COMPARITIVE STUDY OF PARTICLE SWARM OPTIMISATION & GREY WOLF OPTIMIZATION IN ECONOMIC LOAD DISPATCH PROBLEM

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Abstract - *In present scenario, the scarcity of energy resources, the increase in electricity production costs and the concern for the environment requires optimal economic transmission. In fact, the distance between the power plant and the load is not equal and there is no similar fuel cost function. Therefore, the load must be distributed between the different power plants in a way that results in the lowest energy production costs, in order to provide cheaper electricity. The current economic shipping problem (ED) has a very non-linear objective function and has strict substitution and inequality constraints. Use of Particle Swarm Optimization (PSO) and GWO to distribute active power between power plants that meet system requirements and minimize the cost of electricity generation. The accuracy and speed of convergence of these methods is analyzed. The use of PSO and GWO has solved the economic burden distribution problem in electric power bus systems. PSO and GWO are implemented in 14bus and 30bus systems.*

Key Words: **Economic Load Dispatch, PSO, Power Systems, Optimization Techniques, Grey wolf optimization GWO**

1. INTRODUCTION

In the conventional methods, it is difficult to solve the optimal economic problem if the load changed. It needs to compute the economic load dispatch each time which uses a long time in each of computation loops.

It is a computational process where the total required generation is distribution among the generation units in operation, by minimizing the selected cost criterion, and subjects it to load and operational constraints as well.

For an interconnected system, it is necessary to minimize the expenses. The economic load dispatch is used to define the production level of each plant, so that the total cost of generation and transmission is minimum for a prescribed schedule of load.

2. SIMULATED RESULTS

The objective of economic load dispatch is to minimize the overall cost of generation. For solving this well-known non-traditional PSO optimization is chosen, and 14 bus and 30bus IEEE test systems are taken and simulated results are compared with Grey wolf optimization GWO.

1.1 FUEL COST COEFFICIENT

Bus number	a_i	b_i	c_i	P_{min}	P_{max}
1	100	200	10	50	200
2	120	150	10	20	80
5	40	180	20	15	50
8	60	100	10	10	35
11	40	180	20	10	30
13	100	150	10	12	40

1.2 EMISSION COEFFICIENT

Bus number	α_i	β_i	γ_i	ξ_i	λ_i
1	4.091	−5.554	6.490	$2 * 10^{-4}$	2.857
2	2.543	−6.047	5.638	$5 * 10^{-4}$	3.333
5	4.258	−5.094	4.586	$1 * 10^{-6}$	8.00
8	5.426	−3.556	3.380	$2 * 10^{-3}$	2.00
11	4.258	−5.094	4.586	$1 * 10^{-6}$	8.000
13	6.131	−5.555	5.151	$1 * 10^{-5}$	6.667

1.2 COMPARISON BETWEEN PSO AND GWO FOR 14 BUS SYSTEMS

Table -1: Comparison between PSO AND GWO for 14 bus system

ALGORITHM	PSO 14 BUS SYSTEM	GWO 14 BUS SYSTEM
Fuel Cost (rs/hr.)	692.33	690.45
Emission (kg/hr)	275.4733	270.5423
Generator Power		
G1	177.4	175.1
G2	32	35
G3	20.7	20.6
G4	15	16.25

G5	14	11.79
VOLTAGE AT BUS	14 BUS SYSTEM	14 BUS SYSTEM
b1	1.06	1.06
b2	1.043	1.041
b3	1.23	1.023
b4	1.01	1.012
b5	1.01	1.01
b6	1.07	1.071
b7	1.02	1.021
b8	1.01	1.01
b9	1.047	1.048
b10	1.064	1.065
b11	1.082	1.082
b12	1.06	1.061
b13	1.071	1.071
b14	1.0512	1.0516
Generator Cost	700	700

1.2 COMPARISON BETWEEN PSO AND GWO FOR 30 BUS SYSTEMS

Table -2: Comparison between PSO AND GWO for 30bus system

Algorithm	PSO 30 BUS SYSTEM	GWO 30 BUS SYSTEM
Fuel Cost (rs/hr.)	775.11	756.0183
Emission (kg/hr)	344.1790	343.0071
Generator Power		
G1	200	200
G2	21.046	20.029
G3	19.24	15.032
G4	13.62	10.42
G5	10.35	10.03
G6	12	12
VOLTAGE AT BUS	30 BUS SYSTEM	30 BUS SYSTEM
b1	1.06	1.06
b2	1.04	1.04
b3	1.025	1.024
b4	1.0167	1.0163
b5	1.01	1.1
b6	1.0147	1.0143
b7	1.005	1.004
b8	1.01	1.01
b9	1.0529	1.0523
b10	1.046	1.043
b11	1.082	1.082
b12	1.059	1.0599
b13	1.071	1.071
b14	1.045	1.044
b15	1.04	1.03
b16	1.0471	1.046
b17	1.041	1.040
b18	1.03	1.02
b19	1.027	1.02
b20	1.0316	1.0311
b21	1.034	1.033
b22	1.035	1.034
b23	1.0293	1.0294
b24	1.023	1.023
b25	1.02	1.01
b26	1.0024	1.0022
b27	1.026	1.026
b28	1.012	1.012
b29	1.0066	1.0065
b30	0.9952	0.9951
Transmission Loss	12.90	12.83
Generator Cost	824	810

1.3 IEEE 14 BUS System Graphs For PSO and GWO

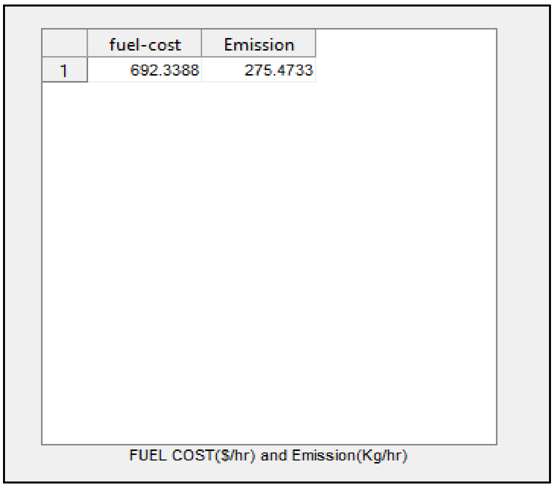


Fig.1(a) : PSO fuel cost and emission

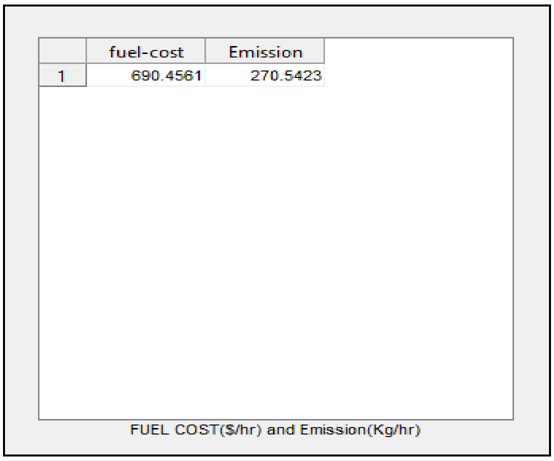


Fig.1(b) : GWO fuel cost and emission

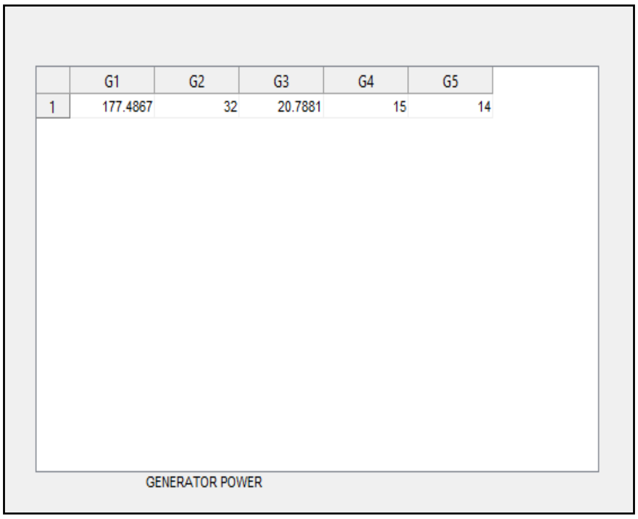


Fig.2(a) : PSO Generator power

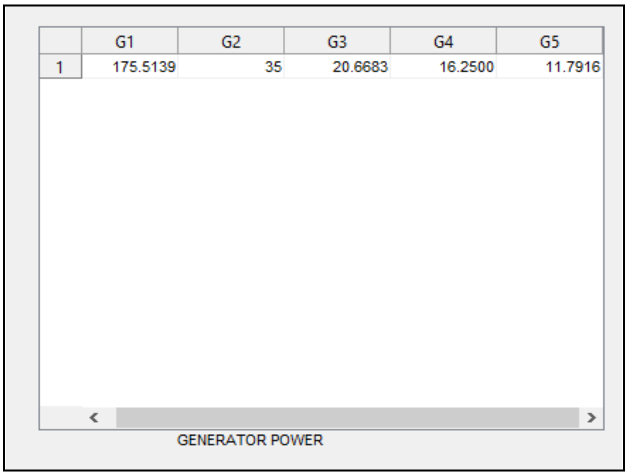


Fig.2(b) : GWO Generator power

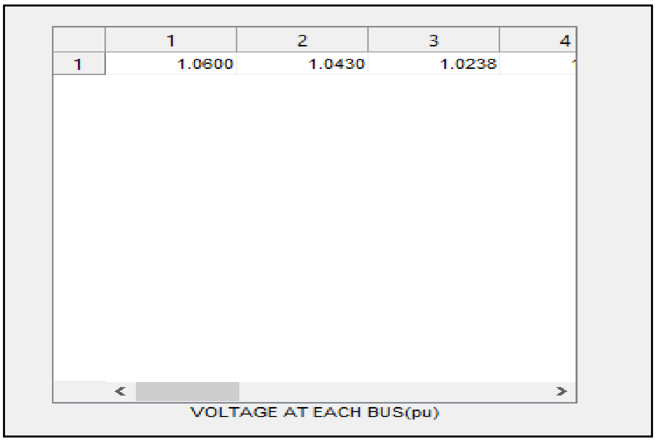


Fig.3(a) : PSO Voltage at each bus

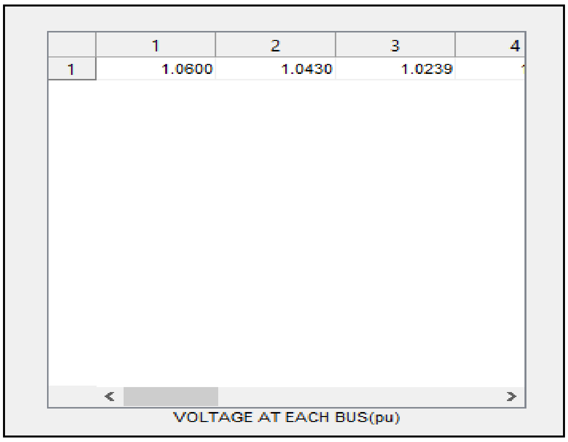


Fig.3(b) : GWO Voltage at each bus

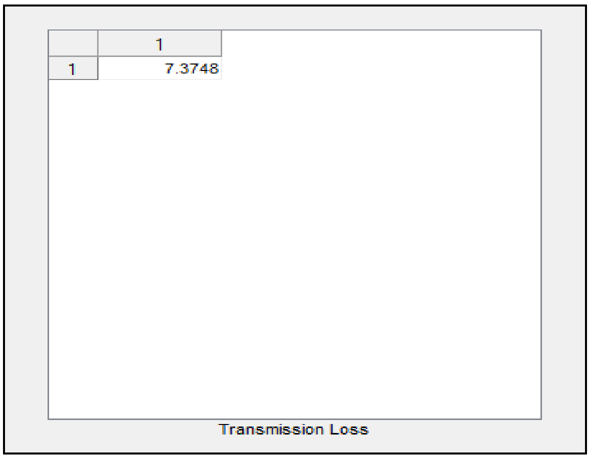
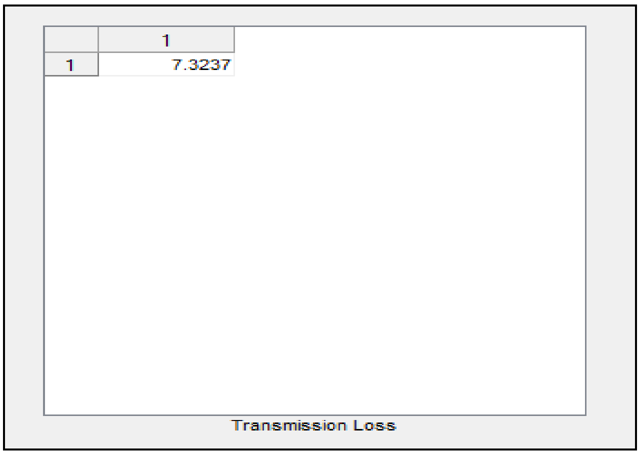


Fig.4(a) : PSO Transmission loss



	1
1	7.3237

Transmission Loss

Fig.4(b) : GWO Transmission loss

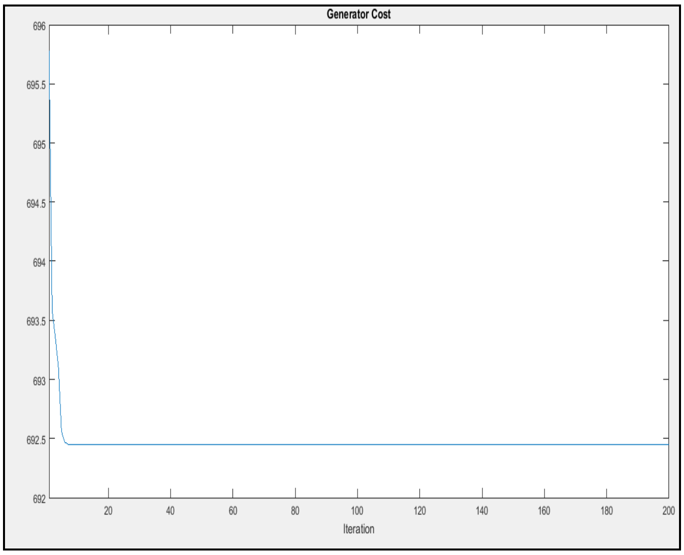


Fig.5(a) : PSO Generator cost

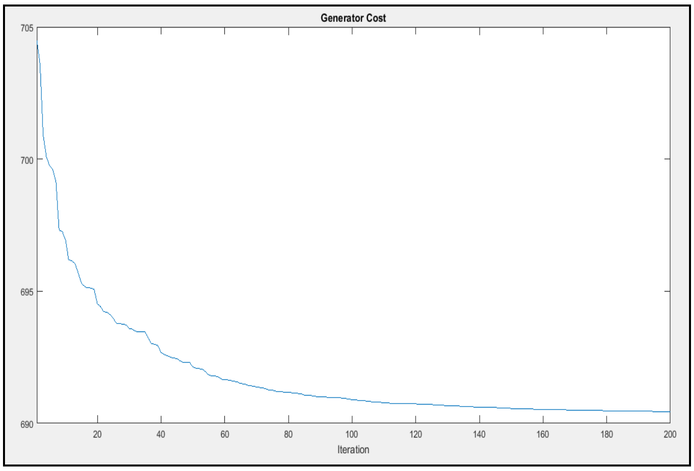
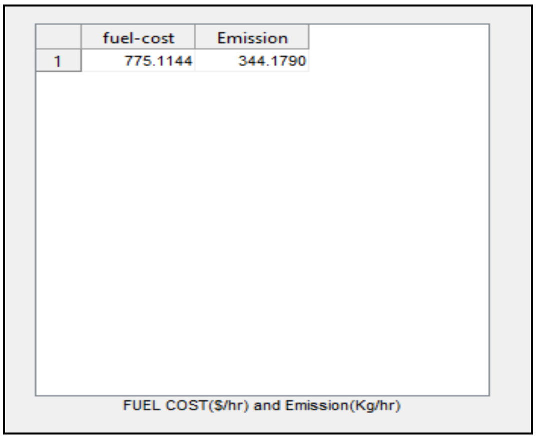


Fig.5(b) : GWO Generator cost

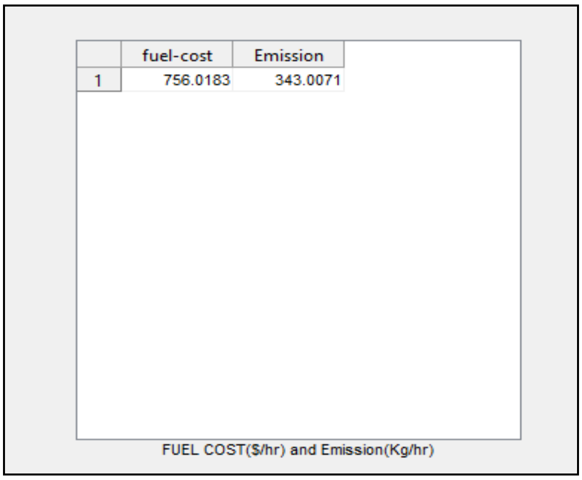
1.4 IEEE 30 BUS SYSTEM GRAPHS FOR PSO AND GWO



	fuel-cost	Emission
1	775.1144	344.1790

FUEL COST($/hr) and Emission(Kg/hr)

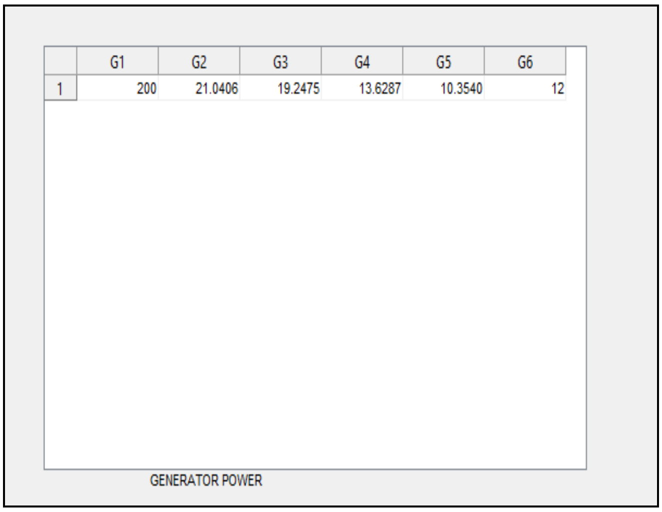
Fig.6(a) : IEEE30-PSO Fuel cost and Emission



	fuel-cost	Emission
1	756.0183	343.0071

FUEL COST($/hr) and Emission(Kg/hr)

Fig.6(b) : IEEE30-GWO Fuel cost and Emission



	G1	G2	G3	G4	G5	G6
1	200	21.0406	19.2475	13.6287	10.3540	12

GENERATOR POWER

Fig.7(a) : IEEE30-PSO Generator Power

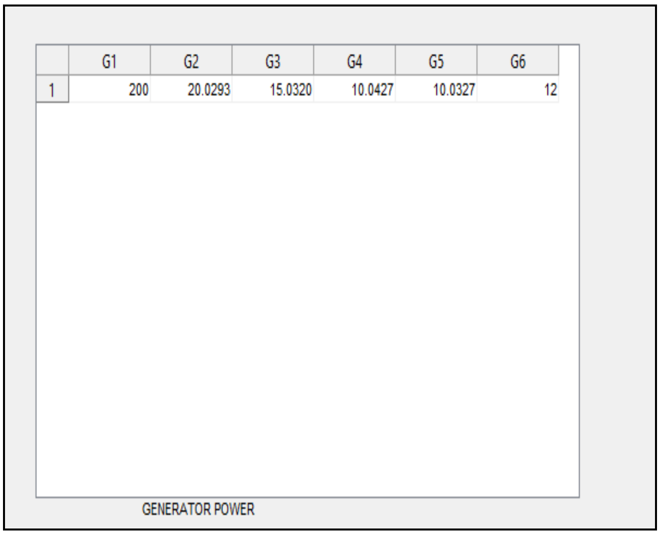


Fig.7(b) : IEEE30-PSO Generator Power

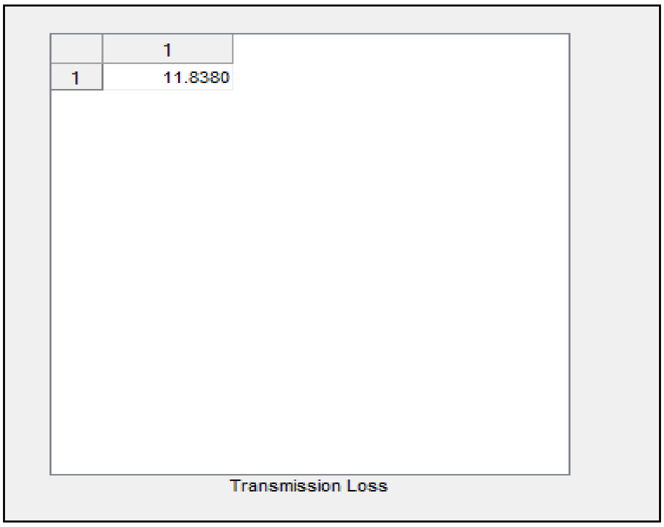


Fig.9(a) : IEEE30-PSO Transmission loss

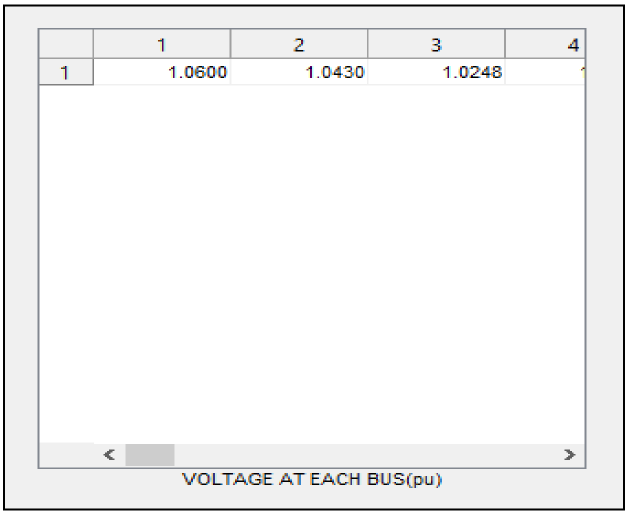


Fig.8(a) : IEEE30-PSO Voltage at Each Bus

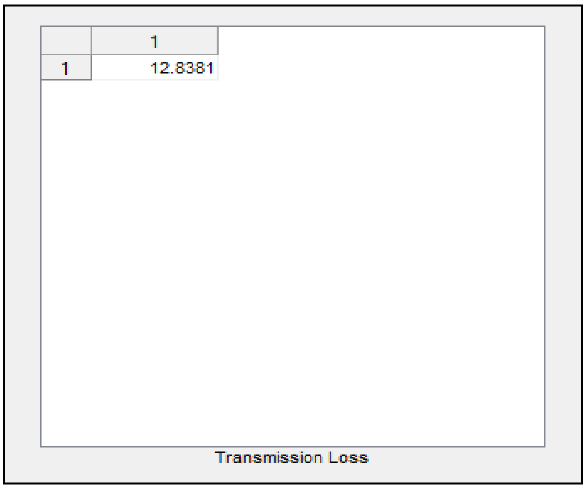


Fig.9(b) : IEEE30-GWO Transmission loss

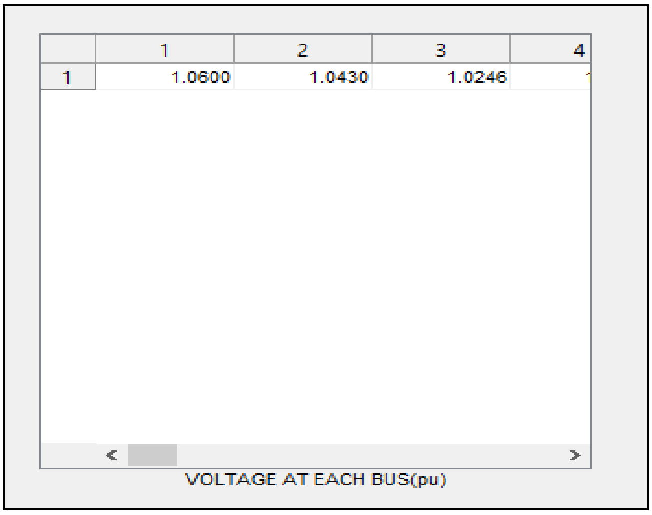


Fig.8(b) : IEEE30-GWO Voltage at Each Bus

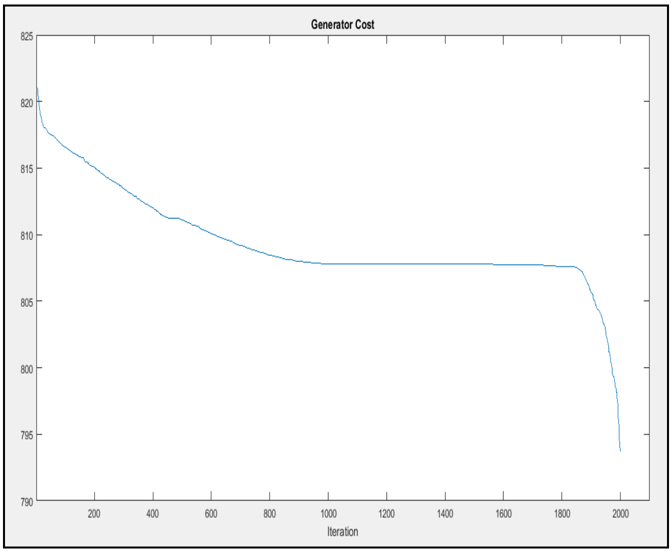


Fig.10(a) : IEEE30-PSO Generator cost

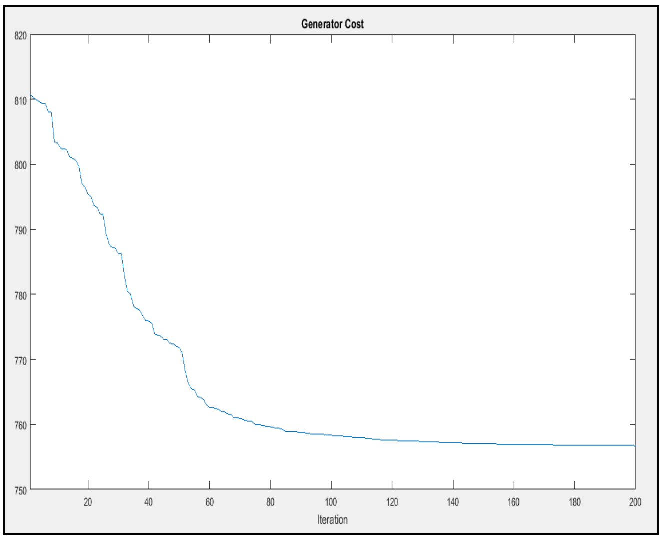


Fig.10(b) : IEEE30-PSO Generator cost

3. CONCLUSION

This work adopts the best meta-heuristic optimization techniques to solve the problem of balance between economy and emissions. The results are better than PSOs. As the complexity of the system increases, the integration progresses to improvement. Therefore, the solution for high -end systems can be obtained in a shorter time compared to conventional methods.

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