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OPTIMAL LOCATION OF SHUNT FACTS DEVICES IN TRANSMISSION LINE USING CUCKOO SEARCH ALGORITHM

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ABSTRACT: In this paper, the FACTS devices are used to compensate the reactive power in the transmission line. The FACTS devices have unique feature of controlling network condition quickly and this can be exploited to enhance the transient stability of the system. FACTS devices are also capable of enhancing power transfer capability either by absorbing reactive power or by injecting it in to the transmission line. Cuckoo Search Algorithm (CSA) is a natural meta-heuristic algorithm based on the finding of best nests. This feature of Cuckoo is used to locate the highest values of reactive power losses in IEEE Standard 14-bus, 30-bus and 57-bus system using NEWTON-RAPHSON Load Flow Analysis Technique for maximum number of iterations. These reactive power losses can be compensated by using shunt FACTS devices by placing them in the optimal location.

KEYWORDS: Flexible AC Transmission System(FACTS),Cuckoo Search Algorithm (CSA).

I.INTRODUCTION

One of the primary objectives of cognitive radio (CR) Recently, the development in Power Electronics have introduced the usage of FACTS devices in the power system. The capability of FACTS devices is that, they can control the network conditions swiftly and it's the unique feature of FACTS devices which can be modified to improve the transient stability of the system. In electrical power system, the compensation of reactive power is an important issue and it can be limited by using the FACTS devices, hence the issues of system voltage fluctuations and stability can be overcome. In this paper, cuckoo Search Algorithm is used on IEEE Standard 14- bus, 30-bus and 57-bus system.

1.1. Existing system

In the existing system the issue of reactive power compensation is done by placing the FACTS devices randomly on sending end, middle end or receiving end of the transmission line which does not provide satisfactory result using conventional methods like Load Flow Analysis using Newton- Raphson method.

1.2. Shunt FACTS Devices

The FACTS devices are capable of controlling the network conditions quickly and this unique feature of FACTS devices can be manipulated as required to improve the transient stability of the system and also it resolves the issue of voltage fluctuations in the system.

II. CUCKOO SEARCH ALGORITHM

Cuckoo Search Algorithm is a nature inspired by lifestyle of the bird family called cuckoo [2]. Random search of best nests is the basis of this algorithm. Generally, cuckoos are used in modelling are of two types namely, mature cuckoos and eggs. Mature cuckoos breed in other nests of some other birds. If these eggs are identified by the host birds then, they will kill these eggs else if not identified then they will grow into matured cuckoos.

In this algorithm, the cuckoo randomly searches for a best nest values [3]. The buses are considered as the nests for the cuckoos such that when they randomly search the nests based on the load flow parameters, then, they find the best nests. Based on the values of best nests the bus with the higher value of reactive power loss are found and this problem is solved by placing the Shunt FACTS devices in that particular bus at the optimal location [1].

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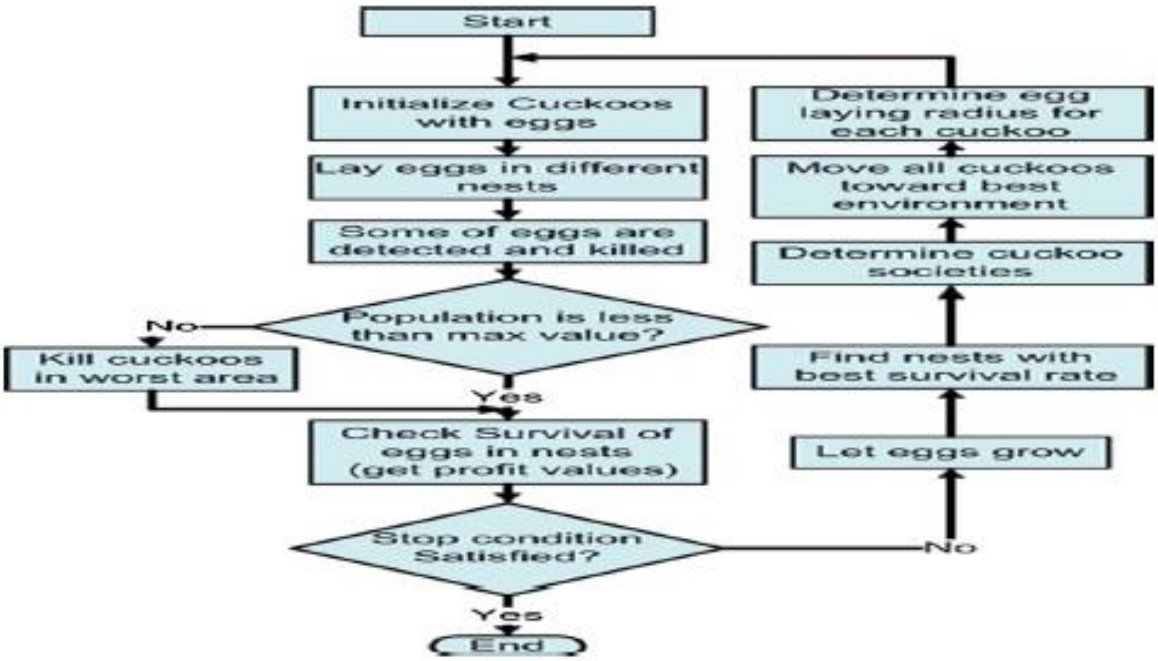

Figure 1: Flow chart for cuckoo search algorithm.

III. FORMULATION OF CUCKOO SEARCH ALGORITHM

This algorithm is formulated using Newton-Raphson load flow analysis technique for IEEE Standard 14-bus, 30-bus and 57-bus system. The number of iterations are taken to be 15000.
Newton-Raphson method is selected since it is more advantageous than others in terms of convergence and speed of computation.

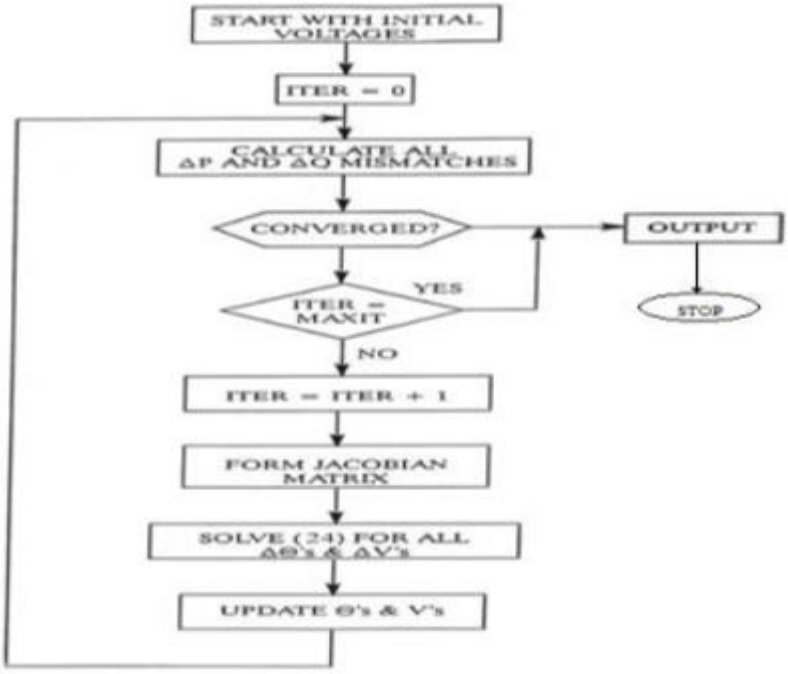

Figure 2: Flow chart Newton-Raphson Load Flow Analysis.

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IV. RESULTS

The results are shown for all the buses that is IEEE Standard 14-bus, 30-bus and 57-bus system.

4.1. 14-bus system

Line FLow and Losses

From Bus	To Bus	P MW	Q MVar	From Bus	To Bus	P MW	Q MVar	Line Loss MW	Line Loss MVar
1	2	0.000	0.000	2	1	0.955	2.915	0.955	2.915
1	5	0.000	0.000	5	1	0.664	2.742	0.664	2.742
Total Loss								3.306	12.845

Figure 3: Output for IEEE Standard 14-bus system.

The above values depict the highest value of reactive power losses hence; this location is optimal to place the Shunt FACTS Device in order to compensate the reactive power loss.

4.2. 30-bus system

Line FLow and Losses

From Bus	To Bus	P MW	Q MVar	From Bus	To Bus	P MW	Q MVar	Line Loss MW	Line Loss MVar
1	2	0.000	0.000	2	1	1.154	3.457	1.154	3.457
1	3	0.000	0.000	3	1	0.728	2.660	0.728	2.660
Total Loss								4.379	16.071

Figure 4: Output for IEEE Standard 30-bus system.

The above values depict the highest value of reactive power losses hence; this location is optimal to place the Shunt FACTS Device in order to compensate the reactive power loss.

4.3. 57-bus system

Line FLow and Losses

From Bus	To Bus	P MW	Q MVar	From Bus	To Bus	P MW	Q MVar	Line Loss MW	Line Loss MVar
8	9	-0.552	-2.817	9	8	1.325	6.759	0.773	3.942
1	15	0.000	0.000	15	1	0.654	3.344	0.654	3.344
Total Loss								3.852	17.941

Figure 5: Output for IEEE Standard 57-bus system.

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VI.CONCLUSION

In this paper, the Cuckoo Search Algorithm is implemented on IEEE Standard 14-bus, 30-bus and 57-bus system such that by randomly finding the best nests from the buses wherein the reactive power loss is higher, that location is termed as optimal location. At this location the Shunt FACTS devices are placed to reduce the reactive power losses.

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