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DESIGN AND SIMULATION OF MULTI OBJECTIVE POWER FLOW OPTIMIZATION IN IEEE-30 BUS SYSTEM USING MODIFIED PARTICLE SWARM OPTIMIZATION

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Abstract: Execution and Reliability of OPF algorithms is an important issue of research for gainful power structure control and orchestrating. Perfect Power Flow is driven for restricting the objective work. This objective limit can be single regarded target work or different objective limits. In the present research, we have executed perfect power stream in order to constrain the fuel cost while satisfying the constraints, for instance, the voltages, power yields of the generator kept inside embraced purpose of repression. Some other objective can be used reliant on utility's preferred position and needs. Many streamlined framework models have been combined in the past by various researchers for OPF issue, for instance, Linear Programming, Non Linear Programming, Quadratic Programming, Newton Based Techniques, Parametric Methods, and Interior Point Methods, etc. A wide variety of bleeding edge optimization methodologies like Evolutionary Programming, Genetic Algorithm, PSO Algorithm, etcare proposed recorded as a hard copy for handling OPF issue. In this proposition, we have executed improved particle swarm optimization algorithm to restrain cost limit while keeping goals inside acceptable most extreme. The adjustments in particle swarm optimization is finished by introducing the idea of quantum computing and optimization of quickening coefficients. The proposed algorithm is associated with IEEE-30 bus structure. Resuts indicated unrivaled execution of proposed algorithm as contrasted and contemporary techniques.
Keywords: Optimal power flow, PSO, ELD, OPF, IEEE-30 Bus, Power System optimization.

I. INTRODUCTION

With the beginning of deregulation and rivalry, electric utilities have new motivators to lessen their expenses. Since a noteworthy part of working cost is the expense of the fuel to power the generators' turbines, the electric business has appeared expanding enthusiasm for lessening fuel costs. A technique is proposed here to limit these expenses by improving the ideal power stream (OPF) algorithm, which is in charge of finding the ideal division of electric load (counting transmission misfortunes) among the accessible age units. At the end of the day, OPF is an economic dispatch (ED) algorithm that represents misfortunes.

Given the reliance of every generator's fuel costs on the load it supplies, the target of the OPF algorithm is to distribute the complete electric power request (and misfortunes) among the accessible generators in such a way, that limits the electric utility's all out fuel cost[1,3,4,6,7,10,11,12,13,16]. By and by, be that as it may, numerous regular economic dispatch algorithms are not sufficiently adaptable to permit precise demonstrating of the fuel costs. Most normal ED algorithms depend on setting the steady age costs (basically gradual fuel costs) of every generator equivalent to each other, maybe with some acclimation to represent misfortunes [1,11,12,16]. For the equivalent gradual cost answer for be ideal, every generator's steady cost bend must be a monotonically expanding capacity of load, which isn't really the situation for a physical generator [7, 11, 16].

Confounding issues is the way that OPF is a compelled optimization. The load stream conditions are equity limitations on the arrangement, while restricts on amounts, for example, power age, voltage greatness, and line streams are imbalance imperatives. In this manner, diagnostic arrangement requires the utilization of such procedures as Lagrange multipliers and the Kuhn-Tucker strategy to implement these imperatives [12, 16]. A few researchers, for example, Bakirtzis [6], linearize the issue and utilize direct programming to play out the optimization. As of late, with an end goal to stay away from the troubles of upholding requirements, procedures utilizing computerized reasoning to ED, OPF, and related issues have started to show up in the literature [3, 6, 7, 10]. In this project, a genetic algorithm (GA), a particular sort of computerized reasoning, is utilized recently to take care of the OPF issue.

II. OPTIMAL POWER FLOW PROBLEM

Fractional Given each generator's cost to generate a given amount of electric power, a utility must determine the optimal amount of power to be supplied by each generator. This optimization is divided into three problems, which differ in their time horizon [12]. Looking ahead a day or two is the unit commitment problem, in which a typical utility uses forecasts for the next day's power demand to decide which generators to bring online. Looking ahead a few minutes is the economic dispatch problem, in which the utility decides how much power should be supplied by each generator. In real time (or nearly in real time) automatic generation control is performed to correct any mismatch between power generated and used. This work will investigate the optimal power flow problem, which is economic dispatch while accounting for transmission losses.

"OPF has been applied to regulate generator active power outputs and voltages shunt capacitors/reactors, transformer tap settings and other controllable variables to minimize the fuel cost, network active power loss, while keeping the load bus voltages, generators reactive power outputs, network power flows and all other state variables in the power system in their operational and secure limits".

In order to compute the power flows in a power system, the system's bus admittance matrix, Y_{BUS}, must be defined. If V and I are respectively vectors of all voltages and currents in the system, the bus admittance matrix will satisfy

$$I = Y_{bus} * V \quad (1.1)$$

Where, Y_{BUS} is a square matrix which depends on the admittance of all transmission lines in the system. Let V_{ij} be the series admittance connecting buses i and j. Note that V_{ij}equals zero if buses i and j are not connected. In the optimal power flow problem, it is necessary to find a relationship between the voltage magnitudes and angles and the real and reactive power at the buses. For bus l, let V_l and δ_l be the voltage magnitude and angle, respectively. Furthermore, let the P_{Gl}be the real power generated, let P_{Dl} be the real power demand (the real power load), let Q_{Gl} be the reactive power generated, and let Q_{Dl} be the reactive power demand. Then, the net real and reactive power at bus l are given by the load-flow equations

For the formulation of the real and reactive power entering a bus, we need to define the following quantities. Let the voltage at the i[th] bus be denoted by

$$V_i = |V_i|\angle\delta_i = |V_i|(\cos\delta_i + j\sin\delta_i)$$

Also let us define the self-admittance at bus-i as

$$Y_{ii} = |Y_{ii}|\angle\theta_{ii} = |Y_{ii}|(\cos\theta_{ii} + j\sin\theta_{ii}) = G_{ii} + jB_{ii}$$

Similarly, the mutual admittance between the buses i and j can be written as

$$Y_{ij} = |Y_{ij}|\angle\theta_{ij} = |Y_{ij}|(\cos\theta_{ij} + j\sin\theta_{ij}) = G_{ij} + jB_{ij} \quad (1.4)$$

Let the power system contains a total number of n buses. The current injected at bus-i is given as

$$I_i = Y_{i1}V_1 + Y_{i2}V_2 + \Lambda + Y_{in}V_n$$
$$= \sum_{k=1}^{n} Y_{ik}V_k$$

It is to be noted we shall assume the current entering a bus to be positive and that leaving the bus to be negative. Therefore, the power and reactive power entering a bus will also be assumed positive. The complex power at bus-i is then given by

$$P_i - jQ_i = V_i^* I_i = V_i^* \sum_{k=1}^{n} Y_{ik}V_k$$
$$= |V_i|(\cos\delta_i - j\sin\delta_i)\sum_{k=1}^{n}|Y_{ik}V_k|(\cos\theta_{ik} + j\sin\theta_{ik})(\cos\delta_k + j\sin\delta_k)$$
$$= \sum_{k=1}^{n}|Y_{ik}V_iV_k|(\cos\delta_i - j\sin\delta_i)(\cos\theta_{ik} + j\sin\theta_{ik})(\cos\delta_k + j\sin\delta_k) \quad (1.6)$$

Note that

$$(\cos\delta_i - j\sin\delta_i)(\cos\theta_{ik} + j\sin\theta_{ik})(\cos\delta_k + j\sin\delta_k)$$
$$= (\cos\delta_i - j\sin\delta_i)[\cos(\theta_{ik} + \delta_k) + j\sin(\theta_{ik} + \delta_k)]$$
$$= \cos(\theta_{ik} + \delta_k - \delta_i) + j\sin(\theta_{ik} + \delta_k - \delta_i)$$

$$P_i = \sum_{k=1}^{n}|Y_{ik}V_iV_k|\cos(\theta_{ik} + \delta_k - \delta_i)$$

$$Q_i = -\sum_{k=1}^{n}|Y_{ik}V_iV_k|\sin(\theta_{ik} + \delta_k - \delta_i)$$

The OPF problem can be formulated as an optimization problem and is as follows:

Minimization of Generation cost function F (P_G)

Min F (P_G)

Subject to satisfaction of Equality Constraints:

g (x,u) = 0

and Inequality Constraints:

III. PARTICLE SWARM OPTIMIZATION BASED OPF

Ideal Power stream (OPF) is issue to designate loads to producing stations for least expense while meeting the system imperatives (correspondence and non-equity limitations). It is displayed as an optimization issue of limiting the complete fuel cost of all dedicated plant while meeting the system (load stream) imperatives. There are various variations of the issues, which show the goal and the imperatives in various ways. The fundamental OPF issue is related scientifically as a minimization of issue of limiting the all out creating cost of fuel of every single submitted plant subject to the fairness and non-equity imperatives.

Minimize$\sum_{i=1}^{n} F_i\ (P_i)$

F(P_i) is the generating cost (Fuel) equation of the 'i[th]' plant. It is the variation of fuel cost ($ or Rs) with generated power (MW).Normally it is expressed as continuous quadratic equation.

$F_i\,(P_i) = a_iP_i^2 + b_iP_i + c_i$,

$P_{imin} \leq P_i \leq P_{imax}$

The total generation should meet the total demand and losses in transmission. The loss can be determined from load flow.

$\sum_{i=1}^{n} P_i = D + P_i.$

$$P_i = real(\textstyle\sum_j^n V_i\, Y_{ij} * V_j), i = 1,2, \dots . n$$

$$Q_i = imag(\textstyle\sum_j^n V_i\, Y_{ij} * V_j), i = 1,2, \dots . n.$$

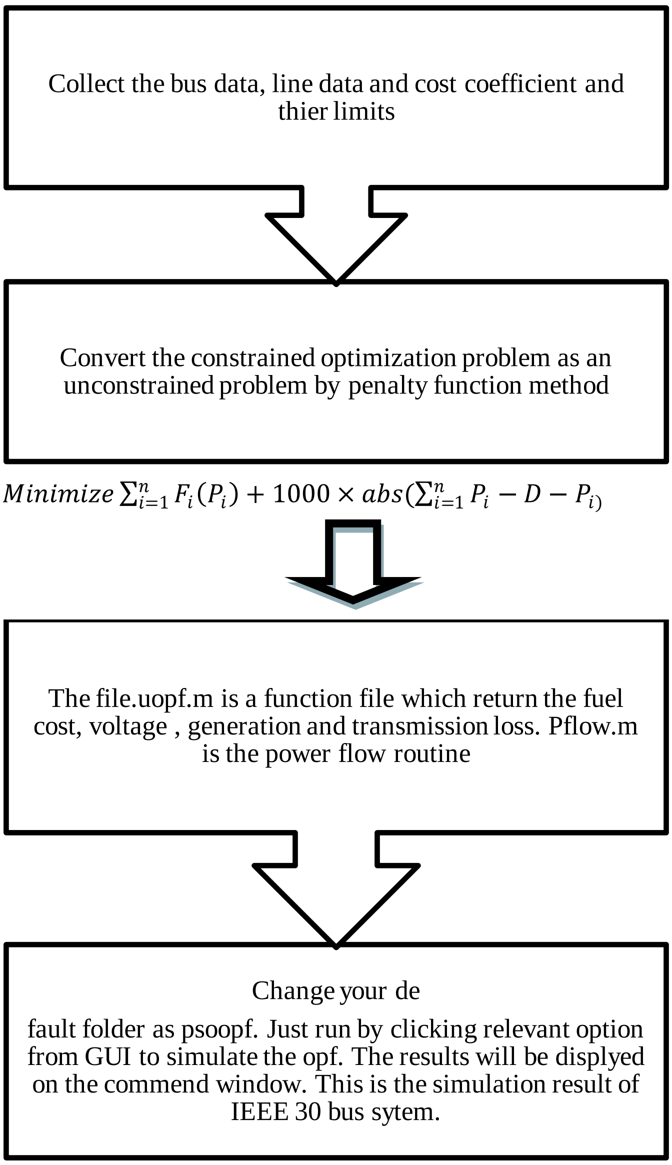
$V_{imin} \leq V_i \leq V_{imax}$

$LF_{ij} \leq$ Line flow limits

Ideal dispatch of receptive power dispatch is a non-direct issue to designate ideal estimation of control factors (uniformity and non-correspondence limitations). It is demonstrated as an optimization issue of limiting the power loss of all dedicated plant while meeting the system (load stream) requirements. There are various variations of the issues, which show the goal and the requirements in various ways. The essential OPD issue is related scientifically as an issue of limiting the all out power misfortune in Mega Watt (MW) of every single submitted plant subject to the correspondence and non-balance imperatives.

$$min \sum_{k \in N_E} P_{kloss} = \sum_{k \in N_E} g_k (v_i^2 + v_j^2 - 2 v_i v_j \cos\theta_{ij})$$

Where,
K= (i,j); i∈ N_B (Total no. of buses)
j∈ N_i (No. of buses adjustment to bus i, including bus i)
$\sum_{k \in N_E} P_{kloss}$ = Total activepower losses in transmission system
g_k = Conductance of branch k (pu)
v_i ,v_j = voltage magnitude (pu) of bus i and j respectively
θ_{ij} = load angle difference between bus i and j (rad) .



Steps of PSO for OPF

IV. RESULTS

This segment exhibits another system for strategy of the multiple objective optimal power flow problem issue with valve-point influence utilizing a changed particle swarm optimization (MPSO) procedure. The reasonable optimal power flow issues have non-smooth cost work with sensibility and uniqueness necessities, which make the issue of finding the general flawless troublesome while utilizing any numerical frameworks. In this research, a changed particle swarm optimization (MPSO) system is proposed to manage the adjustment and distinction obstacles in the ELD issues utilizing Gaussian and Cauchy likelihood courses. The MPSO approach presents new advancement and addition framework into the particles thusly keeping PSO algorithm from untimely blend. To demonstrate the appropriateness of the proposed methodology, the numerical examinations have been performed for 30 bus test frameworks with variable power demand.

Both of soft computing techniques (Genetic Algorithm and PSO) operated at optimum efficiency and results were successfully implemented to solve optimal power flow problem.

Comparative Analysis of PSO and Genetic Algorithm for OPF

Parameters	PSO	Genetic Algorithm	MPSO (Proposed)
Fuel Cost($/h)	801.8436	802.296	798.11
Transmission loss (MW)	9.3374	9.6426	8.71

Both of algorithms worked with almost same optimization efficiency but the value of cost function was slightly more optimized with PSO optimization as compared to its value in Genetic Algorithm. Soft computing techniques proved to be a highly efficient technique to solve these types of load flow problems with a number of variables.Change in acceleration coefficients and change in quantum computing based particle swarm optimization proved to be more efficient in qualitative as well as quantitative analysis of system. MATPOWER was used for solving optimal reactive power dispatch problem. ORPD is a complex optimization problem in which we try to “optimally” set the values of control variables like reactive power output of generators (generator bus voltages), tap ratios of transformers and reactive power output of shunt compensators like capacitors etc. to minimize the total transmission active power losses while satisfying a given set of constraints [16]. In this research work we have used modified particle swarm optimization to solve this objective function moe efficiently than existing methods.

V. CONCLUSION

To begin with, research developed the scientific model of optimization power stream with single imperatives and Newton Raphson cycle technique. Second one is to tackle numerical consequences of power stream count and optimization by applying the scientific model. The third one is reenactment dependent on the IEEE-30 bus framework and shows the investigation of the outcomes. This project for the most part considered the PSO technique and GA strategy. It is utilized to give the arrangement including numerical examination. The PSO strategy and GA technique needs less number of emphasess to achieve intermingling, and is progressively exact and not touchy to the variables. Furthermore, this project likewise contemplated ideal power stream based the IEEE 30 bus framework. Ideal power stream is the condition that the expense of by and large power framework is the most reduced. This project concerns a general cost minimization issue to take care of the power stream issue dependent on IEEE 30 bus framework. objective.

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