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Simulation of Load Dispatch Optimization by Variable Control Method on IEEE Three Generators Six Bus System

K Srinivas

Assistant Professor, Dept. of EEE, JNTUH College of Engineering, Jagitial, Karimnagar, Telangana, India

ABSTRACT: In the modern world, rapid growth in urbanization & in Industrialization electrical power utility increased exponentially. The Economic Load Dispatch (ELD) is one of the modern classical optimization problems of electric power system deals with power generation to minimize the fuel cost and transmission losses to meet the particular load demand. Lagrange Multiplier is used to calculate the optimal combination of generation level of all generating units. All generating units operate within the limits of constrains. The economic load dispatch problem, which has non linear cost function solved by using variable control method to calculate Lagrange multiplier where the optimum value of power generation is possible. The total loss of the transmission system is minimized.

KEYWORDS: Economic load dispatch (ELD), Lagrange Multiplier, Variable Control Method, Transmission Power Loss, and Cost.

I.INTRODUCTION

Nomenclature:

$F_n(P_n)$ - Fuel cost of n^{th} generating unit in Rs./Hour
P_n - Power Generated from n^{th} unit in MW
α, β, γ – Linear Quadratic Cost coefficients
B - Loss coefficient Matrix
B_{ij} – Loss coefficient of i^{th} bus/row and j^{th} bus/column of loss coefficient Matrix
λ - Lagrange multiplier in Rs./MW
P_L – Power Loss in MW
S – Value within the limits of convergence in MW
T – Total power generated from all stations in MW
λ_0 - Minimum of β_i
LL – sum of minimum power limits of the system in MW
UL – sum of maximum power limits the system in MW
Pll – minimum power loss the system in MW
Plu – maximum power loss the system in MW
z –variable. Taken z =10.

Consider a system consisting of n thermal power generating units interconnected to share the load. To operate at minimum generating cost all generating units [1-4] must run with in constrains limits [1-2]. The cost of generation will depend upon the system constraint for a particular load demand [1-3]. This means the cost of the generation is not fixed for a particular load demand but depends upon the operating constrains of the generator [1-3].

Total Economic Fuel cost

$$\text{Minimum } F_T = \sum_{i=0}^{n} F_i(P_i) \qquad \text{(a)}$$

Total Generated power from all units

$$\sum_{i=0}^{n} P_i = P_D + P_L \qquad \text{(b)}$$

Inequality Constraints of each generating unit real active power output for economic operation

$$P_i^{min} \le P_i \le P_i^{max} \quad \text{for } i = 1,2,\dots,n \qquad \text{(c)}$$

The quadratic cost function of unit n^{th} is given by:

$$F_i(P_i) = \alpha_i P_i^2 + \beta_i P_i + \gamma_i \quad \text{for } i = 1,2,\dots,n \qquad \text{(d)}$$

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Using the B-coefficient method, network losses are expressed as:

$P_L = P^T [B] P + P^T B_0 + B_{00}$ (e)

Where [B], B_O and B_{OO} are the generalized loss formula coefficients

[B] is nxn matrix

P and B_0 are nx1 matrices

B_{00} is constant 1x1

B_0 and B_{00} are not given assume that they are null matrix and Zero, the equation rewritten as

$P_L = P^T [B] P$ (e.1)

II. VARIABLE CONTROL METHOD

The initial value of Lagrange multiplier (λ_0) is minimum of β_i , i=1,2,3….n

$\lambda_0 = \min(\beta_i)$

From equation (d) the quadratic cost function of unit n[th] is given by:

$F_i(P_i) = \alpha_i P_i^2 + \beta_i P_i + \gamma_i$ for i = 1,2,…,n

$\frac{dF_iP_i}{dP_i} = \beta_i + 2 * \alpha_i P_i = \lambda_0$ for i = 1,2,…,n (f)

Assume S = -1

Calculate minimum & maximum power losses

$LL = \sum_{i=1}^{n} P^{min}{}_i$ (f.1)

$UL = \sum_{i=1}^{n} P^{max}{}_i$ (f.2)

$Pll = P^{min\ T} [B] P^{min}{}_G + P^{min\ T} B_0 + B_{00}$ (f.3)

$Plu = P^{max\ T} [B] P^{max} + P^{max\ T} B_0 + B_{00}$ (f.4)

Power demand must be within the limits of

$LL - Pll < P_D < UL - Plu$

Otherwise, Convergence is not possible

The power generation of each unit is

$P_n = \frac{(\lambda_0 + z) - \beta_n}{2 * \alpha_n}$ (g)

z varies linearly till the convergence is done.

Convergence criteria, S must be within predefined minimum & maximum limits.

Taking, $S_{min} = 0$ & $S_{max} = 0.01$

$S = \sum P_n - P_L - P_D$

$S_{min} < S < S_{max}$

In this method, iterations are eliminated by varying z.

III. TEST SYSTEM AND RESULTS

IEEE 3-Generating Units [5]

The Power loss is

$P_{loss} = 0.00003P_1^2 + 0.00009P_2^2 + 0.0003P_3^2$

THREE GENERATORS, 6 BUS TEST SYSTEMS CHARACTERISTIC

Unit	*α* *($/MW²hr)*	*β* *($/MWhr)*	*γ* *($/hr)*	*P^{min}* *(MW)*	*P^{max}* *(MW)*
1	0.001562	7.92	561	150	600
2	0.00194	7.85	310	100	400
3	0.00482	7.97	78	50	200

Table:1 three generators, 6 bus test system characteristics

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	Variable control method (VCM)	***Classical Method (CM)***	***Hopfield Neural Network (HNN)***
P_{G1}	152.67	152.19	152.27
P_{G2}	140.559	140.58	140.1
P_{G3}	50	50	50.4
Total Gen	342.72	342.76	342.76
Total Loss	2.722	2.76	2.76
Total Cost	***<u>3742.59</u>***	3742.9	3742.9

Table:2 Comparison of VCM with CM and HNN , Power Demand = 340

Bold & Italic Underlined numbers shows minimum cost calculated by VCM with Power Demand = 340MW

Below given figures for three generators, six bus test system. Power Demand = 340MW

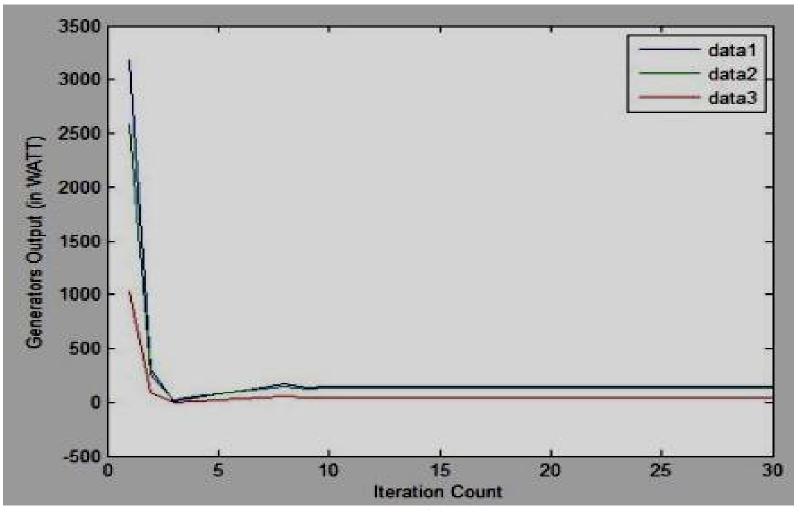

Figure:1 Generator Output vs Iteration of three generators, six bus test system

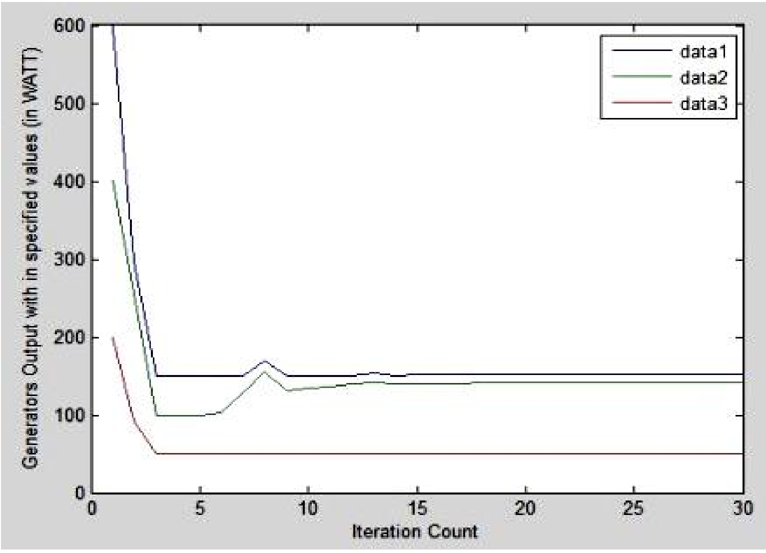

Figure:2 Generator Output with in specified values vs Iteration of three generators, six bus test system

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The Total cost calculated by variable control method is less than Classical Method (CM), Hopfield Neural Network (HNN) [5]

IV. MERITS OF VCM

1. Modulus of S converges within specified convergence limits i.e., S^{min} & S^{max}
2. Convergence limits can be taken up to 3 decimal values for faster convergence.
3. Very accurate Convergence
4. Simple for formulas for Power calculations
5. The output power of all units depend on variable, z in equation –(g)
6. The output of all generators varies as variable, z
7. Low cost of generation compared to Classical Method (CM), Hopfield Neural Network (HNN) and Conventional Genetic Algorithm (CGA) and greater than Micro-Genetic Algorithm (μGA).
8. Variable control method i.e., previous values cannot be substituted in present or future values. Hence requires less time to converge

V. CONCLUSION

In this paper variable control method is compared with Classical Method (CM), Hopfield Neural Network (HNN) for three generator system. From the results variable control method is advantage over Classical Method (CM), Hopfield Neural Network (HNN) [5]. The limitations are power demand must be within the limits of LL-Pll and UL-Plu. The MATLAB programming of the method is very easy. The program was executed on 3.30 GHz Computer. The taken to converge is inversely proportional to the maximum convergence limit. In the examples, B_0 matrix and B_{00} are taken as zero. From the given it is proven that the method is applicable small and large network systems. The main advantage of the method is high reliable convergence.

REFERENCES

1. Wadhwa, C.L (2009). *Electrical Power System.* New Age publishers
2. A. J. Wood and B. F Wollenberg, Power Generation, Operation and Control, John Wiley and Sons, New York, 1996.
3. Y. H. Song and C. S. V. Chou, "Advanced engineered-conditioning genetic approach to power economic dispatch," in *IEE Proceedings - Generation, Transmission and Distribution*, vol. 144, no. 3, pp. 285-292, May 1997. doi: 10.1049/ip-gtd:19970944
4. B. H. Chowdhury and S. Rahman, "A review of recent advances in economic dispatch," IEEE Trans. on Power Systems, vol. 5, pp. 1248-1259, November 1990.DOI: 10.1109/59.99376
5. G. A. Bakare, U. O. Aliyu, G. K. Venayagamoorthy and Y. K. Shu'aibu, " Genetic Algorithms Based Economic Dispatch with Application to Coordination of Nigerian Thermal Power Plants"

BIOGRAPHY

Dr K.Srinivas received B.E. degree in Electrical and Electronics Engineering from Chithanya Bharathi Institutue of Technology and Science, Hyderabad , Osmania University, Hyderabad, India, in 2002, M.Tech. Degree in power systems and Power Electronics from the Indian Institute of Technology Madras, Chennai, in 2005, Ph. D from Jawaharlal Nehru Technological University Hyderabad. Currently, he is an Assistant Professor in Electrical and Electronics Engineering Department, Jawaharlal Nehru Technological University Hyderabad College of Engineering Jagitial. His fields of interest include power quality, power Electronics control of power systems.