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Optimal Efficient Meta Heauristic Based Approch for Radial Distribution Network

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ABSTRACT: *In the present work, a cuckoo search optimisation-based approach has been developed to allocate static shunt capacitors along radial distribution networks. The objective function is to minimize the losses and to improve the voltage profile the proposed approach identifies optimal sizing and placement and takes the final decision for optimum location within the number of buses nominated with minimum number of effective locations and with lesser injected VArs. The overall accuracy and reliability of the approach have been validated and tested on radial distribution systems with differing topologies and of varying sizes and complexities. The results shown by the proposed approach have been found to outperform the results of existing heuristic algorithms found in the literature for the given problem.*

KEYWORDS— *capacitor placement ,minimization of loses voltage profile cuckoo search algorithm*

I. INTRODUCTION

More and more modern Meta heuristic algorithms inspired by nature are emerging and they become increasingly popular. For example, particles swarm optimization (PSO) was inspired by fish and bird swarm intelligence, while the Firefly Algorithm was inspired by the flashing pattern of tropical fireflies [1-3]. These nature-inspired Meta heuristic algorithms have been used in a wide range of optimization problems, including NP-hard problems such as the travelling salesman problem [4-6].The power of almost all modern metaheuristics comes from the fact that they imitate the best feature in nature, especially biological systems evolved from natural selection over millions of years. Two important characteristics are selection of the fittest and adaptation to the environment. Numerically speaking, these can be translated into two crucial characteristics of the modern Meta heuristics: intensification and diversification [7]. Intensification intends to search around the current best solutions and select the best candidates or solutions, while diversification makes sure the algorithm can explore the search space efficiently .This paper aims to formulate a new algorithm, called Cuckoo Search (CS), based on the interesting breeding behavior such as brood parasitism of certain species of cuckoos.

II. METHADALOGY CAPACITOR PLACEMENT

In a distribution system, capacitors are widely installed in anticipation to compensate the reactive power, reduce the energy loss, regulate the electric voltage, enhance the operation security and release the system capacity [8]. A general capacitor placement problem determines the location, type, and size of capacitors to be allocated in an electric distribution system. The economic benefits obtained from the loss reduction can be weighed against the installment cost while keeping the load profile within the allowable limits. In allocating the capacitors, because many parameters such as control settings, capacitor costs, voltage constraints and load variations are all required taking into consideration, the problem has become very complicated. Considerable efforts have been devoted to solving the capacitor placement problem. The size, type, location and cost of the capacitors are the most important factors to be considered while placing capacitors in a distribution system to reduce the power loss. In this paper method based on employing cuckoo search is proposed to solve capacitor placement problem.

Many optimization techniques have been developing to solve capacitor placement problem. Cuckoo search algorithm is most recently developed algorithm by Yang and Deb [9-10]

Cuckoo are fascinating birds, not only because of the beautiful sounds they can make, but also because of their aggressive reproduction strategy. Some cuckoos lay their eggs in communal nests, though they may remove others' eggs to increase the hatching probability of their own egg. Quite a number of species engage the obligate brood parasitism by laying their eggs in the nests of other host birds (often other species). Some host birds can engage direct conflict with the intruding cuckoos. If a host bird discovers the eggs are not own by them, they will either throw these alien eggs away or simply abandon its nest and build a new nest

elsewhere. Some cuckoo species evolved in such a way that female parasitic cuckoos are often very specialized in the mimicry in colour and pattern of the eggs of a few chosen host species [12]. This reduces the probability of their eggs being abandoned and thus increases their reproductively. In addition, the timing of egg-laying of some species is also amazing. Parasitic cuckoos often choose a nest where the host bird just laid its own eggs. In general, the cuckoo eggs hatch slightly earlier than their host eggs. Once the first cuckoo chick is hatched, the first instinct action it will take is to evict the host eggs by blindly propelling the eggs out of the nest, which increases the cuckoo chick's share of food provided by its host bird. Studies also show that a cuckoo chick can also mimic the call of host chicks to gain access to more feeding opportunity.

III. CAPACITOR PLACEMENTS USING CUCKOO SEARCH ALGORITHM

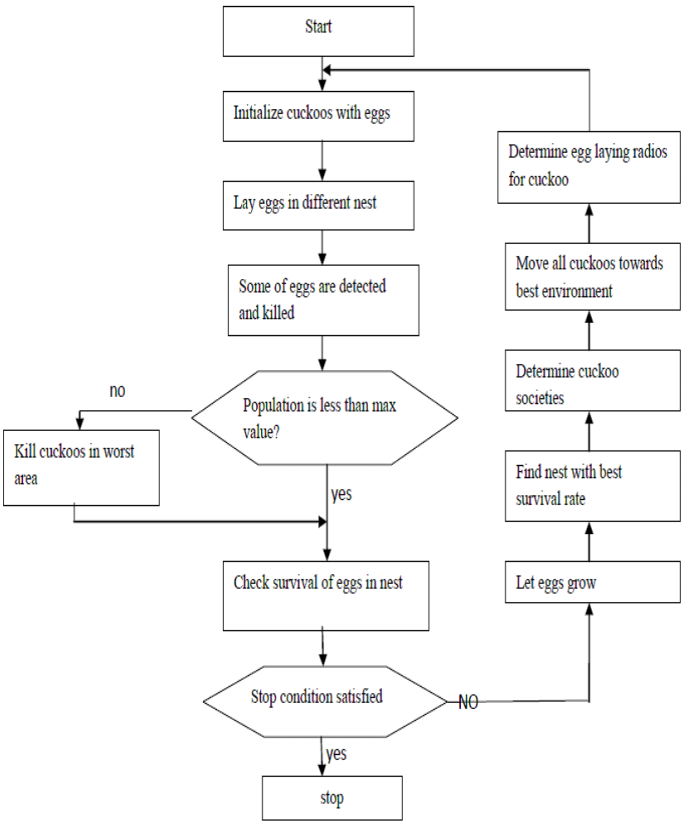
CSA is following three idealised rules:

(i) Each cuckoo lays one egg at a time, and dump its egg in randomly chosen nest;

(ii) The best nests with high quality of eggs will carry over to the next generation

(iii) The number of available host nests is fixed, and the egg laid by a cuckoo is discovered by the host bird.

The cuckoo bird searches the most suitable nest to lay eggs (Solution) in order to maximise their eggs survival rate. Each cuckoo lays one egg at a time. The eggs (high quality of eggs, that is, near to optimal value) which are more similar to the host bird's eggs have the chance to develop (next generations) and become a mature cuckoo. Foreign eggs (Away from optimal value) are detected by host birds with a Probability Pa € [0, 1] and these eggs are thrown away or the nest is discarded, and a completely new nest is built, in a new location and the egg grows up and is alive for the next generation. Good converge behaviour can be obtained if the control parameters namely cuckoo nest population size, maximum generation can be optimally tuned. Setting of these cuckoo parameter optimally would also yield better solution and lesser computational time.



Flow chart of cuckoo search algorithm

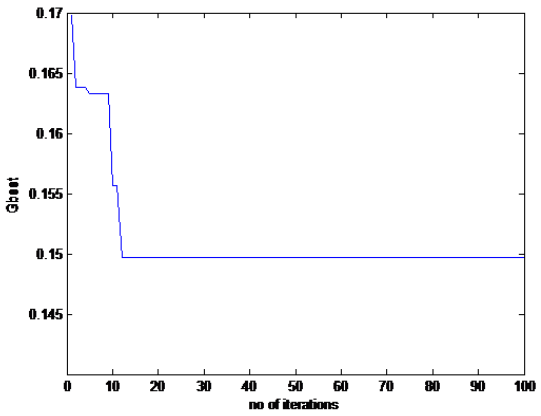
IV. RESULT ANALYSIS

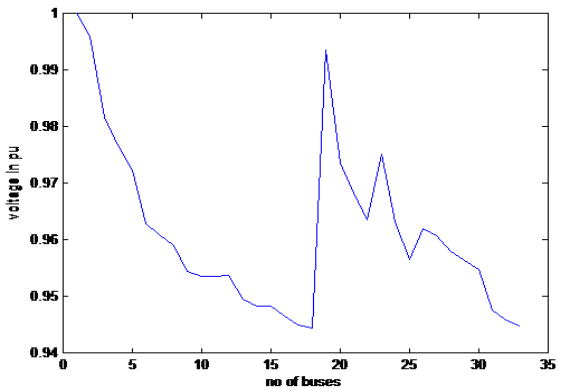
In order to test the effectiveness and performance of the proposed CSA-based algorithm, it has been applied to 33-bus radial distribution systems with different load levels are selected for reporting to examine the applicability of the proposed approach.

	Case1	Case2	Case3
Location	30	30	30
Capacitor rating MVar	0.54	1.5	1.5
Power loss, KW before capacitor placement	78.7	360	971
Power loss, KW After capacitor placement	35.6	149	345
Reduction of loses in %	58	58	64

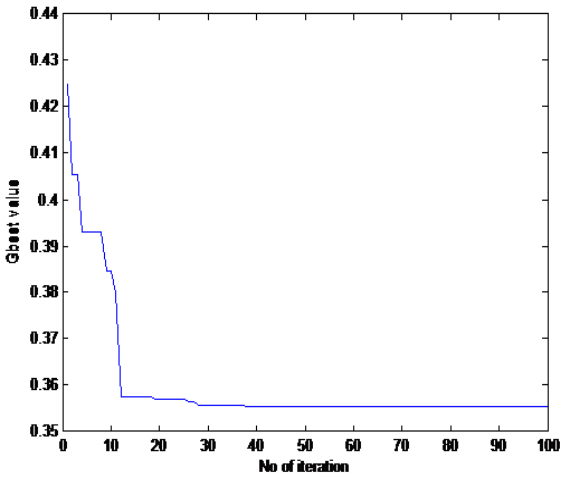
- Fig. 2 Single line diagram of 33 bus test system

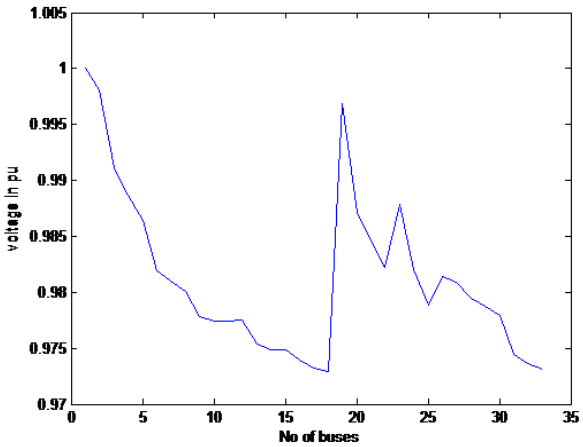
- **Optimal power flow using cuckoo search algorithm**



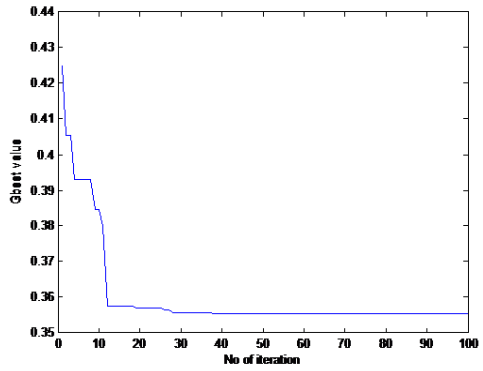


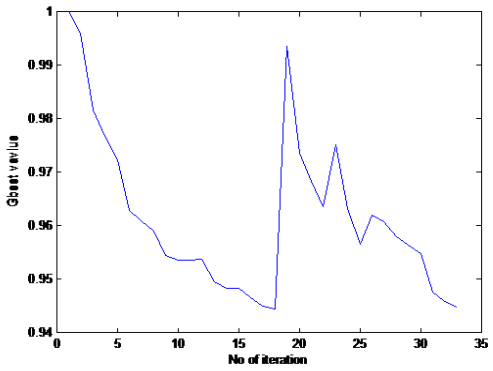
- Case 1





Case 2





Case 3

V. CONCLUSIONS

The application of the CSA-based optimisation approach for solving the problem of capacitor allocations (sizing and location) to minimise the system losses at different load level and to improve system voltage profile has been presented and investigated. The obtained results indicate that the proposed method has a realistic view to this important practical problem and causes the reduction in the power losses. The algorithm has been successfully tested for 33 bus test system for different loading condition in distribution system

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