Hybrid Implementation of FACTS devices in Economic Load Dispatch using Evolutionary Algorithms

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ABSTRACT

Economic load dispatch problem is says that total demand must be shared among the generating units. Economic dispatch is a procedure determine the electrical power to be generated by the committed generating units in a power system so total generation cost of the system is minimized satisfy load demand. Process of allocating generating levels to the generating units so the system is supplied entirely most economic allocation. Depending on load variations the output of generator has to be changed to meet the balance between loads and generation power to make the system efficient. Using evolutionary algorithms is given to the pulse of any facts devices inner thyristor devices. It is used to determine the correct node and improve the performance of the power system. Fit the facts devices and it will useful to reduces the fuel cost. MATLAB is used to verify the results.

KEYWORDS: Economic Load Dispatch, EA(EvolutionaryAlgorithm), GA(Genetic Algorithm) Load Demand, Load variations.

INTRODUCTION

Evolutionary Algorithm can be applied on a broad range of problems. EA methods only need the target (fitness) function for a given problem, which is to be optimised. Additional problem specific knowledge can easily be brought into the EA heuristic to improve performance. EA methods do have negligible demands on the nature. EA methods can be imagined as some kind of toolbox to find high quality solution for complex optimisation problems.

Over the years, many efforts have been made to solve the ELD problem, incorporating different kinds of constraints or multiple objectives through various mathematical programming and optimization techniques. The conventional methods include Newton-Raphson method, Lambda Iteration method, Base point and Participation Factor method, Gradient method etc. However these classical dispatch algorithms require the incremental cost curves to be monotonically increasing or piece-wise linear. To solve economic dispatch problem effectively, most algorithms require the incremental cost curves to be of monotonically smooth increasing nature and continuous.

To obtain accurate dispatch results, the approaches without restriction on the shape of fuel cost functions are necessary. Most of conventional methods suffer from the convergence problem, and always get trap in the local minimum. Moreover, some techniques face the dimensionality problem especially when solving the large-scale system.
In recent years, one of the most promising research fields has been “Evolutionary Techniques”, an area utilizing analogies with nature or social systems. Evolutionary techniques are finding popularity within research community as design tools and problem solvers because of their versatility and ability to optimize in complex multimodal search spaces applied to non-differentiable objective functions. Several modern heuristic tools have evolved in the last two decades that facilitate solving optimization problems that were previously difficult or impossible to solve.

In this paper two different approaches of evolutionary algorithms have been executed and compared i.e. economic load dispatch using quadratic programming and with genetic algorithm for the two test systems

Hybrid Partial Gradient Descent Simulated Annealing (HPGDSA) method to reduce the CPU time of SA while retaining the main characteristics[2]. Application of mixed-integer linear programming (MILP) in power system planning and expansion and obtained fast and robust behaviours. LP method will be investigated as the approaches to exploit TCSC planning problem with consideration of system loadability[4]. Phase shifter transformer installation considering its advantages can control the value of line power obviously. However, because of investment limitations, the installation and usage of phase shifter transformers only based on their advantages will not be economic.

Using evolutionary algorithms determine the correct node. Also find the cost easily. The EA algorithm also used to improve the performance. Fix the facts devices correct place to improve the power system. Instead of Mixed Integer linear program Evolutionary Algorithm is used. In the EA Algorithm in economic load dispatch will reduce the total generation cost of system reduced also satisfies the load demand. In facts device inner thyristor device given pulse is EA algorithm will depends on power factor (reactive power) will increase current is decrease. Depends on this fuel cost will reduced.

![Classification of algorithm](image1)

**Fig. 1:** Classification of algorithm

![Operation of system](image2)

**Fig. 2:** Operation of system

1. **Operation:**
   In Generating Station side If we generate 200MW means in distribution side we get only 150MW The balance 50MW is loss so we want satisfies that demand the load changes is happening every seconds so maintain the generation constant to prevent the loss. For this prevention we using in this paper Evolutionary Algorithm in Economic Load Dispatch. Here using facts controllers the EA is Programmed in Distribution side to maintain powerfactor and current to reduces the loss. Facts device is an igbt controller EA is programmed to maintain this action. So the Loss is reduced Demand also satisfied.

2. **Evolutionary Algorithm:**
   Evolutionary Algorithms (ED) for combinatorial optimization problems, this paper presents a new versatile optimization algorithm called generalized Evolutionary Algorithms (GED), which can be used to solve the
discontinuous, non convex, nonlinear constrained optimization problems. This algorithm is used to solve the complicated, non convex, nonlinear economic dispatch (ED) problem of power systems. Several factors such as, valve-point effects of fuel cost functions, transmission capacity constraints, and system stability constraints are considered in the computation models. Numerical results show that the proposed method is feasible and efficient.

3. **Economic Load Dispatch:**

   Economic Load Dispatch is defined as the sharing of load equally in generating The dynamic economic dispatch problem is a high-dimensional complex constrained optimization problem that determines the optimal generation from a number of generating units by minimizing the fuel cost. The performance of evolutionary algorithms is highly dependent on a number of factors, such as the control parameters, diversity of the population, and constraint-handling procedure used.

   Economic Load Dispatch is an integral part of power system generation planning and it is of utmost importance for the electrical utilities and power engineers to explore this area in short and long term planning scenarios. Load demand requirements subjected to economic feasible solutions matching voltage profile, power demand, minimization of losses, voltage stability and improve the capacity of the system is the need of the hour. Optimization techniques based on evolutionary computing, artificial intelligence, search method finds their applications in the area of economic load dispatch planning to reach global optimal solution for this multi-decision, multi-objective combinatorial problem subjected to different constraints.
For first thing Initialization process Creation of initial population will explains the how many transmission lines to facts devices fit. Only the facts devices will fit either sending end side or the receiving end side. And then Termination point meet Correct place to fit facts devices (either sending or receiving side) is defined terminate point met or not. For example facts devices fitting correct place is obtained means Fix as the best point to fix facts devices and obtained the result (Reduces the fuel cost the Evolutionary Algorithm is given to the pulse of the thyristor used in facts devices). Best Individuals If the correct place is not obtained means in program no will get then check the fitness of the transmission line. If flag is equal to 1 means it is minimum fitness otherwise if flag is equal to 0 means obtain maximum fitness (max and min generation unit). Recombination In recombination is shows combined the transmission line which one is the best transmission line to use (sampling). In Mutation is used to giving better solution of the process. Evaluation off spring in the total yield evaluated. In reinsertion is an revaluation process. Migration process is an to fix the values of facts device. Competition process Competition is process ready to meet termination point and here obtained best point and obtaining the result.

4. **Power Factor and current:**
   Power factor is defined as the cosine of the phase angle between voltage and current. Electric current is a flow of electric charge. In electric circuits this charge is often carried by moving electrons in a wire. Current whenever reduced the power will increase.

5. **Output:**
The Output Shows Difference between Million and optimization approach also efficiency. In the output

6. **Genetic Algorithm:**
Solving Economic Load Dispatch In Which The Total Cost Of Generating Power Is Minimized With A Valve Point Loading Effect While Satisfying The Load Demand Irrespective Of Transmission Line Losses. These techniques can encounter some difficulties such as getting trapped in local minima, increasing computational complexity and being not applicable to certain objective functions. This calls for developing a new class of solution methods that can overcome these limitations. Heuristic optimization is fast nascent tools that can overcome most of the shortcomings found in derivative based techniques. GA is well suited to and has been extensively applied to solve complex design optimization problems because it can handle both discrete and continuous values. The flowchart depicts the behaviour of genetic Algorithm.

7. **Economic Dispatch in GA**
   **Step 1. Initialization:**
   Initialize population size, maximum generation, stall time limit and read the cost coefficients and B coefficients.

   **Step 2. Formation of population:**
The initial power search for each generator can be obtained by $P_{ij} = P_{imin} + ((P_{imax} – P_{imin}) / (2l-1)) * bij$
   Where,
   i = number of generator
   j = number of generation
Step 3. Evaluate the fitness function:

The incremental transmission losses denoted as ‘B’ is calculated as per formula the given below and determines the best fitness and mean fitness values.

Step 4. Apply genetic operators:

Parent individuals are selected using ‘Roulette Wheel’ selection procedure and single point crossover is used and finally mutation operator is used for regaining the lost characteristics during the process.

Step 5:

Repeat the step 3 and step 4 until the process has been converged or it satisfies the stopping criteria.

Fig. 6: Flowchart of GA

8. Output of system:

Fig. 7: Fuel cost vs generation in genetic algorithm

9. Future work and conclusion:

In this paper, we demonstrated that a real-parameter enhanced GA with a non-uniform mutation and a self-adaptive enhanced DE exhibited superior performances in solving DED problems. In this approach, a random
sequential technique was used to consider periodic simpler sub-problems in order to satisfy the equality constraints and dynamic ramp constraints. A dynamic relaxation factor for the equality constraints was set to preserve a few marginally infeasible solutions in order to enhance the convergence rate. Finally, using EA algorithm hybrid system performance improves, fuel cost reduced, customer benefit, demand of load will be satisfied. In this paper, comparison of Evolutionary Algorithm will be used to reduce the fuel cost and reduce the computational cost. Mainly using facts controller devices aim at increasing the control of power flows in the high-voltage side of the network during both steady state and transient conditions. Also used to satisfy the load demands.

REFERENCES