M][\Delta P] \tag{17}$$

Where,

$$[M] = [H]^{-1} \tag{18}$$

To find the values of $(\partial\theta_i)/(\partial P_{Gg})$ and $(\partial\theta_j)/(\partial P_{Gg})$ in (6), the matrix M needs to be determined. However, $[H]$ is a singular matrix of rank one deficiency. So it is not directly invertible. The slack bus in the present work has been considered as the reference node and assigned as bus number 1. The elements of first row and first column of $[H]$ can be eliminated to obtain a matrix $[H_{-1}]$which can be inverted to obtain matrix$[M_{-1}]$, where $(.)_{-1}$ represents a matrix whose first row and column are deleted. Using these relations the following equation can be obtained:

$$[\Delta\theta_{-1}] = [M_{-1}][\Delta P_{-1}] \tag{19}$$

The actual vector $[\Delta\theta]$can be found by simply adding the element$\Delta\theta_1$ to (19) as shown by the following relation:

$$\underset{n\times 1}{[\Delta\theta]} = \underset{n\times n}{\begin{bmatrix} 0 & 0 \\ 0 & M_{-1} \end{bmatrix}} \underset{n\times 1}{[\Delta P]} + \Delta\theta_1 \underset{n\times 1}{\begin{bmatrix} 1 \\ 1 \\ \cdot \\ \cdot \\ \cdot \\ 1 \end{bmatrix}} \tag{20}$$

The second term of the sum in (20) vanishes as$\Delta\theta_1$, being the change in phase angle of slack bus is zero. Accordingly, (20) reduces to:

$$\underset{n\times 1}{[\Delta\theta]} = \underset{n\times n}{\begin{bmatrix} 0 & 0 \\ 0 & M_{-1} \end{bmatrix}} \underset{n\times 1}{[\Delta P]} \tag{21}$$

Thus required elements of $(\partial\theta_i)/(\partial P_{Gg})$ and $(\partial\theta_j)/(\partial P_{Gg})$ are found out from (21).

It is to be noted that the generator sensitivity values thus obtained are with respect to the slack bus as the reference. So the sensitivity of the slack bus generator to any congested line in the system is always zero.

GS_g denotes how much active power flow over a transmission line connecting bus i and j bus would change due to active power injection by generator g. The system operator selects the generators having non uniform and large magnitudes of sensitivity values as the ones most sensitive to the power flow on the congested line and to participate in congestion management by rescheduling their power outputs.

3.2 The objective function:

The main aim of this work is to find the optimal rescheduling of active power generations based on real power sensitivity index of the generators so as to minimize the congestion cost while satisfying the system equality and inequality constraints. The objective function of this congestion management problem can be written mathematically as (Pandya and Joshi, 2013) and Gao *et al.* (2015).

$$\min TC = \sum_{j=1}^{ng} (C_k \Delta P_{Gj}^{+} + D_k \Delta P_{Gj}^{-}) \quad \$/\text{hr} \tag{22}$$

Where,

TC is the total congestion cost in \$/hr

C_k is the incremental biding cost

D_k is the decremented biding cost

ΔP_{Gj}^{+} is the amount of active power increment in the generator j.

ΔP_{Gj}^{-} is the amount of active power decrement in the generator j.

Equality constraints:

Real power balance:

$$P_{gi} - P_{di} - \sum_{j=1}^{N} |V_i||V_j||Y_{ji}| \cos(\delta_i - \delta_j - \theta_{ij}) = 0 \tag{23}$$

Reactive power balance:

$$Q_{gi} - Q_{di} - \sum_{j=1}^{N} |V_i||V_j||Y_{ji}| \sin(\delta_i - \delta_j - \theta_{ij}) = 0 \tag{24}$$

$$P_{gi} = P_{gi}^{c} + \Delta P_{gi}^{+} - \Delta P_{gi}^{-} \quad ; i = 1,2,3...ng \tag{25}$$

$$P_{dk} = P_{dk}^{c} \quad ; k = 1,2,3...Nd \tag{26}$$

Inequality constraints:

Real power generation limit:

$$P_{Gi}^{\min} \le P_{Gi} \le P_{Gi}^{\max} \qquad i = 1,...ng \tag{27}$$

Reactive power generation limit:

$$Q_{Gi}^{\min} \le Q_{Gi} \le Q_{Gi}^{\max} \qquad i = 1,...ng \tag{28}$$

Incremented or decremented real power limit:

$$(P_{gi} - P_{gi}^{\min}) = \Delta P_{gi}^{\min} \le \Delta P_{gi} \le \Delta P_{gi}^{\max} = (P_{gi}^{\max} - P_{gi}) \tag{29}$$

$$\Delta P_{gi}^{+} \ge 0; \Delta P_{gi}^{-} \ge 0 \tag{30}$$

RESULTS AND DISCUSSIONS

The performance of the proposed algorithm in congestion cost minimization problem is tested in the modified IEEE-30 system. The modification dine in the standard IEEE -30 bus system is that the generator buses are numbered first and the load buses follows. The modified IEEE-30 bus system consists of 41 transmission lines, 24 load buses and 6 generator buses with a base load of 283.4 MW real power and 126.2 MVAR reactive power. Line data and bus data for both the test case system is taken from the (Balaraman and Kamaraj, 2010). Here, two cases congestions have been taken Case A Outage of line 1-2 and Case B as Load at all the buses are raised by 20%.

4.1 Case: A Outage of line 1-2:

Outage of transmission line and consequent congestion is considered in this case. Line outage contingency screening and ranking shows that line 1-2 is the most critical one in IEEE-30 bus system. Power flow through the congested lines (line i.e.1-7 line 7-8) and corresponding generator sensitivity indices are given in table 1.When lines 1-7 and 7-8 are congested, generator 3 is contributing more than the other generators in congestion. However, it can be observed that almost all the generators are contributing considerably. This is because of the close interconnection among the system components.

Table 1: Generator Sensitivity factors (case A)

Congested lines	P_{G1}	P_{G2}	P_{G3}	P_{G4}	P_{G5}	P_{G6}
Line 1-7	0	-1.2089	-1.2647	-1.2032	-1.2040	-1.1821
Line 7-8	0	-1.0625	-1.1116	-1.0575	-1.0582	-1.0390

Real power output of generator 3 is adjusted by large amount for relieving congestion due to the outage of the line 1-2. Performance wise BHA is better than the BBBC and PSO algorithms. Total congestion cost suggested by BHA is only 476.983 $ while it is 665.4502$ by PSO and 586.2415$ by BBBC. The cost obtained by BHA, shown in table 2 is much low and improves the strength of the algorithm.

Table 2: Optimal rescheduling

Rescheduled power	BBBC Technique	PSO Technique	BHA Technique
P_{G1}	129.632	129.992	129.915
P_{G2}	67.5414	62.4440	71.9032
P_{G3}	24.7957	28.1494	24.6938
P_{G4}	35.2147	37.8556	35.0047
P_{G5}	21.6808	18.0638	18.0412
P_{G6}	17.7766	20.0729	17.1301
Congestion Cost	586.789	665.4502	476.983
Loss	13.2415	13.1784	13.2884

It is obvious from table 3 that BBBC and BHA are behaving in the same manner in adjusting the generation for reducing congestion cost. They suggest decremental changes in generators 1 and 5 and incremental changes in the remaining three generators. For minimum congestion cost, BHA shows relatively large change at generator 2 than that shown by.

Table 3: Optimal change of real power

Technique	UP/DOWN adjustment of participating generators (MW)					
	ΔP_{G1}	ΔP_{G2}	ΔP_{G3}	ΔP_{G4}	ΔP_{G5}	ΔP_{G6}
BBBC	-8.9577	9.9814	0.2357	0.2147	-0.1534	1.1666
PSO	-8.5973	4.8840	3.5894	2.8556	2.1429	3.4629
BHA	-8.6746	14.3432	0.1338	0.0047	-0.7999	0.5201

Power flow in the lines of the system under different conditions are compared in figure 2. Outage of line 1-2 results in overflow in lines 1-7 and 7-8. The congested flow in these two lines are removed by rescheduling of generator powers. It is obvious from the figure that all the three algorithms are succeeded in congestion management.

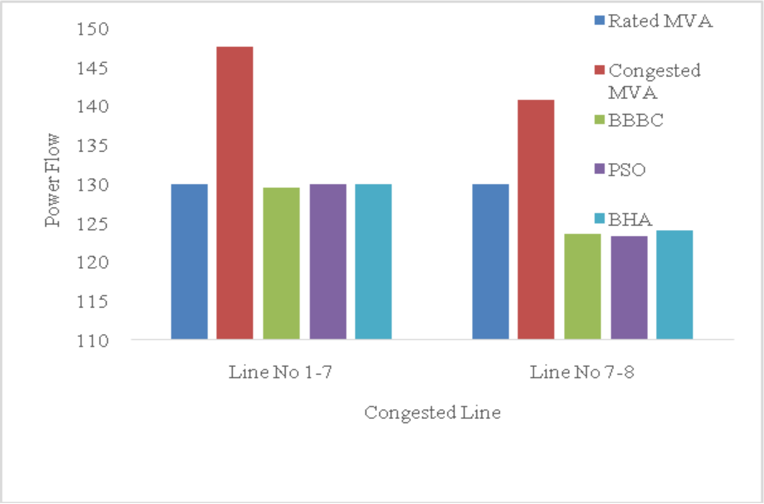

Fig. 2: Power flow through the lines (Case A)

Strength of the proposed algorithm is analyzed by the number of iterations it takes for finding the global best solutions. The algorithm maintains the best solution over different iterations and converges to the global best solution at about the 8th iteration is shown in figure 3. That is within 10 iterations best solution is reached. This proves the strength and reliability of the algorithm.

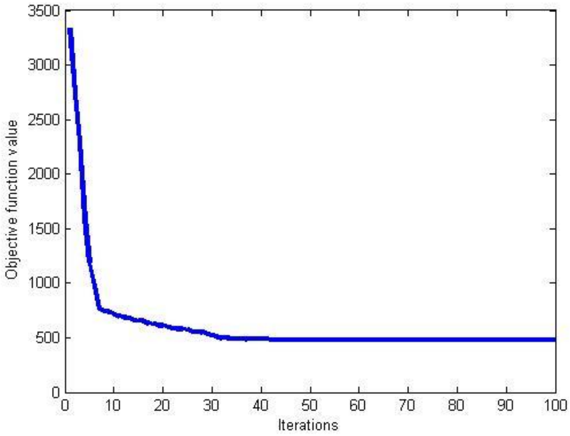

Fig. 3: Convergence behaviour of BHA in case A

4.2 Case B: Load at all the buses are raised by 20%.:

In this case, congestion due to increased load is taken. Loads at all the 24 load buses are increased by 20%. The total real and reactive power demands are increased to 340.08 MW and 151.44 MVAR.As a result, line 1-2 gets congested.

For rescheduling of real power, the generators whose generation are more influencing the power flow through the congested line are identified first. The generator sensitivity indices of all the six generators are calculated and given in table 4. Sensitivity index of generator 2 is the greatest among the indices showing largest influencing on the power flow in the congested line. Amount of real power outputs from the generators are adjusted according to the value of sensitivity index. The more is the value of the index the more is the amount of power adjusted.

Table 4: Generator Sensitivity factors of congested lines (case B)

Congested lines	P_{G1}	P_{G2}	P_{G3}	P_{G4}	P_{G5}	P_{G6}
Line 1-2	0	-0.8805	-0.8552	-0.7302	-0.7202	-0.6832

The new method suggested is run for minimizing the total congestion cost. Congestion cost optimal power output reported the three methods are compared in table 5. Congestion cost found by BHA algorithm is better than the costs reported by PSO and BBBC algorithms.

Table 5: Optimal rescheduling

Rescheduled power	BBBC Technique	PSO Technique	BHA Technique
P_{G1}	173.1753	191.1673	192.2697
P_{G2}	81.6502	61.0376	65.2524
P_{G3}	24.6078	25.4064	25.0714
P_{G4}	36.9597	35.8816	35.1743
P_{G5}	18.6786	22.1884	18.0023
P_{G6}	17.0605	16.9090	17.2231
Congestion Cost	1391.4	1486.3	1387.4
Loss	12.0521	12.5103	12.9132

In rescheduling of real power, all the three algorithms are behaving in the same manner. The change in power is incremental at all the generator buses. Because of high sensitivity, amount of power changed in generator 2 is the highest one as shown in table 6.

Table 6: Change in power

Technique	UP/DOWN adjustment of participating generators (MW)					
	ΔP_{G1}	ΔP_{G2}	ΔP_{G3}	ΔP_{G4}	ΔP_{G5}	ΔP_{G6}
BBBC	34.5853	24.0902	0.0478	1.9597	0.7486	0.1505
PSO	52.5773	3.4776	0.8464	0.8816	4.2584	-0.0010
BHA	53.6797	7.6924	0.5114	0.1743	0.0723	0.3131

For clear understanding of the congestion relief, power flow through the congested line 1-2 is depicted in figure 4. BBBC outperforms the other two algorithms of PSO and BHA in relieving the line from excessive power flow. However, the objective of minimum cost for removing congestion is achieved only by the proposed BHA algorithm.

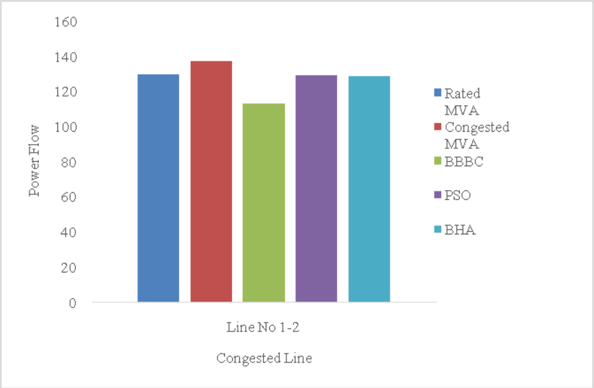

Fig. 4: Power flow through the lines (Case B)

Convergence characteristic of BHA in this case is shown in figure 5. The number of iterations taken to reach the best result is only 30. The number of iterations taken is much encouraging and proves the efficiency of the algorithm.

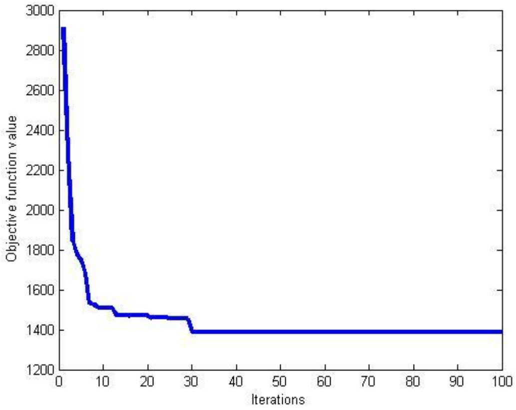

Fig. 5: Convergence behavior of BHA in case B

Conclusion:

In this work, the new nature inspired BHA algorithm is adopted for the congestion management problem. The algorithm is found to be with less number of parameters needs that are to be tuned and can be realized in Matlab coding with little effort. The main challenge in the operation of restructured power markets is managing congestion and this work is well addressed using the proposed algorithm. To keep the congestion cost minimum, the participating generators are more importance for real power generation adjustment Sensitivity based rescheduling of real power generation is followed in this work for congestion management. Transmission congestion caused by line outage and overload are considered here. Three different algorithms of BBBC, PSO and BHA are used for congestion management through real power rescheduling. The performance of the BHA is tested on Modified IEEE-30 bus system. It is obvious from the numerical results that the BHA algorithm performs better than the other two algorithms. Congestion cost reported by the proposed algorithm is better than that by the other two optimization methods. The algorithm is reliable with regard to its convergence quality. The algorithm converges to the global best results and takes less number of iterations.

The present work can be tried using other contemporary algorithms or the same work may be extended for addressing the same problem with different causes of transmission congestion. The cause congestion can be due to bilateral and multilateral transactions.

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