Advanced Honey Bee Algorithm For Optimization of Voltage Stability In Ieee 14 Bus System Using Facts Devices

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ABSTRACT:

Optimization technique plays very important part in frequent issues. During this optimization techniques like Advanced Honey Bee algorithmic program are tested in an IEEE-14 Bus installation. As a result of reducing the power losses, the voltage profile improvement and voltage stability improvement can be maintained throughout the power system. In addition, these views show the enhanced optimization technique that ensemble the power system to take care of voltage stability by reducing power losses in transmission line. Among a variation of FACTS controllers, Unified Power Flow Controller (UPFC) is the main powerful and versatile device in facts controller. To boost system bus voltage and to reduce the reactive power and active power losses within the lines as well as steady state model of UPFC in Newton-Raphson (NR) power flow algorithmic program. To see the steady state performance of the UPFC within the load Flow studies an IEEE-14 bus system has taken. Also, this paper shows the higher optimization performance that suit in the ability of power system to retain the voltage stability by reducing losses in the transmission system. These results are tabulated to improve the power quantity losses and reduced from the actual losses in the power system.

KEYWORD: *Unified Power Flow Controller (UPFC), Advanced Honey Bee algorithmic*

INTRODUCTION

Power Generation and Transmission could be a composite process, everywhere power is to be resettled, and therefore the 2 main parts are active and reactive power. During a three-phase ac power structure reactive power and real power flows at the generating station toward the load through various transmission lines and networks buses. The true power and reactive power flow line is termed as the power flow or load flow in transmission system.

In this paper, a singular optimization method primarily based on the mixing of the normal honey-bee mating optimization algorithm with a plant boom model for this set of rules are carried out. Initially, then Honey-bee mating optimization algorithm became most commonly mimic the mate and breeding of the queen of a hive. Its calculation begins with a mate flight procedure with the aid of the usage of an annealing characteristic to pick out correct solutions and save in the sperm theca.The plant growth simulation set of rules was technologically advanced based on the categorization of the plant growth process and plant phototropism, only sure solutions pleasurable the limitations in conjunction by their health are superior to one of the basis version and are stored in the following search. The effects can be compared with numerous strategies toward analyze of robustness and working out efficiency of this technique.

As a consequence, the optimization of control strategies and development in the performance of ac strength systems, we require the various exceptional kinds' compensators. These devices represent an emerging technology known as FACTS (bendy alternating contemporary transmission structures).The FACTS generation open up new opportunity for calculating the each kind of real and reactive power and enhancing the existing transmission structure.

The power through a transmission line may be prohibited for increasing the capacity of strains. This prospect will rise thru the capacity of FACTS controllers to regulate the electrical parameters along with series impedances and shunt impedances connected in power system

HONEY-BEE MATING OPTIMIZATION TECHNIQUES:

A colony of honey bees be inclusive of a queen, numerous hundred drones, 30,000 to 80,000 people and brood at some stage in the energetic season. The queen and handiest has capable of laying eggs upto 1,500 throughout a one day processing time period. Drones' position is to mate with the queen.

The obligations of an employee bee are consisting of rearing brood, nurture of the queen and drones, clean-up, regulating temperature, grouping of nectar, pollen, water, and so forth. The HBMO technique Algorithm is the aggregate of numerous

techniques correspond to exclusive section of mating procedure of the queen.

The primary points of HBMO set of guidelines Based on their mating process are given beneath:

Initially the mating process is done which queen select drones to form the sperm theca (list of drones) probabilistically. Subsequently, a drone is chosen from the mention list at random process for the era of the broods. Making a new broods through crossover of genotypes, by their drone's and their queens.

Before starting of mating technique, the queen's length of sperm theca huge range equals to certain level of the quantity with mating of the queen and unmarried mating escape is determined. When the queen pals efficaciously, the genotype drone is saved.

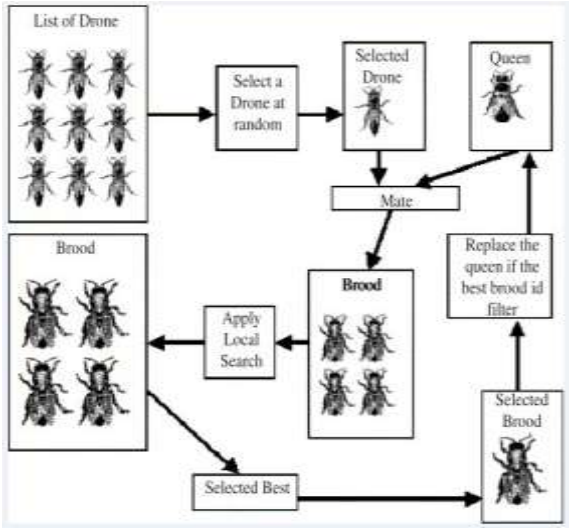


Figure 1. The HBMO algorithm

Two distinctive parameters need to be described, the wide sort of queen and the quantity broods as a manner to be borne by means of queens. In this performance advanced HBMO set of rules, then variety of queens is same to be one, and the quantity of broods is situate equal to the amount of the queens sperm theca period. Drone buddies with queen probabilistically the usage of an annealing that means as follow:

$$\text{Prob}(D) = \exp(-\Delta(f)/S(t))$$

When the queen is at high-speed quantity or health of drone is same as the queens, then possibility of mating is extreme. After seeing each process, the velocity of queens and energy level is decreases by keeping this equation:

$$S(t+1) = \alpha \times S(t)$$

$$\text{Energy}(t+1) = \alpha \times \text{Energy}(t)$$

Let α is speed and strength reduction issue in each step. Initially, fee and the energy of each queen are generating at different process. Since the speed and strength are equal impact on their mating procedure, in this paper, speed of queen and strength has been determined. This brood may be stepped forward, inside the next degree, via using people to use local search.

The people put into effect the limited search techniques to improve broods produced with mating process. This technique is implemented by using the number of local seek heuristics (NWorker1) and combining with them (Nworker2). Therefore, wide varieties of workers are calculated with the aid of sum that number.

CALCULATION OF THE ADVANCED HONEY-BEE MATING OPTIMIZATION TECHNIQUE:

The certain range of optimization solution in honey-bee mating technique with set of rules and qualification lies in the variant of control parameters. As a result of combining both the merits and demerits of omission with outside parameter and reduction of infeasible answers which exhibit in plant growth reproduction technique, then most advanced HBMO algorithm with set of rules to improve the result

Step 1. Input places in the shielding gadgets

The calculation process starts with the evolved records and retrieval of relay & Circuit breakers from SCADA method. Then this parameter contains of colony range, and wide variety of queen and brood.

Step 2. Structure the hive

Using colony N bees are shaped at this stage, in which all bees consist of M gene. An environment shape H= [H1 H2 H3….Hi…..HN] T is used to symbolize this type of colony, wherein Hi =xi,1 xi,2…xi,j…..Xi,M], and xi. Then Honey-bee colony usually includes of queen, drones, workers, and broods. Only the queen bees are capable to lay the eggs. The drones inside the honey-bee colony are haploid and act as their moms' genome by changing its genetic symphony. Then fitness standards (Hi) of its every bee in the colony is evaluated and differentiate between the queens and drones, where

$$F(H) = 1 / (1 + \text{job } j).$$

Step 3. Mating of the queens, breed & broods

Based on their mating possibility compute are suggested, and then threat sperm maintenance within the queen's spermatheca. A lay down of N broad answers (broods) Hbroad be subsequently generated in the crossover process. In this line to line fault are estimated and trouble shouted, by this mating a solution will be modified chances of line fault happening at a positive section in an energy storage device.

Step 4. Advanced Bee fitness with broods

In this process, fitness of each bee generated answer f (Hbroad) is calculated. These solutions are most important fitness serves as compared to foundation version R0. Then R0 may be a fundamental view to look N answer, such that the trunks locate T is fashioned. If the fitness of d^{th} node f (Td) be greater than (R0) then there is deemed the

viable answer; in any other case, Td is abandoned. Until the answer determined within the new brood gives the preceding queen, then comes with an anticipated solution.

Step 5. Preventive circumstance

The complete procedure is terminated to end process when the computation fallout converges. To improve the facilitate and visualization process, a picture with user interface design is essential to expose the location of faulted phase.

THE PLANT GROWTH SIMULATION TECHNIQUES:

Here PGS technique based on the power system in which plant increase, where as stem grow beginning from the roots and the plants; some of the branches develop from nodes at trunk; at this time a few sparkling branches develop from the nodes on the branches. Inspired by the matching with the plant development technique, an optimization set of rules may be defined. The gadget that is to be optimized initial then `grows' begin at the bases of a plant stem and keep `growing' subsequences branches is located.

The Plant Growth simulation law procedure:

The following records were proved through the organic experiments approximately the increase laws of plant,

(i)There is a morphactin concentration in the node and it's far above the ground, the chance of developing a brand new buds and branch at the node.

(ii)Here morphactin awareness in any node to be analysis in the plant simulation. The ecological information to plant growth with node is depending on the digital role. Here morphactin concentrations of nodes are assigning to the new atmosphere records to a certain node which is new branch.

Probability of plant growth Model:

A possibility model which is famous for simulate the boom process in plant phototropism. During this structure, the feature g(Y) is defined for illustrating the surrounding process of node Y in a plant. The much less significant cost of g(Y) is higher for surroundings condition of the node Y for developing a fresh branch. The most important comic strip of this form can be explained as shown: At first, Plant growth simulation trunk M at its origin B0. but we imagine that there is k nodes B_{M1}; B_{M2};: : : ; B_{Mk} are better environment than the root node B_0, and the trunk M, significance in that job g(Y) of its nodes B_{M1}; B_{M2}; : : : ; B_{Mk}, and B_0 suit $g(B_{M\,i}) < g(B_0)$ (i = 1; 2; 3; : : : ; k), next morphactin concentration C_{M1}; C_{M2}; : : : ; C_{Mk} of its nodes B_{M1}; B_{M2}; : : ; B_{Mk} are obtain from the subsequent steps.

$$C_{Mi}=\frac{g(B0)-g(Bmi)}{\Delta 1} \text{ Where (i = 1, 2, :: : k)}$$

$$\Delta 1 = \sum_{i=1}^{k} g(B0) - g(BMi)$$

The following Equation are the morphactin concentration at any node is dependent to their relative magnitude with the gap of the environmental function between the root nodes and the corresponding node in the nodes, in which it's essential, to give the relationship between the Morphactin concentration and location.

$\sum_{i=1}^{k} Cmi = 1$, that means there is morphactin concentration C_{M1}, C_{M2},….M_k of the nodes.

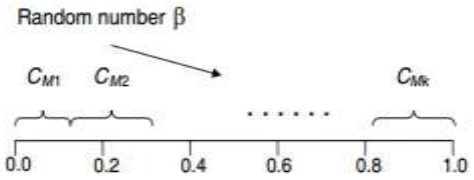


Figure 2. Morphactin concentration state space.

New superior plant growth nodes will grow a new branch in next step which can gain a similar way as that of B_{M2}. This procedure is repeated till here is no new fresh branch are grown, which means that plant are produced.

UPFC Injection Model for Load Flow Studies:

The UPFC is the most controlling and versatile FACTS-equipment used to manage the power system over the power flow and stability of the system. UPFC can be performing static as well as dynamic condition. Static is an analysis at the steady state condition and dynamic state analysis at the transient condition such as faults occur in power system.

Operation of UPFC:

The UPFC is a device that can manipulate simultaneously all three parameters of line strength float (line impedance, voltage and segment perspective).UPFC is one of the FACTS households that used to lessen strength float in transmission. The UPFC is mixture of both STATCOM and SSSC. Converters are operating from common dc system with a dc storage capacitor. The controller provide the gating alerts to the converter valves to provide the favored collection voltages and concurrently drawing the vital shunt currents, In order to provide the desired collection injected voltage, the inverter calls for a dc supply with regenerative skills. The viable solution is to use shunt inverter with help of dc bus voltages.

Advantages of UPFC:

The UPFC can make a feature of STATCOM and SSSC and phase perspective regulator. The Unified Power Flow Controller (UPFC) is includes two switching converter, which

can be consider as voltage source inverter the use of gate thyristor valves, as illustrated. These inverters, named as "VSC1" and "VSC2" can be determined and its operated with a common place dc hyperlink supplied by way of a dc storage capacitor.

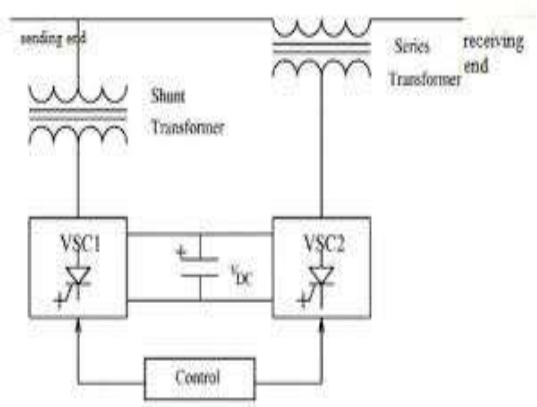


Figure 3. The Schematic diagram of UPFC

While the collection converter of the UPFC can inject a voltage with choppy importance and segment angle it is able to alternate actual power with the transmission line with the assist out of series transformer. However, a UPFC as a whole (each converter) can't deliver or soak up real electricity in regular state (besides for the electricity interested in atone for the losses).

The characteristic of voltage source converter to be generate or take into the account of real and reactive power by converter 2 on common place dc hyperlink. Inverter 2 gives the foremost feature of UPFC is to inject a voltage with controllable converter significance (zero= V= V) and its section attitude ρ (zero = ρ = 360°), on the electricity frequency is delivered with line thru an insertion transformer.

Then modern transmission line flows through voltage supply which will resultant an actual or true power and reactive power trade between them. So, that Inverter may be operates at a unity power factor or manage to have a reactive power flow in transmission system and its alternate with reactive power which is exchange between the two Inverter.

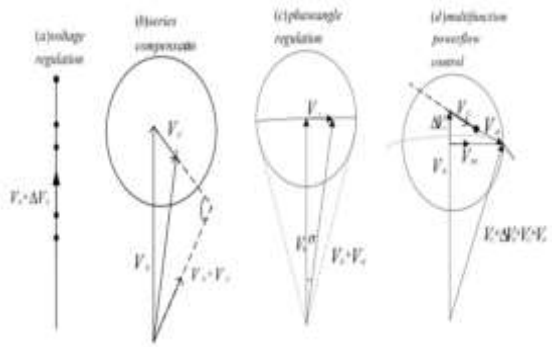


Figure 4. Basic diagram for UPFC control function.

The Unified Power Flow Controller are standard and conventional devices in power system which based on its real and reactive series compensation, shunt compensation, then UPFC is the only device which can complete all the role in transmission line.

In this representation, conventional series compensators are needed for phase shifting. An UPFC can control both the magnitude and angular position of injected voltage in the real system, and also to improve the real and reactive power flow in the transmission line.

RESULT AND DISCUSSION

In this research advanced Honey bee mating technique and advanced plant growth simulation process are based on hybrid algorithm for the voltage stability and to enhance the system. This was performed on MATLAB and output was evaluated in IEEE-14 bus system.

First of all, Newton-Raphson load flow analysis is used to analyze the system performances. Contingency analysis for the systems were performed and based on that performance indices were calculated at normal load and were ranked accordingly. Thus, the optimal solution for UPFC is determined based on its contingency analysis. Then the location of UPFC is determined by PGS which depend on the value. Bus 1,2,3,6 and 8 are the generator buses excepted whereas UPFC is connected at all other buses. The standard IEEE 14 bus system was shown in figure.

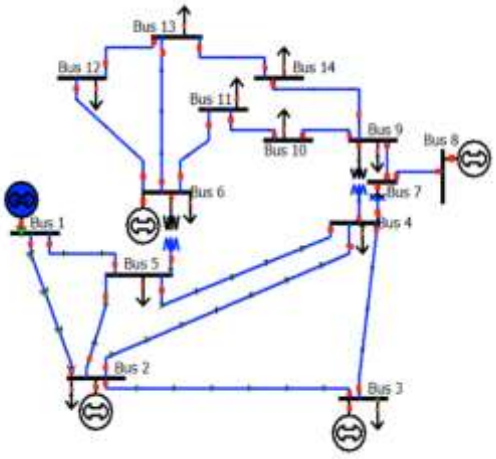


Figure 5. Systematic diagram to an IEEE-14 Bus System.

An IEEE-14 bus system was important for voltages, active and reactive powers at each bus. A MATLAB plan is used for IEEE-14 bus system with standard IEEE-14 bus system data input file.

Bus No	Bus Code	Voltage Magnitude	Angle Degrees	Load		Generator				Injected MVAR
				MW	MVAR	MW	MVAR	Qmin	Qmax	
1	1	1.06	0	30.38	17.78	40	-40	0	0	0
2	2	1.045	0	0	0	232	0	-40	50	0
3	2	1.01	0	131.88	26.6	0	0	0	40	0
4	0	1	0	66.92	10	0	0	0	0	0
5	0	1	0	10.64	2.24	0	0	0	0	0
6	2	1.07	0	15.68	10.5	0	0	-6	24	0
7	0	1	0	0	0	0	0	0	0	0
8	2	1.09	0	0	0	0	0	-6	24	0
9	0	1	0	41.3	23.24	0	0	0	0	0
10	0	1	0	12.6	8.12	0	0	0	0	0
11	0	1	0	4.9	2.52	0	0	0	0	0
12	0	1	0	8.54	2.24	0	0	0	0	0
13	0	1	0	18.9	8.12	0	0	0	0	0
14	0	1	0	20.86	7	0	0	0	0	0

TABLE.1 LINE DATA FOR IEEE 14 BUS SYSTEMS

Sending End Bus	Receiving End Bus	Resistance P.U.	Reactance P.U.	Half Susceptance P.U.	Transformer Tap
1	2	0.01938	0.05917	0.0264	1
2	3	0.04699	0.19797	0.0219	1
2	4	0.05811	0.17632	0.0187	1
1	5	0.05403	0.22304	0.0246	1
2	5	0.05695	0.17388	0.017	1
3	4	0.06701	0.17103	0.0173	1
4	5	0.01335	0.04211	0.0064	1
5	6	0	0.25202	0	0.932
4	7	0	0.20912	0	0.978
7	8	0	0.17615	0	1
4	9	0	0.55618	0	0.969
7	9	0	0.11001	0	1
9	10	0.03181	0.0845	0	1
6	11	0.09498	0.1989	0	1
6	12	0.12291	0.25581	0	1
6	13	0.06615	0.13027	0	1
9	14	0.12711	0.27038	0	1
10	11	0.08205	0.19207	0	1
12	13	0.22092	0.19988	0	1
13	14	0.17093	0.34802	0	1

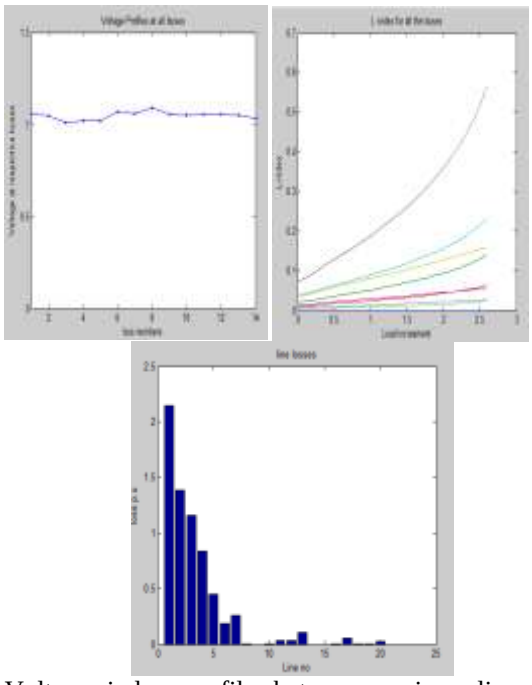
After simulate the list, it displays outcome of voltage, active & Reactive Power and line losses.

Case1: IEEE-14 bus system without an optimization technique

Power Flow Solution by Newton-Raphson Method
Maximum Power Mismatch = 0.000712011
No. of Iterations = 3

Bus No.	Voltage Mag.	Angle Degree	------Load------ MW	Mvar	---Generation--- MW	Mvar	Injected Mvar
1	1.060	0.000	0.000	0.000	232.314	-16.794	0.000
2	1.045	-4.981	21.700	12.700	40.000	42.660	0.000
3	1.010	-12.719	94.200	19.000	0.000	23.568	0.000
4	1.018	-10.318	47.800	-3.900	0.000	0.000	0.000
5	1.020	-8.781	7.600	1.600	0.000	0.000	0.000
6	1.070	-14.242	11.200	7.500	0.000	13.070	0.000
7	1.061	-13.357	0.000	0.000	0.000	0.000	0.000
8	1.090	-13.357	0.000	0.000	0.000	18.023	0.000
9	1.054	-14.935	29.500	16.600	0.000	0.000	19.000
10	1.049	-15.098	9.000	5.800	0.000	0.000	0.000
11	1.056	-14.800	3.500	1.800	0.000	0.000	0.000
12	1.055	-15.096	6.100	1.600	0.000	0.000	0.000
13	1.050	-15.174	13.500	5.800	0.000	0.000	0.000
14	1.034	-16.041	14.900	5.000	0.000	0.000	0.000
Total			259.000	73.500	272.314	80.527	19.000

Voltage deviation of load = 0.673280
Real power loss =13.393360 MW.
L-index = 0.565328
Voltage stability index = 2.700000
Then Weak bus is 14



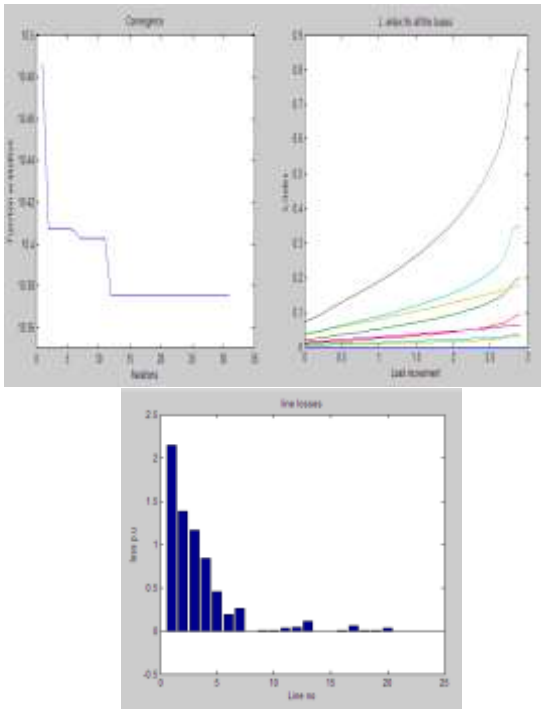
Voltage index profile between various lines the system is also calculated using LSI methods.

Case 2: IEEE-14 bus system by advanced honey bee mating optimization technique

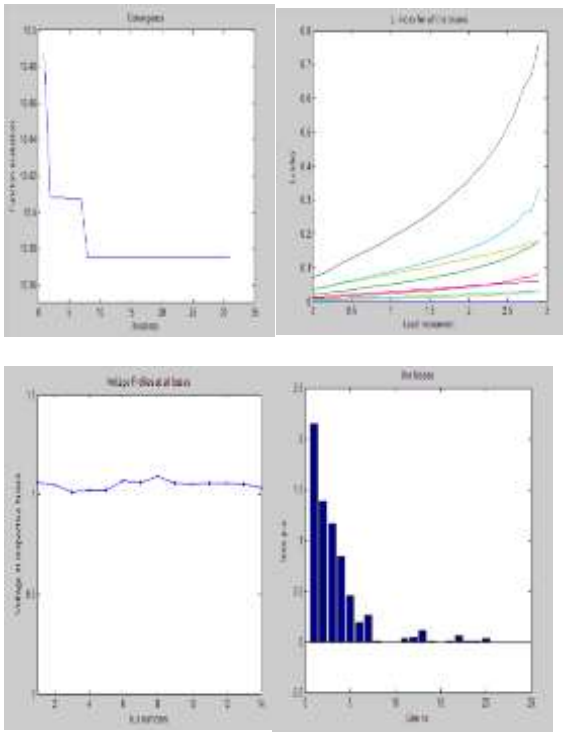
Power Flow Solution by Newton-Raphson Method
Maximum Power Mismatch = 0.000443533
No. of Iterations = 5

Bus No.	Voltage Mag.	Angle Degree	------Load------ MW	Mvar	---Generation--- MW	Mvar	Injected Mvar
1	1.060	0.000	0.000	0.000	232.344	-16.774	0.000
2	1.045	-4.981	21.700	12.700	40.000	42.737	0.000
3	1.010	-12.719	94.200	19.000	0.000	23.608	0.000
4	1.018	-10.318	47.800	-3.900	0.000	0.000	0.000
5	1.020	-8.781	7.600	1.600	0.000	0.000	0.000
6	1.070	-14.242	11.200	7.500	0.000	13.146	0.000
7	1.061	-13.357	0.000	0.000	0.000	0.000	0.000
8	1.090	-13.357	0.000	0.000	0.000	18.061	0.000
9	1.054	-14.935	29.500	16.600	0.000	0.000	19.000
10	1.049	-15.098	9.000	5.800	0.000	0.000	0.000
11	1.056	-14.800	3.500	1.800	0.000	0.000	0.000
12	1.055	-15.096	6.100	1.600	0.000	0.000	0.000
13	1.050	-15.174	13.500	5.800	0.000	0.000	0.000
14	1.034	-16.041	14.900	5.000	0.000	0.000	0.000
Total			259.000	73.500	272.344	80.779	19.000

Load voltage deviation is 0.673299
Real power loss is 13.393541 MW
L-index is 0.858395
Voltage stability index is 3.000000
The weak bus is 14
Location of UPFC is 9 - 14
Series injection voltage is 0.030000
Angle of injection is 0.165724

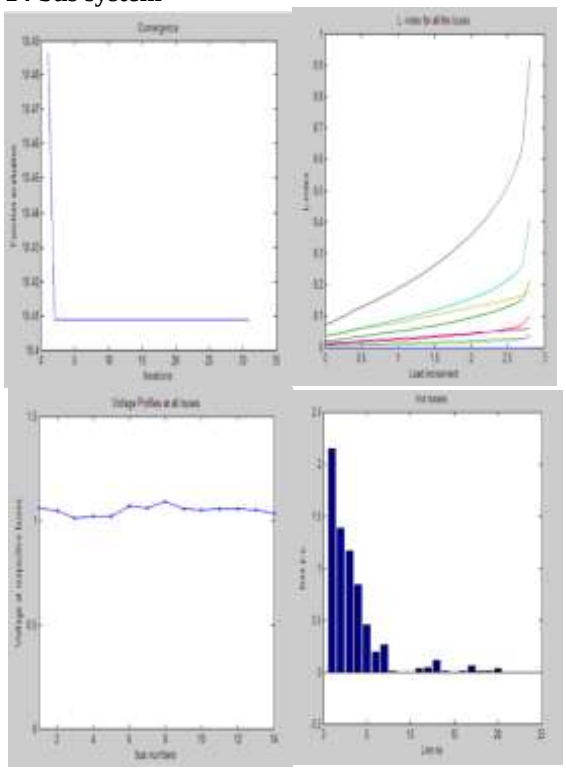


Case 3: Plant Growth Optiminization Technique for IEEE 14 bus system



Load voltage deviation is 0.673282
Real power loss is 13.393283 MW
L-index is 0.762855
Voltage stability index is 3.000000
Weak bus is 14
Location of UPFC is 13 - 14
Series injection voltage is 0.020265
Angle of injection is 1.030045

Case 4: Hybrid Optimization Technique for IEEE 14 bus system



Load voltage deviation is 0.673229
Real power loss is 13.391747 MW
L-index is 0.922264
Voltage stability index is 2.900000
Weak bus is 14
Location of UPFC is 9 – 10
Series injection voltage is 0.020252
Angle of injection is 0.89036

CONCLUSION:

The hybrid approach becomes proposed for fixing IEEE 14 bus device hassle in electricity transmission system. FACTS gadgets play a great task to control the power flow in transmission line. Advanced Honey Bee technique and plant growth simulation is proposed to optimize the area of UPFC device.. The proposed hybrid technique is carried out in MATLAB operating platform which is examined with IEEE 14 bus bench mark machine. Here, loading instances are taken into consideration to evaluate the proposed technique and the entire system cost, power loss, voltage stability index are as compared with conventional AHB algorithm. The comparative analysis completed for the effectiveness hybrid set of rules for solving objective of optimization.

FUTURE SCOPE:

Further extension of the thesis can be completed by using incorporating present day synthetic intelligences (AI) techniques Such Grey wolf optimization, Symbiotic organisms search set of rules, Fruit fly set of rules, Water cycle and evaporation set of rules, Bacterial foraging optimization, Satin bowerbird optimization and so on…for checking out the IEEE 30 bus system, and it as compared with IEEE 14 bus machine.