ECONOMIC LOAD DISPATCH OPTIMIZATION USING BAT ALGORITHM WITH VARIOUS PERCENTAGES OF LOADS AT DIFFERENT TIME INTERVALS

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Abstract- Nowadays the economic load dispatch is the vital issue in the electrical system due to the greater requirement of the consumer. This issue can be optimized using improved technologies like BAT algorithm, Genetic algorithm, Cuckoo algorithm and Intelligence water drop methods helps to upgrade the economic dispatch issues. BAT algorithm was developed in 2010 and it is a meta-heuristic and Nature-inspired algorithm which depends on echolocation behavior of micro-bats in searching their prey. The strength of BAT algorithm is examined on IEEE30 bus system at various loads with different time interval. The results represent the greater convergence capability and effectiveness of the BAT algorithm.

Keywords- Bat algorithm (BA), Meta-heuristic, Loudness and Pulse rate of emission

I. INTRODUCTION

Economic dispatch is the process of optimization of operating cost is important in operational planning issues. Nowadays organizing and utilization of power system is a demanding task due to its complexity and to satisfy the consumer requirements for electrical energy with continuity of service and reliability. The conventional approaches for solving the load dispatch issues are by applying non-linear programming technologies. This approach minimizes a convex objective function over a convex set thus insuring a single minimum. Meta-heuristic optimization is another method of resolving optimization issues. These algorithms are commonly based on process in physics and biology. The meta-heuristic algorithm is perfect for non-convex load dispatch issues as they do not affected from continuity. Bat algorithm is the population based algorithm. This algorithm emulates the echolocation capability of micro-bats which uses for recognizing and hunting the prey. The position of the Bat gives the possible result for the load dispatch issues. Aim of the solution is represented by best position of BAT to its food. BA and its constraints have been used to solve the load dispatch issues. Some well-liked nature-inspired algorithms like Ant colony optimization (ACO) based on hunting behavior, Artificial bee colony (ABC) based on behavior of honey bee, Cuckoo search based on the brooding behavior of cuckoo spices and many more methods are used to optimize the load dispatch issues among them BAT algorithm has less convergence time to operate hence it is very reliable method for power dispatch issue.

The Bat algorithm also applied for the non-smooth convex and non convex problems which has unbalanced constraints which affect the economic operation of the system.
II. METHODOLOGY

2(a): Echolocation behavior of bats:
Echolocation is the use of sound waves and echoes to recognize where objects are in surrounding. To Echolocate, bats send out sound waves from their mouth or nose. When the sound waves hit an object they produce echoes.

\[ f_{min} = f_{min} + (f_{max} - f_{min}) \times \beta \]

\[ v_i^t = v_i^{t-1} + \left( x_i^{t} - x_* \right) \times f_i \]

\[ x_i^t = x_i^{t-1} + v_i^t \]

2(b): Loudness and pulse emission:
Micro bats release about 10-20 sound rapture per second. When searching for food this can varies up to 200 pulses a second as they are nearer to their prey. The loudness \( A_i \) and the pulse emission rate \( r_i \) are reformed appropriately as the iteration proceeds. Once a BAT is recognized its food loudness reduces and the rate of pulse emission factor varies

\[ A_i^{t+1} = \alpha \ A_i^t \]

\[ r_i^{t+1} = r_i^t [1 - \exp(-\gamma t)] \]

where \( \alpha \) & \( \beta \) are the constants.

At the point of echolocation the micro-bats discharges string of short and high frequency noise impacts after showing interest for echoes that rebounds back from the nearer objects. According to this echo the Bats determines the object dimension, shape, direction and movement. Also it recognizes the distance for its food. Even as the Bats move nearer to its food, the rate of pulse emission will increase as high as 200 pulses per 2d.

![Fig 1: BAT sonar](image)

The use of sonar (Sound Navigation And Ranging) with exceptional morphological and physiological modification allows bats to detect with sound. Most bats produce echolocation sounds by contracting their larynx. Echolocation calls are usually ultrasonic ranging in frequency from 20 to 200 kHz, whereas human hearing will be more than 20kHz. In terms of loudness, bats emit calls as low as 50dB as high as 120dB, which is louder than smoke detector 10cm from our ear. That sound damages to human ear. The ears and brain cells in bats are mainly attuned to the frequencies of sound they discharge and the echoes that result. The exterior formation of bat’s ears also plays a special role in observing echoes. Echolocation is highly technical and interesting strategy.
2(c): Flow chart of BAT algorithm:

![Flowchart of BAT algorithm]

**Fig 2: Flowchart of BAT algorithm**

**Description:**
- Initiate the Bat population
- Define the system frequency and velocity
- Initiate the rate of pulse emission and the loudness
- Define the number of iterations wants to generate
- Find the best fitness function and update it
- If the rand value is less than rate of pulse emission find new best solution and update the velocities and the current best solution
- If the rand value is less than loudness and the new best fitness function is greater than previous function, accept the new best solution and update it
- Upgrade the bat position and the current best solution
III. RESULTS AND DISCUSSION
The standard IEEE30 bus system is considered for the study, the generation cost and power losses has illustrated in the table 1 at different % of load with time intervals. The graphs are obtained using MATLAB coding.

<table>
<thead>
<tr>
<th>Time Delay in hour</th>
<th>Load in (%)</th>
<th>Generation cost in ($/hr)</th>
<th>Power loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>19607</td>
<td>204.39</td>
</tr>
<tr>
<td>2</td>
<td>60</td>
<td>7111.6</td>
<td>80.50</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>4657.2</td>
<td>52.03</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>662</td>
<td>9.18</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>29177</td>
<td>697.7</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>17832</td>
<td>188.54</td>
</tr>
</tbody>
</table>

Table 1: IEEE30 bus system at various % of load with time interval

Generation cost of 1\textsuperscript{st} hour with 20\% load

Generation cost of 2\textsuperscript{nd} hour with 60\% load

Generation cost of 3\textsuperscript{rd} hour with 80\% load

Generation cost of 4\textsuperscript{th} hour with 100\% load
The above figures represent the variation of generation at different percentage of load at different time interval.

**IV. CONCLUSION**

The convergence time is less for the Bat algorithm as compared to other methods. As shown in the table 1 the generating cost and total loss of the system is shown and the graphs are shown for each hour with various percentages of loads using MATLAB coding. The BAT algorithm has less convergence time for computations with moderate fuel cost. The results represent efficient and reliable behavior for solving economic dispatch issues. Bat algorithm need less memory as the computations are less. Bat algorithm works for multi-model systems which are having complex constraints and unbalanced parameters which affect the economy of power dispatch. The improved BAT algorithm works for the non-convex dynamic problems which can reduce the economy dispatch problem and optimize the generating cost of the system.

**REFERENCES**