INTERNATIONAL RESEARCH JOURNAL OF ENGINEERING & APPLIED SCIENCES
ISSN: 2322-0821(O) VOLUME 7 ISSUE 2
ISSN: 2394-9910(P) Apr 2019 - June 2019
www.irjeas.org

TRANSMISSION OVERLOAD MANAGEMENT USING VIW-PSO

Rashmi Singh[1], Kausal Sen[2]

[1] M.Tech Scholar, Department of Electrical & Electronics Engineering, OCT, Bhopal
[2]Asst. Professor, Department of Electrical & Electronics Engineering, OCT, Bhopal

Abstract— Deregulation of the electricity sector has brought the benefits of supplying electricity at lower rates, better service quality and large-volume electricity trade can be conducted cross-border in the competitive electricity markets. But such large electricity trade may cause large-scale transmission of electric power across regions where the unexpected power flows may push electricity networks towards their physical limits and transmission overload of problem could arise. In this paper overload of transmission line is formulated and then solved by Varying Inertia Weight Particle Swarm Optimization.

Keywords - PSO, Transmission, Overload Alleviation

I. INTRODUCTION

Transmission overload is also defined as overloading in transmission lines which may occur due various unexpected unforeseen event like large load variations, sudden increase of load demand, outage of transmission lines, transformers, generators, etc. Any of these, may cause system parameters to surpass the limits which leads to an insecure system. This necessitates the power system operator to be alert to keep the system performance in the normal condition. The alleviating overload transmission line in the emergency condition is a critical problem in power system operation. For secure operation of power system, the network loading has to be maintained within specified limits. Hence, the operator has to maintain the security level by proper analysis and reschedule the system accordingly.

Power system configuration undergoes regular changes due to contingencies and disturbances. If the power system survives after the trouble, it will be operating in a new steady state in which one or more transmission lines may be overloaded. The mitigation of emergency transmission line overload is a serious problem in power system operation.

Overloading of transmission lines can occur in any power system and it prevents the systems operator to dispatch additional power from a specific generator, additional outages, creates market power and damages power system components. Therefore, overload management becomes necessary and is done by system operator, who ensures that the transmission system is operating within operating limits. Because of impacts described above of overload on electricity market, it is necessary to manage congestion, and this important task is performed by the independent system operator. Following are the various methods through which congestion can be managed:-

- Generation redispatch:- At first, sufficient numbers of the least expensive generators are selected to meet system predicted demands and the market-clearing price is determined by the most expensive bid that has been accepted. Next, ISO will check whether there are constraint violations or not and if there are, it would execute a generation re-dispatch. System operator re-dispatches power generation in such a way that resulting power flows does not overload any line.
- FACTS Devices:- They can be used to improve system performances in existing constrained system by controlling the power flows.
- Demand Response:- DR can be defined as the change in electricity usage by the end-user customers from the normal consumption patterns in response to change in the price of electricity over time.

In this paper Congestion is mainly overloading in line which has to be solved by the method Varying Inertia Weight Particle Swarm Optimization (VIW-PSO). Overloading alleviation is done in line .Alleviation of line overloading is done by distributing the load of overloaded line and then minimization of generation cost is done.

II.TRANSMISSION LINE OVERLOAD

With rapid growth of electricity market trades and the availability of insufficient transmission resources leads to network congestion. Real-time transmission overload is defined as the operating condition in which there is not enough transmission capability to implement all the traded transactions simultaneously due to some unexpected contingencies.
It may be alleviated by the following processes:

International Research Journal of Engineering & Applied Sciences, IRJEAS
www.irjeas.org, ISSN(O): 2322-0821, ISSN(P): 2394-9910, Volume 7 Issue 2, Apr 2019-Jun 2019, Page 10-13

- Redispatch of active power of generators.
- Load shedding.

III. PARTICLE SWARM OPTIMIZATION

The original version of PSO is developed by Kennedy and Eberhart in 1995, Eberhart, Simpson, and Dobbins in 1996, Russell C. Eberhart and Yuhui Shi in 2001.

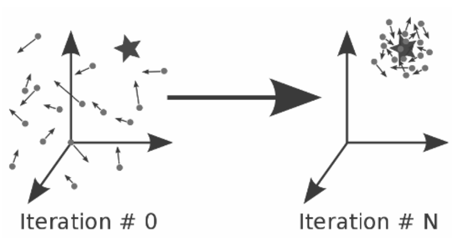

Figure 1. PSO Convergences

The original intent was to graphically simulate the graceful but unpredictable choreography of a bird flock. Initial simulations were modified to incorporate nearest-neighbor velocity matching, eliminate ancillary variables, and incorporate multidimensional search and acceleration by distance. At some point in the evolution of the algorithm, it was realized that the conceptual model was, in fact optimizer.PSO is initialized with a population of random solutions. Each potential solution is also assigned a randomized velocity, and the potential solutions, called particles, are then "flown" through the problem space. Each particle keeps track of its coordinates in the problem space which are associated with the best solution (fitness) it has achieved so far. This value is called pbest. Another "best" value that is tracked by the global version of the particle swarm optimizer is the overall best value, and its location, obtained so far by any particle in the population. This location is called gbest.

III. GENERATOR REDISPATCH

For continuous secure operation of the system, its involves determination of new states of operation in which lines are not overloaded or congested. Therefore, it becomes necessary to perform security analysis and to make and implement contingency plans at regular intervals. In a large complex power system, for number of contingencies to be analyzed in a short period of time, a fast method of generation rescheduling for line overload alleviation is needed.

IV. MATHEMATICAL FORMULATION

Redispatch cost of generator is taken as objective function in the work

- Objective Function

$$\text{Minimize} \sum_{g}^{Ng} C_{Pg}\left(\Delta P_g\right)\Delta P_g$$

Transmission Overload

- Constraints

$$\sum_{g}^{Ng}\left((GS_g)\Delta P_g\right) + F_k^o \leq F_k^{max}$$

$$P_g^{min} \leq P_g \leq P_g^{max}$$

$$P_g - P_g^{min} = \Delta P_g^{min} \leq \Delta P_g \leq \Delta P_g^{max} = P_g^{max} - P_g$$

Where:

GS_g : Generator sensitivity
F_k^o : MVA flow
F_k^{max} : MVA flow limit
Δ Pg : Real power adjustment at bus-g
Cg : Incremental and decremented price bids submitted by generators. These are the prices at which the generators are willing to adjust their real power outputs.
F_k^o : Power flow caused by all contracts requesting the transmission service.
F_k^{max} : Line flow limit of the line connecting bus-i and bus-j
Ng : Number of participating generators
N_l : No. of transmission lines in the system
Pgmin & Pgmax : Minimum and maximum limits of generator outputs.

V.TEST SYSTEM

The IEEE 30 bus system is used in the present work to test the proposed algorithm PSO. This system is used as a standard test system to study different power problems and evaluate programs to analyze such problems. This system consists of 6 generator units and 41 transmission lines.

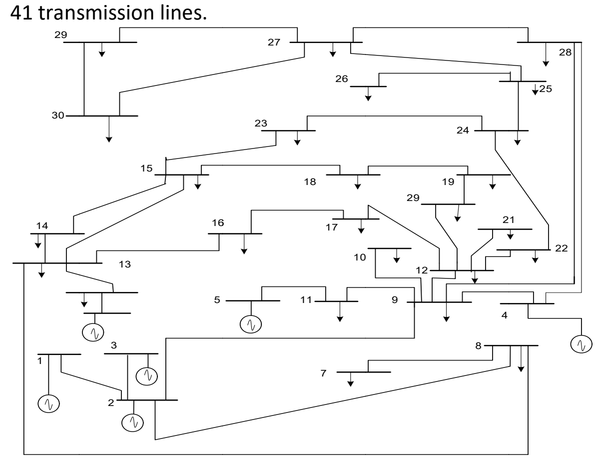

Figure 2. Single line diagram of IEEE 30 bus system

Congestion Management of IEEE 30 Bus system generating system has been determined using linearly decreasing inertia weight PSO and compared with other classical methods. Matlab coding has been done on MATLAB 7.10.0.499 and simulated results are analyzed at different population sizes.

Table1. Result Tabulation

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
ΔP_{g1} (MW)	98	96	250	275	100
ΔP_{g2} (MW)	135.68	156.496	1017.55	1032.93	140.317
ΔP_{g3} (MW)	34.178	26.0121	149.907	148.526	31.0235
ΔP_{g4} (MW)	13.865	19.1647	39.5435	82.6209	13.928
ΔP_{g5} (MW)	11.199	11.2158	82.7120	57.0074	2.7817
ΔP_{g6} (MW)	19.072	17.3621	58.6112	30.8013	14.02
Total Cost ($/day)	**36512.323**	**40712.867**	**38959.9**	**39045.4**	**35841.4**

Table2. Result Tabulation

GENERATOR	MW
1	270
2	850.9439
3	79.25543
4	83.30504
5	52.11353
6	78.64817
TOTAL GENERATION(MW)	308.785 MW
GENERATION COST($/day)	**34062.39 $/day**

Table3. Result Tabulation

OPTIMAL SOLUTION(MW)	RESULT REPORTED [16]	VAPSO
P_{G1}[MW]	-59	270
P_{G2}[MW]	19.9	850.9439
P_{G3}[MW]	13	79.25543
P_{G4}[MW]	6	83.30504
P_{G5}[MW]	6.5	52.11353
P_{G6}[MW]	7	78.64817
Total Generation[MW]	11.4	308.785
Generation Cost($/day)	50466	34062.39

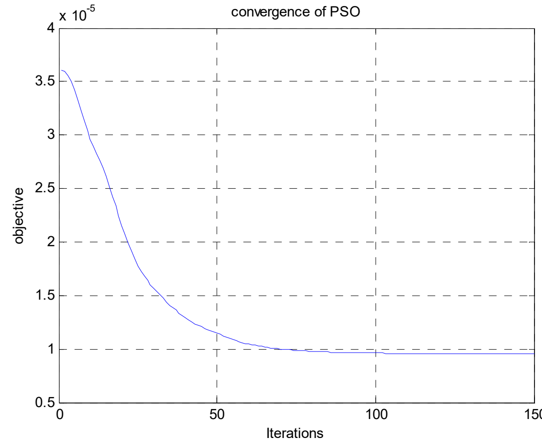

Figure2.Convergence of Objective Function

VI.CONCLUSION

In this thesis work, the optimal congestion management approach based on varying inertia weight particle swarm optimization(VIW-PSO) is used which efficiently minimize rescheduled generation cost of generators. The problem of congestion is formulated as an optimization problem and solved by particle swarm optimization technique. Re-dispatched generators are selected based on the outage of line. Line outage due to unexpected line outage & sudden load variation is considered in this work. The method has been tested on modified IEEE 30-bus and successfully implemented. The proposed method is compared with classical method and also with evolutionary method. The proposed approach gives better result and also converges to a optimal solution in a faster manner. The proposed approach is useful for ISOs in managing the transmission congestion in a deregulated electricity environment. The proposed approach is useful for the system operator to choose a suitable optimum solution among the different possibilities according to the system requirement.

REFERENCES

1. Manoj Kumar Maharana and K.Shanti Swarup, “Local Optimization Based Corrective Control Strategies for Mitigation of overloads using Direct Acyclic Graph”, International Journal of Electrical and power Engineering 3(4): 198-207, 2009, ISSN: 1990-7958.
2. A.Safari and H.Shayeghi, “Iteration particle swarm optimization procedure for economic load dispatch with generator constraints”, Expert System with Applications 38(2011) 6043-6048.
3. A. Kumar, S. C. Srivastava, and S. N. Singh, —Congestion management in Competitive Power Market: A Bibliographical Survey, Elect. PowerSyst. Res., vol. 76, pp. 153–164, 2005

4. A K sinha and D hazarika, "A fast algorithm for line overload alleviation in power system", IE (I) JEL, vol. 81, pp 64—71, 2001.
5. A. Shandilya, H. Gupta, J. Sharma, "Method for generation rescheduling and load shedding to alleviate line overloads using local optimization", IEE Proceedings Generation, Transmission and Distribution, Vol. 140, pp. 337-342, 1993.
6. B. K. Talukdar , A K sinha, and S M , A Bose , "A computationally simple method for cost coefficient generation rescheduling and load shedding for congestion management ", Int. J. Elec. Power Energy syst. vol. 27,no.5&6, pp 379—388,2005.
7. Bhaskar G.Mohan MR(2009),"Contingency constrained economic load dispatch using improved particle swarm optimization for security enhancement", Electric Power System Research 79:615-621.
8. International Journal of Emerging Trends in Electrical and Electronics (IJETEE) Vol. 1, Issue. 1, March-2013.
9. Tulika Bhattacharjee 1, Ajoy Kumar Chakraborty, "Congestion Management in a Deregulated Power System by Rescheduling Of Sensitive Generators and load curtailment using PSO", International Journal of Emerging Technology and Advanced Engineering Volume 2, Issue 3, March 2012
10. Vries, L., J., "Capacity Allocation in a Restructured Electricity Market: Technical and Economic Evaluation of Congestion Management Methods on Inter-connectors", IEEE 2001.
11. V. Srinivasarao, S.P. Singh and G.S. Raju, "Active and Reactive Power Rescheduling for Congestion Management Using Descent Gradient Method", Fifteenth National Power Systems Conference (NPSC), IIT Bombay, December 2008.
12. V.L.Sravanthi, K.Padma, Multiobjective, "Particle Swarm Optimization with Pollution Control Constraintand FACTS Controller", International Journal of Engineering Research and technology(IJERT),ISSN:2278-0181,Vol.2 Issue 10,October-2013.
13. V.P. Sakthivel , S.V.Vijayasundaram, "Chaotic Particle Swarm Optimization for Congestion Management in an Electricity Market", International Journal of Scientific and Research Publications, Volume 4, Issue 6, June 2014,ISSN 2250-3153.
14. T.K.P.Medicherla, R.Billinton, and M.S.Sachdev, "Generation Rescheduling and Load Shedding to Alleviate Line Overload Analysis", IEEE Trans. Power App. Syst", vol.PAS-98, no.6, pp.1876–1884, Nov./Dec.1979.
15. Z. Wang, C.W. Yu, A.K. David, C.Y. Chung, C.T. Tse, "Transmission congestion management in restructured electricity supply system", Proceedings of the 5th International Conference on Advances in Power System Control, Operation and Management, APSCOM 2000, Hong Kong, October 2000
16. Sudipta Dutta, S.P. Singh, "Optimal rescheduling of generator for congestion management based on particle swarm optimization," IEEE Trans. Power Syst., vol.23, no.4, pp.1560-1568, Feb.2008.