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# Optimal Power Flow with Environmental Constraints of the Algerian Network using Decomposed Parallel GA

B. Mahdad, K. Srairi, and T. Bouktir

***Abstract*—Due to the rapid increase of electricity demand, consideration of environmental constraints in optimal power flow (OPF) problems is increasingly important. In Algeria up to 90% of the electricity demand produced by thermal generators (vapor, gas), in order to keep the emission of gaseous pollutants like sulfur dioxide (SO2) and Nitrogen (NO2) under the admissible ecological limits, many conventional and global optimization methods proposed to study the trade-off relation between fuel cost and emissions. This paper presents an efficient decomposed Parallel GA to solve the multi objective environmental/ economic dispatch problem. At the decomposed stage the length of the original chromosome is reduced successively and adapted to the topology of the new partition. To validate the robustness of the proposed approach, the algorithm proposed tested on the Algerian 59-bus network test and compared with conventional method and with global optimization methods (GA, FGA, and ACO). The results show that the approach proposed can converge to the near solution and obtain a competitive solution at critical situation and with a reasonable time.**

***Key Words*— Environmental economic dispatch, Dynamic control, Parallel Genetic Algorithm, multi-objective, System loadability, Optimal power flow, System security, Planning and control.**

## I. INTRODUCTION

In recent years and with the growth in electricity demand, environmental considerations have become one of the major management concerns and due to the pressing public demand for clean air, integrating pollution control in the standard Optimal Power Flow (OPF) have become a vital concern for organizations and country governments, and forced the utilities to modify their operational strategies to reduce the pollution and atmospheric emissions of the thermal power plants [1-5].

The main objective of an OPF strategy is to determine the optimal operating state of a power system by optimizing a particular objective while satisfying certain specified physical and operating constraints. In its most general formulation, the OPF is a nonlinear, nonconvex, large-scale, static optimization problem with both continuous and discrete control variables. It becomes even more complex when flexible ac transmission systems (FACTS) devices are taken into consideration as control variables [1-4].

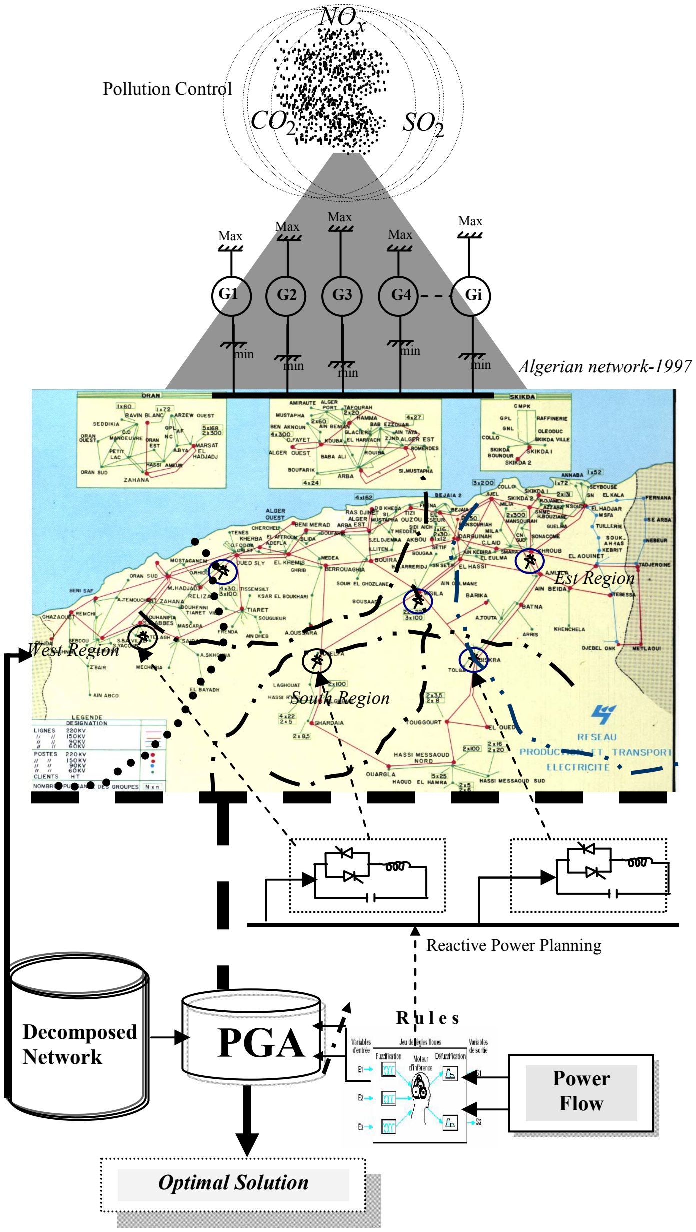

Fig. 1 Efficient decomposed parallel GA approach proposed coordinated with FACTS for the Environmental/economic dispatch.

The global optimization techniques known as genetic algorithms (GA), simulated annealing (SA), tabu search (TS), and evolutionary programming (EP), which are the forms of probabilistic heuristic algorithm have been successfully used to overcome the non-convexity problems of the constrained ED [5]. The GA method has usually better efficiency because the GA has parallel search techniques. Due to its high

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potential for global optimization, GA has received great attention in solving optimal power flow (OPF) problems. Fig.1 shows the Decomposed parallel genetic approach combined with FACTS devices to enhance the optimal power flow (OPF).

The literature on the application of the global optimization in the OPF problem is vast and [6] represents the major contributions in this area. In [7] authors present an enhanced genetic algorithm (EGA) for the solution of the OPF problem with both continuous and discrete control variables. The continuous control variables modeled are unit active power outputs and generator-bus voltage magnitudes, while the discrete ones are transformer-tap settings and switchable shunt devices. With the aid of the problem specific operators proposed the efficiency and the accuracy of the solution are enhanced.

In [8], authors have proposed the use of an ant Colony search algorithm to solve the economic power dispatch with pollution control, to accelerate the processes of Ant Colony Optimization (ACO), the controllable variables are decomposed to active constraints that affect directly the cost function are included in ACO process and passive constraints which are updating using conventional power flow.

Authors in [9] proposed a combined GA-Fuzzy based approach for solving the optimal power flow (OPF). The GA parameters e.g. crossover and mutation probabilities are governed by Fuzzy rule base. Authors in [10] proposed a method based on an efficient successive linear programming technique for optimal power flow (OPF) with environmental constraint. The algorithm tested on the Algerian 59-bus power system.

This paper, proposes a simple approach based in a decomposed parallel genetic algorithm implemented with Matlab program to minimize the total fuel cost of generation and environmental pollution caused by fossil based thermal generating units and also maintain an acceptable system performance in terms of limits on generator reactive power outputs, bus voltages and overload in transmission lines. The advantages of the proposed approach over other traditional optimization techniques and global optimization methods have been demonstrated through the results of the Algerian 59-bus test system.

## II. OPTIMAL POWER FLOW FORMULATION

The active power planning problem is considered as a general minimization problem with constraints, and can be written in the following form:

$$\text{Min} \quad f(x,u) \tag{1}$$

$$\text{S. t} \quad : g(x,u)=0 \tag{2}$$

$$h(x,u)\le 0 \tag{3}$$

$$x=\begin{bmatrix}\delta & V_L\end{bmatrix}^T \tag{4}$$

$$u=\begin{bmatrix}P_G & V_G & t & B_{svc}\end{bmatrix}^T \tag{5}$$

$f(x,u)$ is the objective function, $g(x,u)$ and $h(x,u)$ are respectively the set of equality and inequality constraints. x is the state variables and u is the vector of control variables. The control variables are generator active and reactive power outputs, bus voltages, shunt capacitors/reactors and transformers tap-setting. The state variables are voltage and angle of load buses. For optimal active power dispatch, the objective function $f$ is total generation cost as expressed follows:

$$\text{Min } f=\sum_{i=1}^{N_g}\left(a_i+b_iP_{gi}+c_iP_{gi}^2\right) \tag{6}$$

where $N_g$ is the number of thermal units, $P_{gi}$ is the active power generation at unit i and $a_i$, $b_i$ and $c_i$ are the cost coefficients of the $i^{th}$ generator.

The equality constraints $g(x)$ are the power flow equations.

The inequality constraints $h(x)$ reflect the limits on physical devices in the power system as well as the limits created to ensure system security.

### A. *Emission Objective Function*

An alternative dispatch strategy to satisfy the environmental requirement is to minimize operation cost under environmental requirement. Emission control can be included in conventional economic dispatch by adding the environmental cost to the normal dispatch. The objective function that minimizes the total emissions can be expressed as the sum of all the three pollutants ($NO_x$, $CO_2$, $SO_2$) resulting from generator real power [9].

In this study, $NO_x$ emission is taken as the index from the viewpoint of environment conservation. The amount of $NO_x$ emission is given as a function of generator output (in Ton/hr), that is the sum of quadratic and exponential functions [10].

$$f_e=\sum_{i=1}^{ng}10^{-2}\times\left(\alpha_i+\beta_iP_{gi}+\gamma_iP_{gi}^2+\omega_i\exp\left(\mu_iP_{gi}\right)\right) \quad \text{Ton/h} \tag{7}$$

where $\alpha_i$, $\beta_i$, $\gamma_i$, $\omega_i$ and $\mu_i$ are the parameters estimated on the basis of unit emissions test results.

The pollution control can be obtained by assigning a cost factor to the pollution level expressed as:

$$f_{ce}=\omega.f_e \qquad \$/\text{h} \tag{8}$$

where $\omega$ is the emission control cost factor in \$/Ton.

Fuel cost and emission are conflicting objective and can not be minimized simultaneously. However, the solutions may be obtained in which fuel cost an emission are combined in a single function with different weighting factor. This objective function is described by:

$$\mathit{Minimize} \quad F_T=\alpha f+(1-\alpha)f_{ce} \tag{9}$$

where $\alpha$ is a weighting factor that satisfies $0\le\alpha\le 1$.

In this model, when weighting factor $\alpha$=1, the objective function becomes a classical economic dispatch, when weighting factor $\alpha$=0, the problem becomes a pure minimization of the pollution control level.

## III. REACTIVE POWER DISPATCH

The solution of the reactive power dispatch problem involves the optimization of the nonlinear objective function with nonlinear constraints. In general the objectives considered are the real power loss in transmission network and voltage deviations at the load buses.

### A. Power loss

The objective function here is to minimize the active power loss ( $P_{loss}$ ) in the transmission system. It is given as:

$$P_{loss} = \sum_{k=1}^{N_l} g_k \left[ (t_k V_i)^2 + V_j^2 - 2 t_k V_i V_j \cos \delta_{ij} \right] \tag{10}$$

Where, $N_l$ is the number of transmission lines; $g_k$ is the conductance of branch k between buses i and j; $t_k$ the tap ration of transformer k; $V_i$ is the voltage magnitude at bus i; $\delta_{ij}$ the voltage angle difference between buses i and j.

### B. Voltage Deviation

One of the important indices of power system security is the bus voltage magnitude. The voltage magnitude deviation from the desired value at each load bus must be as small as possible. The deviation of voltage is given as follows:

$$\Delta V = \sum_{k=1}^{N_{PQ}} \left| V_k - V_k^{des} \right| \tag{11}$$

where, $N_{PQ}$ is the number of load buses and $V_k^{des}$ is the desired or target value of the voltage magnitude at load bus k.
Shunt

## IV. STRATEGY OF THE EFFICIENT PARALLEL GA FOR OPF

### A. Principle of the Approach Proposed

Parallel execution of various SGAs is called PGA (Parallel Genetic Algorithm). Parallel Genetic Algorithms (PGAs) have been developed to reduce the large execution times that are associated with simple genetic algorithms for finding near-optimal solutions in large search spaces. They have also been used to solve larger problems and to find better solutions.

The proposed algorithm decomposes the solution of such a modified OPF problem into two linked sub problems. The first sub problem is an active power generation planning solved by the proposed Efficient Genetic Algorithm, and the second sub problem is a reactive power planning [14-15] to make fine adjustments on the optimum values obtained from the EPGA. This will provide updated voltages, angles and point out generators having exceeded reactive limits.

### B. Decomposition Mechanism

Problem decomposition is an important task for large-scale OPF problem, which needs answers to the following two technical questions.

1- How many efficient partitions needed?
2- Where to practice and generate the efficient inter-independent sub-systems?

The decomposition procedure decomposes a problem into several interacting sub-problem that can be solved with reduced sub-populations, and coordinate the solution processes of these sub-problems to achieve the solution of the whole problem.

#### 1) Standard Genetic Algorithm

GA is a global search technique based on mechanics of natural selection and genetics. It is a general-purpose optimization algorithm that is distinguished from conventional optimization techniques by the use of concepts of population genetics to guide the optimization search. Instead of point-to-point search, GA searches from population to population. The advantages of GA over traditional techniques are [7]:

i) It needs only rough information of the objective function and places no restriction such as differentiability and convexity on the objective function.
ii) The method works with a set of solutions from one generation to the next, and not a single solution, thus making it less likely to converge on local minima.
iii) The solutions developed are randomly based on the probability rate of the genetic operators such as mutation and crossover; the initial solutions thus would not dictate the search direction of GA.

Figure. 3 shows the chromosome structure within the proposed approach.

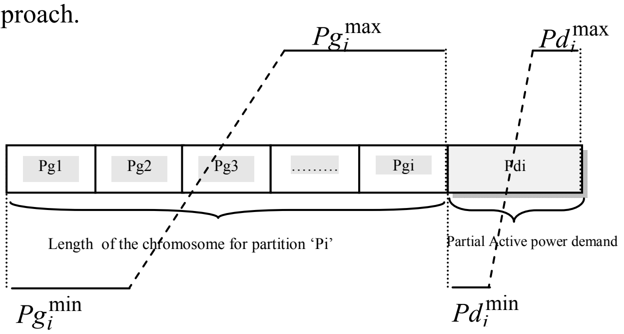

Fig. 3 Chromosome structure.

#### 2) Algorithm of the Proposed Approach

### A. Initialization based in Decomposition Procedure

The main idea of the proposed approach is to optimize the active power demand for each partitioned network to minimize the total fuel cost. An initial candidate solution generated for the global N population size.

1-For each decomposition level estimate the initial active power demand:
For NP=2 Do

$$Pd1 = \sum_{i=1}^{M1} P_{Gi} \tag{14}$$

$$Pd2 = \sum_{i=1}^{M2} P_{Gi} = PD - Pd1 \tag{15}$$

Where NP the number of partition
$Pd1$ : the active power demand for the first initial partition.
$Pd2$ : the active power demand for the second initial partition.
$PD$ : the total active power demand for the original network.
The following equilibrium equation should be verified for each decomposed level:
For level 1:

$$Pd1 + Pd2 = PD + Ploss \tag{16}$$

2-Fitness Evaluation based Load Flow

For all sub-systems generated perform a load flow calculation to evaluate the proposed fitness function. A candidate solution formed by all sub-systems is better if its fitness is higher.

$$f_i = 1/\left(F_{\cos t} + \omega_l F_{li} + \omega_V F_{Vi}\right) \tag{17}$$

$$F_{Vi} = \sum_{j=1}^{NPQ} \left(\left|V_{PQij} - V_{PQij}^{\lim}\right|\right) \Big/ \left(\left|V_{PQij}^{\max} - V_{PQij}^{\min}\right|\right) \tag{18}$$

where $f_i$ is fitness function for sub- systems decomposed at level i.

$F_{li}$ denotes the per unit power loss generated by sub-systems at level i; $F_{\cos t}$ denotes the total cost of the active power planning related to the decomposition level i; $F_{Vi}$ denotes the sum of the normalized violations of voltages related to the sub-systems at level i.

3-Consequently under this concept, the final value of active power demand should satisfy the following equations.

$$\sum_{i=1}^{N_g}\left(Pg_i\right) = \sum_{i=1}^{part_i}\left(Pd_i\right) + ploss \tag{19}$$

$$Pg_i^{\min} \le Pg_i \le Pg_i^{\max} \tag{20}$$

### *3. Final Search Mechanism*

- All the sub-systems are collected to form the original network, global data base generated based on the best results $U_{best}^{Parti}$ of partition 'i' found from all sub-populations.
- The final solution $U_{best}^{Global}$ is found out after reactive power planning procedure to adjust the reactive power generation limits, and voltage deviation, the final optimal cost is modified to compensate the reactive constraints violations. Fig. 4 shows an example of tree network decomposition.

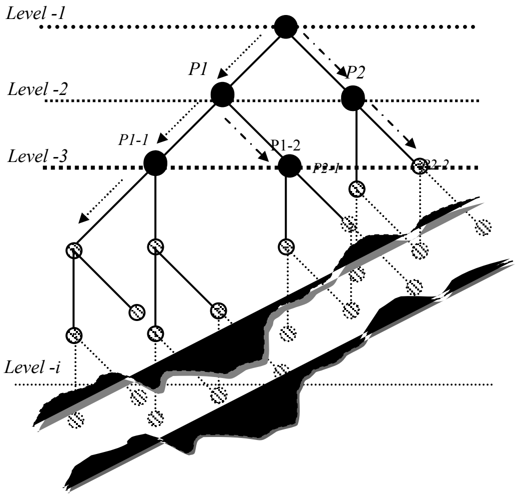

Fig. 4 Sample of network with tree decomposition

## V. APPLICATION STUDY

### *1) Active Power Dispatch without SVC Compensators*

The algorithm proposed is developed in the Matlab programming language using 6.5 version. The approach proposed has been tested on a part of the Algerian network. It consists of 59 buses, 83 branches (lines and transformers) and 10 generators. Table I shows the technical and economic parameters of the ten generators. Knowing that the generator of the bus N°=13 is not in service. Table II shows the generators emission coefficients. The values of the generator emission coefficients are also given in Table II.

The generators data and cost coefficients are taken from [8]-[10]. For the voltage constraint the lower and upper limits are 0.9 p.u and 1.1 p.u., respectively. The GA population size is taken equal 30, the maximum number of generation is 100, and crossover and mutation are applied with initial probability 0.9 and 0.01 respectively. For the purpose of verifying the efficiency of the proposed approach, we made a comparison of our algorithm with others competing OPF algorithm. In [9], they presented a fuzzy controlled genetic algorithm. In [8] they presented a standard GA, in [8], the authors presented an ACO algorithm, and then in [10], they proposed fast successive linear programming algorithm. Fig. 5 shows the topology of the Algerian network test with 59-Bus.

To demonstrate the effectiveness and the robustness of the approach proposed, three cases have been considered with and without consideration of SVC Controllers installation:

**<u>Case 1</u>**: Minimum total operating cost (α =1).

**<u>Case 2</u>**: Minimum total emission (α =0).

**<u>Case 3</u>**: Minimum total operating cost and emission (α =0.5).

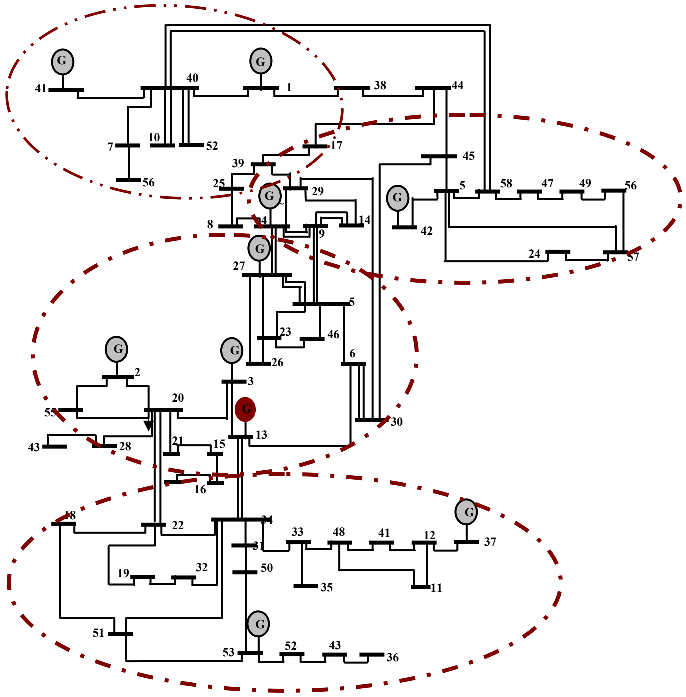

Fig. 5 Topology of the Algerian production and transmission network before 1997.

the results obtained by the application of the proposed decomposed parallel GA are compared with those found by global optimization (GA, FGA, and ACO) and conventional methods (FSLP) are reported in the Table III and Table IV. The proposed approach gives more important results compared to all cases. For example at the case corresponding to the minimum total operating cost (***α =1***), the fuel cost is **1769.70** \$/h, and power loss **17.921** MW which are better compared with the results found by the global and conventional methods. It is important to note that all results obtained by the approach proposed do not violate the physical generation capacity constraints. The security constraints are satisfied for voltage magnitudes (**0.9<V<1.1 p.u)** and line flows. Table V shows clearly the simulations results for voltage phase profile and reactive power generation for three cases. Figure 7 shows the voltage magnitude improvement using SVC Compensators installed at critical buses. Table VI shows the results of the best cost and average CPU time for the four best decomposed networks. Figure 8 shows the convergence of the approach proposed for the first partition at **α =1**. These results confirm clearly the ability of the proposed approach to find accurate and efficient OPF solution with consideration of environmental constraints.

TABLE I
TECHNICAL ADMISSIBLE PARAMATERS OF GENERATORS AND THE FUEL COST COEFFICIENTS

| *Bus Number* | *Pmin [MW]* | *Pmax [MW]* | *Qmin [Mvar]* | *Qmax [Mvar]* | *a [\$/hr]* | *b [\$/MWhr]* | *c [\$/MW$^2$hr]* |
|---|---|---|---|---|---|---|---|
| **1** | 8 | 72 | -10 | 15 | 0 | 1.50 | 0.0085 |
| **2** | 10 | 70 | -35 | 45 | 0 | 2.50 | 0.0170 |
| **3** | 30 | 510 | -35 | 55 | 0 | 1.50 | 0.0085 |
| **4** | 20 | 400 | -60 | 90 | 0 | 1.50 | 0.0085 |
| **13** | 15 | 150 | -35 | 48 | 0 | 2.50 | 0.0170 |
| **27** | 10 | 100 | -20 | 35 | 0 | 2.50 | 0.0170 |
| **37** | 10 | 100 | -20 | 35 | 0 | 2.00 | 0.0030 |
| **41** | 15 | 140 | -35 | 45 | 0 | 2.00 | 0.0030 |
| **42** | 18 | 175 | -35 | 55 | 0 | 2.00 | 0.0030 |
| **53** | 30 | 450 | -100 | 160 | 0 | 1.50 | 0.0085 |

TABLE II
GENERATOR EMISSION COEFFICIENTS

| Bus Number | Generator | *α* | *Bx1e-2* | *γ x1e-4* | *ω* | *μ x1e-2* |
|---|---|---|---|---|---|---|
| **1** | 1 | 4.091 | −5.554 | 6.490 | 2.00e-04 | 2.857 |
| **2** | 2 | 2.543 | −6.047 | 5.638 | 5.00e-04 | 3.333 |
| **3** | 3 | 4.258 | −5.094 | 4.586 | 1.00e-06 | 8.000 |
| **4** | 4 | 5.326 | −3.550 | 3.380 | 2.00e-03 | 2.000 |
| **13** | 5 | 4.258 | −5.094 | 4.586 | 1.00e-06 | 8.000 |
| **27** | 6 | 6.131 | −5.555 | 5.151 | 1.00e-05 | 6.667 |
| **37** | 7 | 4.091 | −5.554 | 6.490 | 2.00e-04 | 2.857 |
| **41** | 8 | 2.543 | −6.047 | 5.638 | 5.00e-04 | 3.333 |
| **42** | 9 | 4.258 | −5.094 | 4.586 | 1.00e-06 | 8.000 |
| **53** | 10 | 5.326 | −3.550 | 3.380 | 2.00e-03 | 2.000 |

TABLE III
COMPARISON OF THE RESULTS OBTAINED WITH CONVENTIONAL AND GLOBAL METHODS: CASE:1 MINIMUM COST

| Generators N° | FGA [9] | GA [8] | ACO [8] | FSLP [10] | Our Approach |
|---|---|---|---|---|---|
| $P_{g1}$ (MW) | 11.193 | 70.573 | 64.01 | 46.579 | 41.272 |
| $P_{g2}$ (MW) | 24.000 | 56.57 | 22.75 | 37.431 | 37.319 |
| $P_{g3}$ (MW) | 101.70 | 89.27 | 82.37 | 134.230 | 133.83 |
| $P_{g4}$ (MW) | 84.160 | 78.22 | 46.21 | 137.730 | 142.32 |
| $P_{g5}$ (MW) | **0.000** | **0.00** | **0.00** | **0.000** | **0.00** |
| $P_{g6}$ (MW) | 35.22 | 57.93 | 47.05 | 23.029 | 24.80 |
| $P_{g7}$ (MW) | 56.80 | 39.55 | 65.56 | 35.238 | 39.70 |
| $P_{g8}$ (MW) | 121.38 | 46.40 | 39.55 | 39.972 | 39.54 |
| $P_{g9}$ (MW) | 165.520 | 63.58 | 154.23 | 117.890 | 119.78 |
| $P_{g10}$ (MW) | 117.32 | 211.58 | 202.36 | 131.650 | 123.46 |
| PD(MW) | 684.10 | 684.10 | 684.10 | 684.10 | 684.1 |
| Ploss(MW) | 33.1930 | 29.580 | 39.980 | 19.65 | **17.921** |
| Cost[\$/hr] | 1768.50 | 1937.10 | 1815.7 | 1775.856 | **1769.70** |

TABLE IV
COMPARISON OF THE RESULTS OBTAINED WITH CONVENTIONAL METHOD

| | FSLP[10] | | | **Our Approach** | | |
|---|---|---|---|---|---|---|
| $P_{gi}$ (MW) | Case1 ***α =1*** | Case 2 ***α =0*** | Case 3 ***α =0.5*** | Case1 ***α =1*** | Case 2 ***α =0*** | Case 3 ***α =0.5*** |
| $P_{g1}$ | 46.579 | 28.558 | 37.464 | 41.272 | 30.5995 | 36.8311 |
| $P_{g2}$ | 37.431 | 70.000 | 52.675 | 37.319 | 70.00 | 53.170 |
| $P_{g3}$ | 134.230 | 114.200 | 116.080 | 133.83 | 109.40 | 119.06 |
| $P_{g4}$ | 137.730 | 77.056 | 141.490 | 142.32 | 79.80 | 138.32 |
| $P_{g5}$ | **0.000** | **0.000** | **0.000** | **0.00** | **0.00** | **0.000** |
| $P_{g6}$ | 23.029 | 87.575 | 28.286 | 24.80 | 80.58 | 22.860 |
| $P_{g7}$ | 35.238 | 32.278 | 34.565 | 39.70 | 34.86 | 39.800 |
| $P_{g8}$ | 39.972 | 63.176 | 56.644 | 39.54 | 70.04 | 59.900 |
| $P_{g9}$ | 117.890 | 95.645 | 101.800 | 119.78 | 100.62 | 109.52 |
| $P_{g10}$ | 131.650 | 135.540 | 133.920 | 123.46 | 128.02 | 122.92 |
| Cost (\$/h) | 1775.856 | 1889.805 | 1786.000 | **1769.70** | **1854.8** | **1765.7** |
| Emission (ton/h) | 0.5328 | 0.4329 | 0.4746 | **0.5307** | **0.4213** | **0.4723** |
| Power loss (MW) | 19.65 | 19.93 | 18.83 | **17.921** | **19.8195** | **18.2811** |

TABLE V
SIMULATION RESULTS FOR VOLTAGE PHASE PROFILE AND REACTIVE POWER GENERATION -THREE CASES:WITHOUT SVC COMPENSATORS

| | Case 1: ***α =1*** | | Case 2: ***α =0*** | | Case 3**: *α =0.5*** | |
|---|---|---|---|---|---|---|
| **Bus** | **Phase (degre)** | **Qg (Mvar)** | **Phase (degre)** | **Qg (Mvar)** | **Phase (degre)** | **Qg (Mvar)** |
| 1 | 0.00 | 3.8300 | 0.00 | 7.391 | 0.00 | 5.56 |
| 2 | 3.2215 | 38.768 | 5.1849 | 33.588 | 2.3129 | 35.992 |
| 3 | 8.283 | 26.209 | 7.6622 | 27.654 | 6.0354 | 26.66 |
| 4 | -8.975 | 57.312 | -10.3037 | 80745 | -11.2228 | 58.807 |
| 13 | -0.74002 | -29.947 | -1.1833 | -28.596 | -2.6164 | -29.131 |
| 27 | -9.0873 | 28.74 | -10.2907 | 7.46 | -11.3271 | 29.099 |
| 37 | -2.315 | 17.605 | -9.3887 | 22.036 | -3.9299 | 17.524 |
| 41 | -3.9747 | 26.823 | -1.1206 | 18.383 | -2.4137 | 21.32 |
| 42 | -0.08364 | 43.906 | -1.2318 | 47.509 | -1.4423 | 46.126 |
| 53 | 2.8753 | 26.002 | 3.0538 | 23.802 | 1.1658 | 25.824 |

TABLE VI
RESULTS OF THE BEST COST AND AVERAGE CPU TIME FOR THE BEST FOUR DECOMPOSED NETWORK

| Partition | **Pgi** | **Best Cost \$/hr** | **Worst Cost \$/hr** | **Average CPU time (s)** |
|---|---|---|---|---|
| Part **1** | [Pg1, Pg2] | 187.4522 | 187.6080 | 0.230 |
| Part **2** | [Pg3, Pg4] | 737.6220 | 737.9309 | 0.230 |
| Part **3** | [Pg6, Pg7] | 171.7722 | 171.9310 | 0.230 |
| Part **4** | [Pg8, Pg9, Pg10] | 662.3062 | 662.6031 | 0.260 |

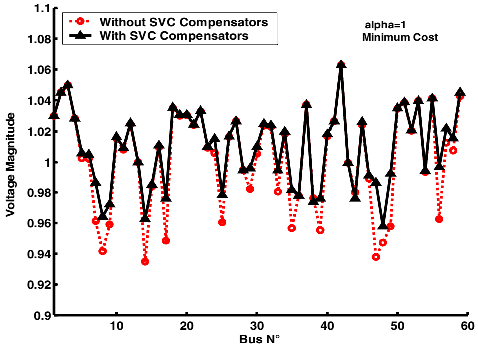

Fig. 7 Voltage Magnitude improvement using SVC Compensators: Case: α =1; Minimum Cost

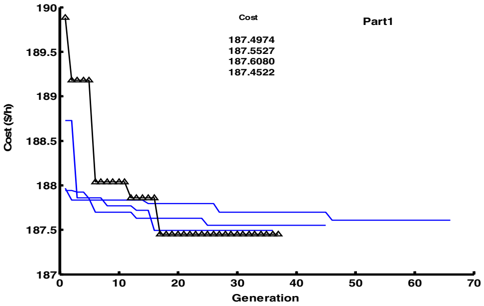

Fig. 8 Convergence of the approach proposed for the first partition: Case: α =1: Minimum Cost.

## VI. CONCLUSION

A decomposed parallel GA approach to solve the optimal power flow (OPF) with consideration of environmental constraints is presented. The main objective of the approach proposed is to improve the performance of the standard GA in term of reduction time. In the first stage the original network was decomposed on multi sub-systems and the problem transformed to optimize the active power demand associated to each partitioned network, a global data base generated containing the best technical sub-systems. In the second stage an active power dispatch strategy proposed to enhance the final solution of the optimal power flow of the original network. The performance of the proposed approach was tested on the Algerian 59-bus test case, the algorithm proposed compared with conventional method and with recent evolutionary algorithms, it is found the approach proposed can converge at the near solution and obtain a competitive solution at a reduced time.

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