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Review Article

REVIEW ON OPTIMIZATION TECHNIQUES EMPLOYED IN DISTRIBUTION GENERATION

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Abstract

Distributed Generators are playing a vital role and had achieve lot of attention due to their greater impact on various distribution systems. This approach encourages small scale technologies to produce electricity to the need at consumer end by utilizing the renewable energy sources. Power quality and reliability of distributed power can be attained by proper placing of Distributed Generators at appropriate location. Optimization tools were predominantly increasing their importance in integration of distributed generation. This paper proposes various reviews on recent optimization techniques being used over the years to the problem solving and sizing of DG units. In contrast this paper analyses the economical, technological, environmental etc., which are rapidly growing interest on integration of distributed generation by overcoming all the challenges. At last it presents several optimization techniques of the integration of distribution generation from renewable energy sources.

.**Keywords:** DGs, RES, Optimization Techniques

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INTRODUCTION

Renewable energy sources are inexhaustible, clean and free from pollution so they are considered widely rather than fossil fuels in distribution generation. Energy sources like solar, wind, biomass, geothermal, ocean energy etc., among all these solar and wind energies are gaining importance in very wide range applications. However, there is some drawback is that all these sources are non linear in nature due to which maximum power generation is difficult. In order to overcome from such drawback optimization techniques were developed to track maximum power from these sources. Several optimization techniques were proposed since 1960s and gained importance in various applications like distribution generation is one among them.

Optimization technique are being rapidly growing during the past few decades. Many recent theoretical and computational algorithms have been contributed for various problem solving in engineering. Basically they are divided into deterministic and heuristic approaches. Deterministic approach takes advantage of the analytical properties of problem solving to produce a sequence of points that converge to a global optimal solution. Heuristic approach is flexible and efficient but the quality of the produced solution cannot be guaranteed. However, the chances of getting the global solution decreases when the problem size increases.

The main objective of the system is to create net zero Greenhouse gas emissions by using renewable energy sources. These sources faced many challenges like intermittent in nature, economic and technical issues during their initial setup. They were concentrated at only some specific locations where the resources were available for power generation but they face difficulty with the distribution system which are very far away from their location. In order to overcome all such constraints optimization techniques has gained a greater importance which helped in proper planning and decision making like plant size, location etc., To enhance the importance and development of RES the investment cost have been reduced, and Distributed Generations are developed in order to encourage huge investments by creating competiveness for the usage of renewable energy. Distributed generators are optimized with a greater impact in reducing the technical challenges which are associated with grid integration. Proper Location of DGs not only reduces the losses but improves reliability and voltage which is one important objectives for the power utilities which are planning for new installation for generating power.

Increasing in demand for electricity, DGs are were widely being developed because they are installed at less risk and also change in the traditional system which transforms to a decentralised system. To achieve this various optimization technique were developed with good benefits with multiple objectives.

In this proposed paper various existing optimization techniques which are implemented for installation and integration of distribution generation from renewable energy sources. A brief of all these techniques are discussed which provides information about the most effective technique can be used.

REVIEW OF OPTIMIZATION TECHNIQUES

Literature survey of various optimization techniques utilized in distribution generation for various applications like maximum power tracking from renewable energy sources as these sources are intermittent in nature. Optimal location of distribution generation and various technical issues can be resolved. Table 1 gives the analysis of various optimization techniques and their performances under various parameters are studied.

Table 1 Analysis of various optimization techniques "in scientific literature

MPPT	Array Dependent	A/D	Tuning	Detected Parameter	Starting Parameter requirement	Processing Speed	Difficulty	Sensitivity	Maximum Tracking
Voc	Y	A/D-D/A	Y	V	Y	Moderate	Low	Low	N
Isc	Y	A/D-D/A	Y	I	Y	Moderate	Moderate	Low	N
Inc	Y	Digital	N	V, I	Y	Varies	Moderate	Moderate	Y
RCC	N	Analog	Y	V, I	N	Fast	Low	Moderate	Y
P &O	N	A/D-D/A	N	V	N	Varies	Low	Moderate	Y
PSO	N	Digital	N	V, I	Y	Fast	Low	High	Y
Cuckoo	N	Digital	N	V,I	Y	Fast	High	Moderate	Y
GA	N	Digital	N	Varies	Y	Fast	High	Moderate	Y
GSA	N	Digital	N	Varies	Y	Fast	High	Moderate	Y
BBO	N	Digital	N	Varies	Y	Very Fast	High	High	Y
GW	N	Digital	N	Varies	Y	very Fast	High	High	Y
ESA	N	Digital	N	Varies	Y	Fast	High	High	Y

*Y Yes *No A Analog D Digital

Incremental conductance MPPT Technique

IC is commonly used MPPT in PV system to track maximum power. It frequently Compares with the particular conductance i.e., I/V and di/dv to the solar PV array. It computes I_{PV} and V_{PV} until there is no change then it do not generate the duty pulses required to the converter. The algorithm is as shown in figure 1

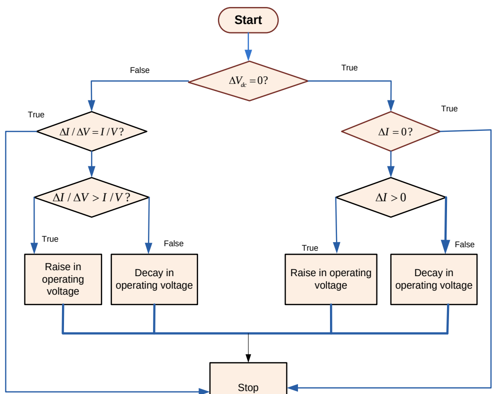

Fig 1. Incremental Conductance algorithm

IC is commonly used MPPT in PV system to track maximum power. It frequently Compares with the particular conductance i.e., I/V and di/dv to the solar PV array. It computes I_{PV} and V_{PV} until there is no change then it do not generate the duty pulses required to the converter. The algorithm is as shown in figure 1.[1-25]

Perturb and Observe MPPT Technique

Generally, MPP techniques are commonly used track maximum power from sources which are intermittent in nature like renewable energy sources. P&O is most commonly used techniques which continuously compares and computes the reference voltages until a best value is obtained to generate duty pulses which is required to operate the converter. In order to maintain less power loss, the size of P&O is set to a very small value. The main drawback is it fails to derive maximum power under fast change atmospheric conditions. It's very easy and popular technique. [25-40]

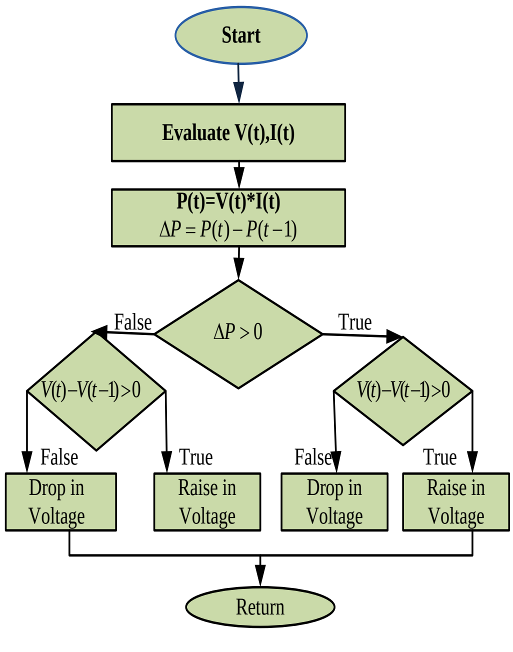

Fig. 2 Perturb and Observe algorithm

PSO MPPT Technique

PSO is an intelligent technique majorly used for evaluating optimization which functions on the movement of swarms. Problem solving such as social communication is applied using PSO. It utilizes number of particles which constitute swarms moving in a specified search space to track the best solution. Each particle tries to track its neighboring particles in the search space which is accomplished with the best solution P_{best}.PSO tracks another best values among the best values obtained which is called global best G_{best}. Both the G_{best} and P_{best} are saved and determined by the following velocity.[15-56]

Velocity function:

$$V_{i(k+1)} = V_{i(k)} + t_{1i}(P_i - X_i(k)) + t_{2i}(G - X_i(k))$$

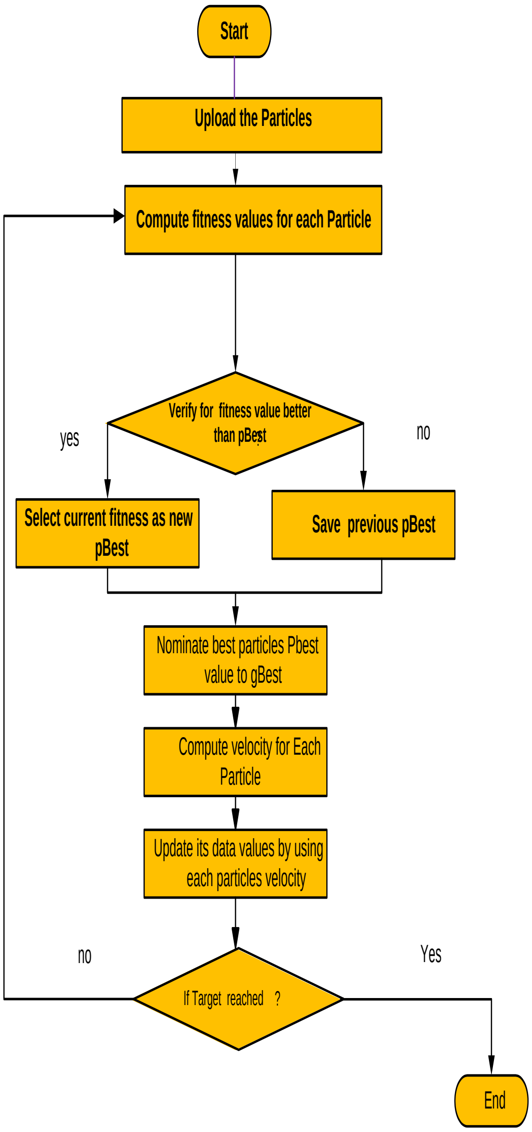

Fig. 3 Algoritham for PSO MPPT

Cuckoo search algorithm

Generally, this algorithm works on random search in the search region depending upon the problem to be computed. Generally, the search is not random but these is some mechanism in the algorithm which provide guidelines during the search so that the result gets improved with iterations. Exploitation and exploration are two basic characteristics of this algorithm. Voltage, current, power and number of variables are set to the value during initializing. By computing the present values of voltage and current the power which is calculated has fitness and stored. It repeats every time by checking the samples either achieved convergence if not then the power evaluated is stored in the fitness array until the best solution is obtained the process repeats.[56-60]

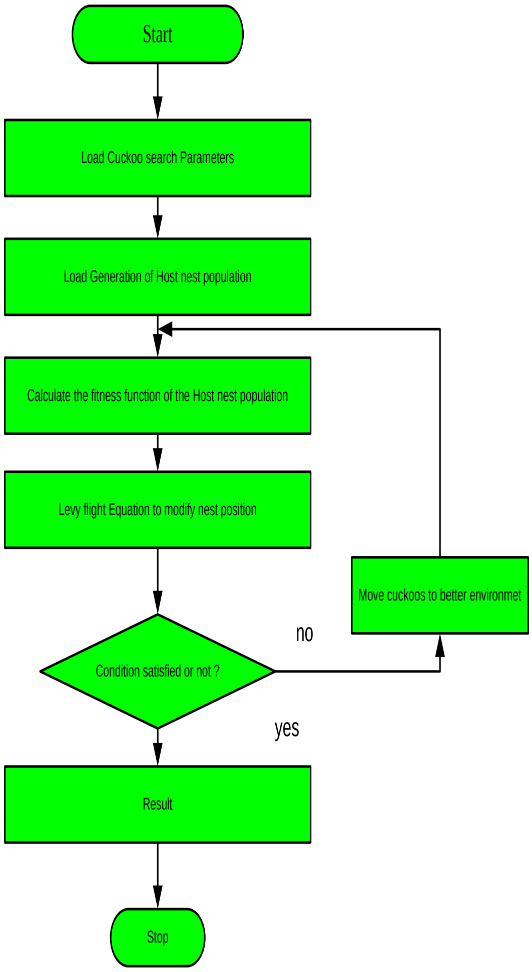

Fig.4 Flowchart for Cuckoo MPPT

By computiong the array, the data among which the highest power is chosen as the best sample. Thereafter the rest of the saampled datat are made to follow to the best values. The step sizes are calculated by performing the Levy flight as described by equations.[56-60]

$$V_i^{t+1} = V_i^t + \alpha \oplus levy(\lambda)$$

$$S = \alpha_0 (V_{best} - V_i) \oplus levy(\lambda)$$

Genetic Algorithm

It is a natural computational procedure which is considered to prove the optimization problems so it is generally known as heuristic search algorithm. It is initialized from a set of population with N, size in which every individual regulates a point in search space and thus their solution is called chromosome which indicates list of genes. Selection, crossover and mutation are the three operators is used to compute the genetic composition. During each cycles new generation which has highest fitness function with best solution is produced from the existing population during selection process. Cross over operator produces two off spring by rejoining the information from two parents. Gene values in individuals are changed using random process using mutation. The allele of each gene is a candidate for mutation, and the function is determining by mutation. Until the optimization criteria is reaches the process keeps on repeating. [57-58]

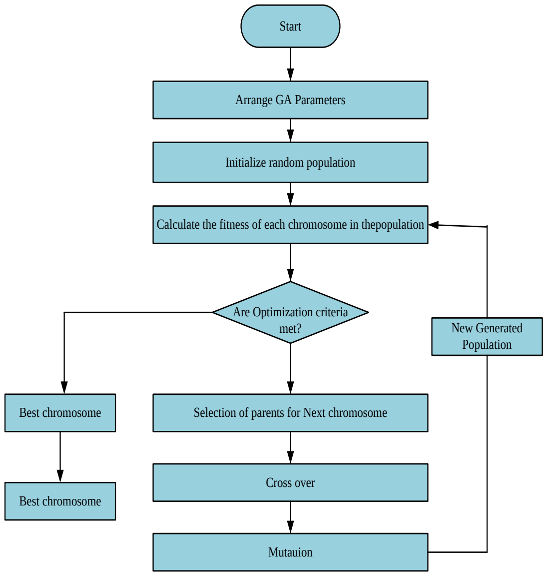

Fig. 5 Genetic Algorithm

Gravitational Search algorithm

GSA is an evolutionary algorithm which is also a population based which works on mass and gravity. Solutions in GSA is known as Agents which generally interact with neighbor agents through force of gravity and their characteristics is measured by their mases. The agent with higher mass would be the best solution. Global movement of every agent is considered as object and all objects movements towards the other agents which has higher mass. Agent or object with more mass will move slowly which denotes exploitation step of the algorithm and leads to best solutions. [57-58]

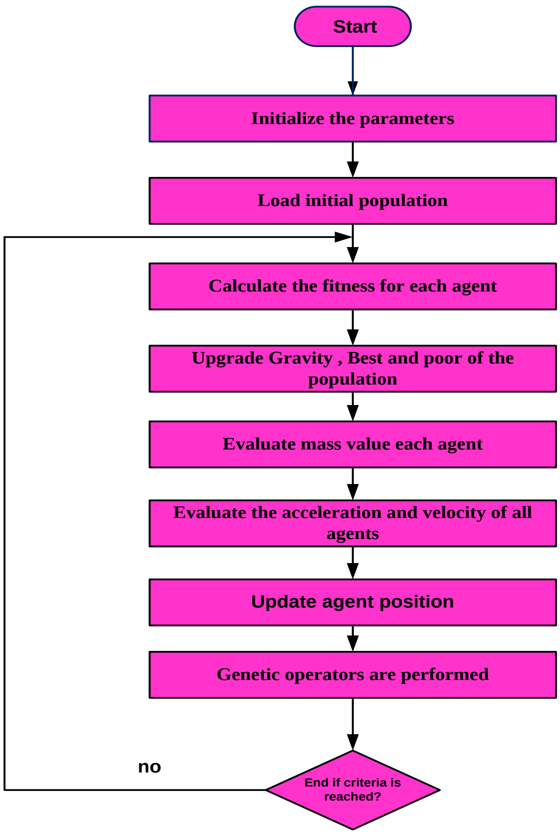

Fig.6 Gravitational Search Algorithm

Bio-Geography Based optimization

BBO is an evolutionary optimization which is again motivated from Swarm behavior in the nature. Biological species and their activities are observed. Immigration and emigration are the characteristics of any algorithm. Usually the area has land, rainfall, vegetation, temperature etc. which indicates high habitat suitability index so the species shifts from one island to the other. Suitability Index Variables which indicates the habitability. Species with large number indicates HIS is called emigration and less indicates low HIS is called immigration. Compared to high HIS low HIS are ready to accept a lot of new features from good solutions and results in praise of the quality of those solutions. BBO optimization is a latest approach to problem solving.[61-62]

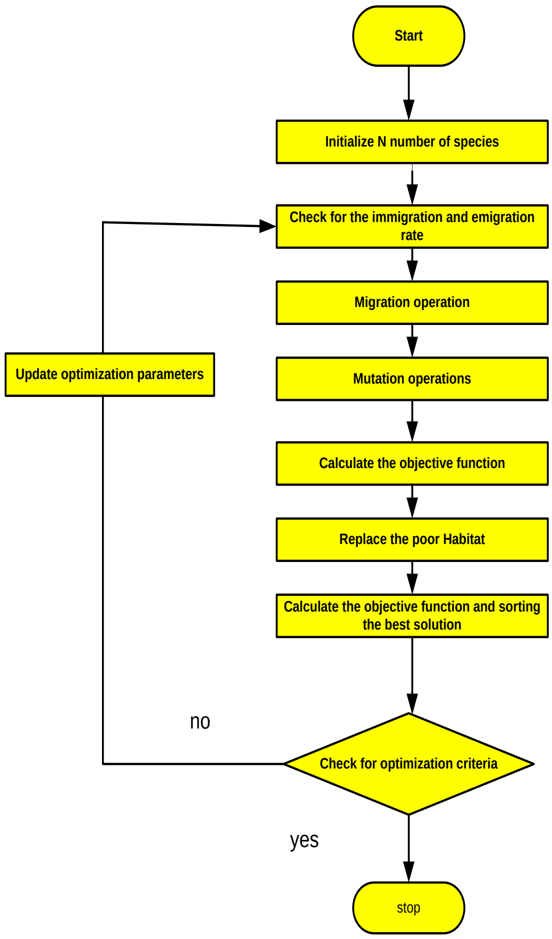

Fig. 7 BBO based optimization

Extended Search Algorithm:

In order to keep dc link voltage like a regular we used ESA with some set of rules. Here reference voltage and regular dc link voltages are fed as inputs to the set of guidelines used in ESA. Generally, ESA is the advanced optimization technique generally applied to crossover, mutation and genetic operators. Quality factor is strongly used in the considered set of rules in order to supply contemporary individual a set of first rate men or women used to produce in the crossover operation by considering a fantastic individual part of the person.[66]

ESA is used to keep a DC-Link voltage in the converter by reducing the errors.

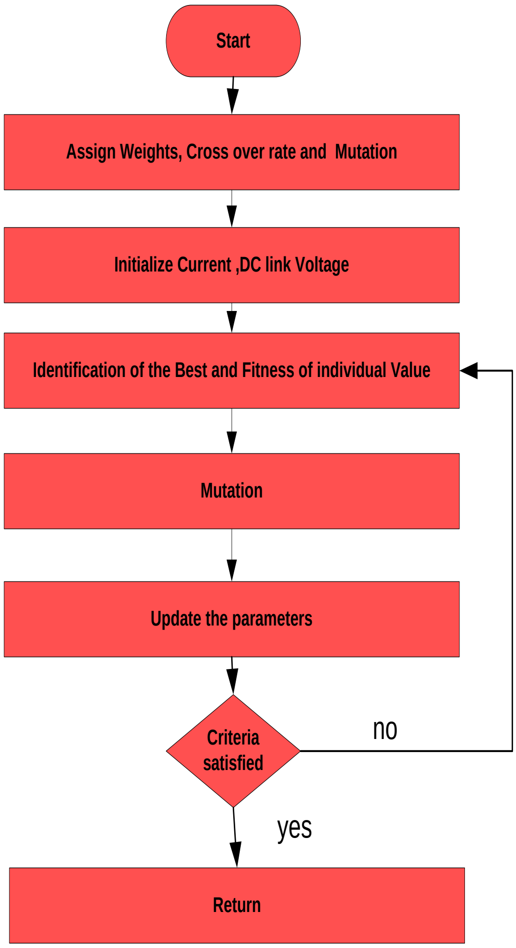

Fig 8. ESA Optimization

I Grey Wolves algorithm:
Grey Wolves are generally called as apex predators which means that they are at the top of the food chain. They generally live in groups on an average size of 5-12 and has strict social dominant hierarchy. They generally categorized into three levels:
First level: Alphas
Second level: Betas
Lowest level: Omega

Alphas: Here the leaders are a male and female which are most responsible to take decision about hunting, place for shelter, when to wake up and so on. The decision is dictated among the group and sometimes the behaviors of other among the wolf group is also followed by alphas. The rest of the wolf acknowledges the alpha by holding their tails down as the alpha is the dominant one. This shows how organized and discipline of the group.

Beta: They are the subordinate's wolves that helps alpha in decision making or the other activities of the group. They can be either male/female which is the best candidate in case of the alpha wolves dies or become very old. In other words, they have to respect alpha and also have command over the lowest level and also acts as a feedback to the alpha.

Omega: They are ranked as the lowest which play the role of scape goat. They are allowed to eat at the last as all other were dominant. Even though they are not having an individual importance but due to not to cause problems they are not lost in the group. Sometimes they are called as babysitters in the group. [63-65]

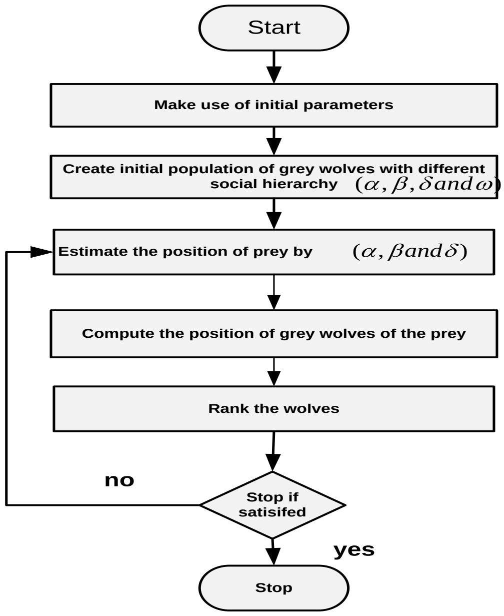

Fig9. Grey Wolf Optimization

CONCLUSIONS
This paper presents the need for optimization technique applied for Renewable energy sources based grid integration of DGs. This paper offers a review of the recent published works about the application. This paper presents review of the recent published contribution about the application of various optimization techniques to solve various parameters like size of DG, optimal location, control techniques etc., In addition, future planning to extract energy from renewable sources, location and planning of DGs will have greater impact.

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