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Transmission Losses Minimization Considering Wind Power Using Teaching-Learning-Based Optimization

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Abstract:
In our daily life, Electrical power demand increases day by day. The power system becomes increasingly more complex to operate and the system can become less secure for riding through the major outages. It may lead to large power flows with inadequate control, excessive reactive power in various parts of the system. In this process, the existing transmission lines are overloaded and lead to unstable system. New transmission lines or FACTS devices on the existing transmission system can eliminate transmission overloading, but FACTS devices are preferred in the modern power systems based on its overall performance. To improve the voltage profile and stability margin of the system, one should placed FACTS devices at best location is the most effective way. The proposed work presents optimal location and sizing problem of FACTS devices in a transmission system, and also identifies the rating of Wind Power. In presented work Static VAR compensator (SVC) is used for the above purpose. The SVC injects reactive power into system which helps in maintaining better voltage profile. In present study Newton Raphson power flow algorithms using TLBO is incorporated with wind farm and Static VAR compensator. The proposed algorithms are tested on the IEEE-14 bus power system and IEEE 30-bus power system. The result of the proposed work is tested on the three different cases namely Base case system, Base case system with SVC, Base case system with SVC and wind farm The test results are compared which reveals that proposed technique has better Solution accuracy and convergence results.

Key Words: TLBO, Transmission losses, FACTS, SVC

I. INTRODUCTION

Wind energy is a continually growing source of alternative power generation in many countries around the world. It is a clean, renewable energy source that has many inherent advantages when compared with other alternative and even some conventional power generation methods.

An optimal power flow (OPF) resolution adjusts the network settings of a power system to achieve objective functions and meet the necessities of apparatus operation constraints, power flow equations and power system security.

The objective perform of an OPF program is to reduce the fuel prices of a power system. The problems that are to be faced in strategy planning stage area unit acceptable type, location, size and setting of those controllers for various applications. This thesis is based on the optimum location and sizing drawback of SVC within the transmission line during a power system.

The objective function is developed to find the active loss and reactive loss reduction with voltage profile enhancement subjected to some network constraints. This dissertation uses the wind power equation with varied equality and non-equality constraints of power system and SVC device setting.

Minimize the power Loss: Losses in system depends upon the bus on the system and it's tested on 14 bus 30 bus and 75 bus. The objective of real power loss reduction depends on the choice of variable combination, losses minimizes concurrently satisfying all constraints of the network.

II. TEACHING–LEARNING-BASED OPTIMIZATION

Based on the above teaching process, a mathematical model is prepared and implemented for the optimization of an unconstrained non-linear continuous function, thereby developing a novel optimization technique called Teaching–Learning-Based Optimization (TLBO).

The process of TLBO is divided into two parts. The first part consists of the 'Teacher Phase' and the second part consists of the 'Learner Phase'.

The 'Teacher Phase' means learning from the teacher and the 'Learner Phase' means learning through the interaction between learners. Where σ^2 is the variance, μ is the mean and *x* is any value for which the normal distribution function is required.

The mean of a class increases from M_A to M_B depending upon a good teacher. A good teacher is one who brings his or her learners up to his or her level in terms of knowledge. But in practice this is not possible and a teacher can only move the mean of a class up to some extent depending on the capability of the class. This follows a random process depending on many factors.

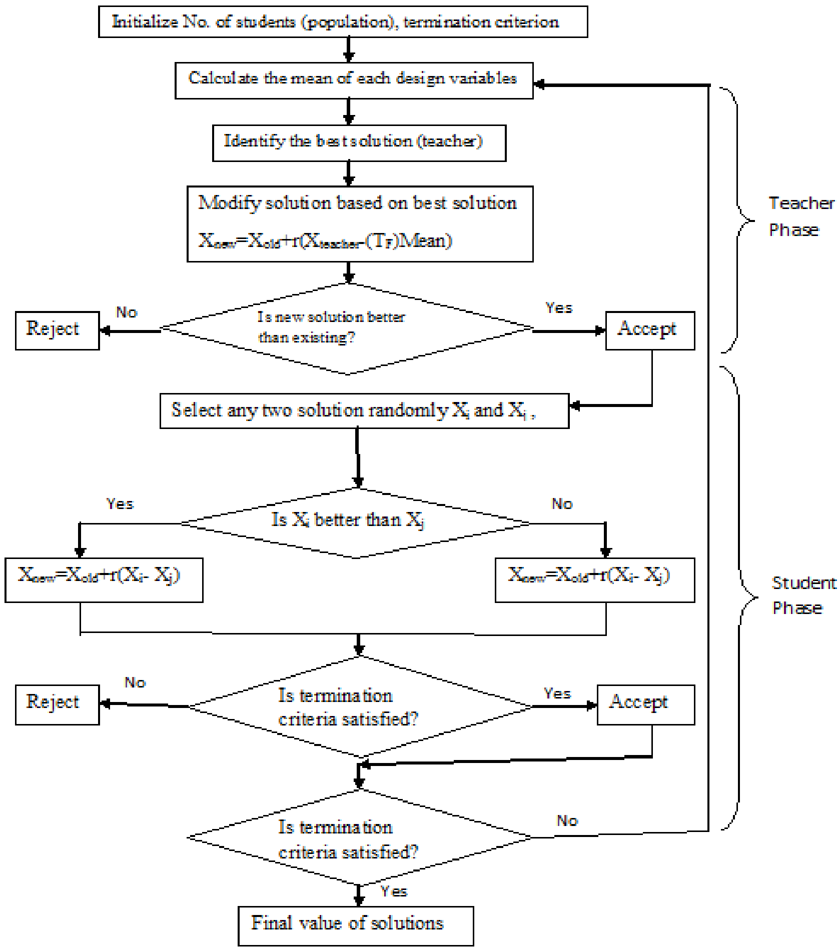

Figure.1. Flow chart for Teaching–Learning-Based Optimization (TLBO)

Let M_i be the mean and T_i be the teacher at any iteration i. T_i will try to move mean M_i towards its own level, so now the new mean will be T_i designated as M_{new}. The solution is updated according to the difference between the existing and the new mean given by

$$Difference\_Mean_i = r_i (M_{new} - T_F M_i) \quad (2)$$

WhereT_F is a teaching factor that decides the value of mean to be changed, and r_i is a random number in the range [0, 1]. The value of $T_F$can be either 1 or 2, which is again a heuristic step and decidedrandomly with equal probability as T_F = round [1 + rand (0, 1) {2 − 1}]. This difference modifies the existing solution according to the following expression

$$X_{new,i} = X_{old,i} + Difference\_Mean_i \quad (3)$$

Learner Phase

Learners increase their knowledge by two different means: one through input from the teacher and the other through interaction between themselves. A learner interacts randomly with other learners with the help of group discussions, presentations, formal communications, etc. A learner learns something new if the other learner has more knowledge than him or her. Learner modification is expressed as

For i =1: Pn

Randomly select two learners X_i and X_j, where $i \neq j$ *If* $f(X_i) < f(X_j)$

$X_{new,i} = X_{old,i} + r_i (X_i - X_j)$

Else

$X_{new,i} = X_{old,i} + r_i (X_j - X_i)$

End If

*End For*Accept X_{new} if it gives a better function value.

Implementation of TLBO for optimization

The step-wise procedure for the implementation of TLBO is as mentioned in coming paragraph.

Step 1: Define the optimization problem and initialize the optimization parameters. Initialize the population size (P_n), number of generations (G_n), number of design variables (D_n), and limits of design variables (U_L, L_L).

Define the optimization problem as: Minimize $f(X)$.

Subject to $X_i \in x_i = 1, 2, \ldots, D_n$

Where (X) is the objective function, X is a vector for design variables such that $L_{L,i} \le x_{,i} \le U_{L,I}$

Step 2: Initialize the population. Create an arbitrary populace as indicated by the populace size and number of plan factors. For TLBO, the populace estimate demonstrates the quantity of learners and the plan factors show the subjects (i.e. courses) advertised. This population is expressed as

$$Population = \begin{bmatrix} x_{1,1} & x_{1,2} & \cdots & x_{1,D} \\ x_{2,1} & x_{2,2} & \cdots & x_{2,D} \\ \vdots & \vdots & \ddots & \vdots \\ x_{P_n,1} & x_{P_n,2} & \cdots & x_{P_n,D} \end{bmatrix}.$$

Step 3: Teacher phase.

Calculate the mean of the population column-wise, which will give the mean for the particular subject as

$M_{,D} = [m_1, m_2, \ldots, m_D]$.

The best solution will act as a teacher for that iteration

$X_{teacher} = X_{f(X)=min}$.

The teacher will try to shift the mean from $M_{,D}$ towards $X_{,teacher}$, which will act as a new mean for the iteration. So,

$M\_new_{,D} = X_{teacher,D}$.

The difference between two means is expressed as

$$\text{Difference}_{,D} = r\,(M\_\text{new}_{,D} - T_F M_{,D})\,. \quad (7)$$

The value of T_F is selected as 1 or 2. The obtained difference is added to the current solution to update its values using

$$X_{\text{new},D} = X_{\text{old},D} + \text{Difference}_{,D}. \quad (8)$$

Accept X_{new} if it gives better function value.

Step 4: Learner phase.

As clarified above, learners increment their insight with the assistance of their shared communication. The scientific expression is clarified in Section 3.2.

Step 5: Termination criterion.

Stop if the maximum generation number is achieved; otherwise repeat from Step 3.

It is seen from the above steps that no provision is formed to handle the constraints within the drawback. Many varieties of constraint handling technique are accessible within the literature, like incorporation of static penalties, dynamic penalties, adaptive penalties etc. Deb's heuristic constrained handling technique [12] is employed within the proposed TLBO technique. This technique uses a tournament selection operator within which two solutions are selected and compared with one another. The following three heuristic rules are implemented on them for the selection: If one solution is feasible and the other infeasible, then the feasible solution is preferred. If both the solutions are feasible, then the solution having the better objective function value is preferred. If both the solutions are infeasible, then the solution having the least constraint violation is preferred. These rules are implemented at the end of Steps 2 and 3, i.e. at the end of the teacher phase and the learner phase. Instead of accepting solution Xnew, if it gives better function value at the end of Steps 2 and 3, Deb's constraint handling rules [12] are used to select Xnew based on the three heuristic rules.

Comparison of TLBO with other optimization techniques

Like GA, PSO, ABC, and HS, TLBO is also a population-based technique which implements a group of solutions to proceed to the optimum solution. Many optimization methods require algorithm parameters that affect the performance of the algorithm. GA requires the crossover probability, mutation rate, and selection method; PSO requires learning factors, the variation of weight, and the maximum value of velocity; ABC requires the limit value; and HS requires the harmony memory consideration rate, pitch adjusting rate, and number of improvisations. Unlike other optimization techniques TLBO does not require any algorithm parameters to be tuned, thus making the implementation of TLBO simpler.

III. RESULTS AND DISCUSSION

The results obtained using Wind generator. The goal of optimization is to perform the best utilization of the existing transmission lines. In this respect, the Wind generator including SVC devices are located in order to minimize the power losses and maximize the system liability while considering voltage drops of SVC. In the following section, optimal placement of Wind generator on the IEEE 14 bus, and 30 bus Indian bus test system are found using TLBO algorithms. The results obtained from TLBO algorithms are considered and compared with each bus system. The proposed algorithms are written in the MATLAB environment and applied on a 4 GHz, i4 personal laptop with 4 GB RAM. The parameter of the optimization algorithm is identified through trial and error method. Table no 1 shows the IEEE-14 bus wind farm with the TLBO without any FACTS device

Table.1. Normal loading IEEE-14 bus with TLBO

Newton Raphson Load Flow Analysis								
Bus	V	Angle	Injection Pc,Qc		Load Pl,Ql		Generation Pg,Qg	
No	Pu	Degree	MW	MVar	MW	Mvar	MW	MVar
1	1.06	0	116.973	88.489	0	0	116.973	88.489
2	1.015	-2.1021	18.3	31.507	21.7	12.7	40	44.207
3	1.08	-3.3043	8.8	18.425	11.2	7.5	20	25.925
4	0.96	-8.6903	-94.2	25.159	94.2	19	0	44.159
5	1.14	-0.1932	0	25.297	0	0	0	25.297
6	1.1009	-0.1932	84	0	0	0	84	0
7	1.1607	-3.0571	-29.5	-16.6	29.5	16.6	0	0
8	0.9663	-2.9334	-7.6	-1.6	7.6	1.6	0	0
9	0.9241	-3.1854	-47.8	3.9	47.8	-3.9	0	0
10	1.1422	-3.1103	0	-5.8	0	5.8	0	0
11	1.109	-3.3575	-3.5	-1.8	3.5	1.8	0	0
12	1.0721	-4.003	-6.1	-1.6	6.1	1.6	0	0
13	1.0749	-4.0903	-13.5	-5.8	13.5	5.8	0	0
14	1.1066	-4.3828	-14.9	-5	14.9	5	0	0
Total			10.973	154.576	250	73.5	2.61	2.281
Total Loss				10.973	128.979			

Line FLow and Losses					
From	To	Line Flow		Line Loss	
Bus	Bus	Pik1	Qik1	Pik in MW	Qik inMVar
8	3	2.787	-30.112	0	2.284
9	6	-25.966	-69.823	0	12.998
9	7	-0.864	228.449	0	84.979
1	8	32.53	35.791	1.177	2.143
2	8	15.824	22.455	0.439	-0.328
4	9	-35.479	35.651	1.881	3.265
9	8	-35.123	-81.642	1.228	3.301
1	2	84.443	52.698	1.736	2.458
2	4	60.525	15.955	1.804	5.463
6	5	0	-24.43	0	0.867
2	9	24.657	43.337	1.45	2.638
6	7	58.034	-58.391	0	6.152
7	10	9.674	121.827	0.135	0.357
3	11	-5.663	-13.029	0.164	0.344
3	12	5.793	0.569	0.036	0.074
3	13	11.457	-1.512	0.076	0.149
7	14	17.997	14.903	0.515	1.096
10	11	9.539	15.669	0.212	0.495
12	13	-0.343	-1.105	0.003	0.002
13	14	-2.464	-8.568	0.118	0.239
Total Loss				10.973	128.979

Figure no 2 shows the graphical representation of the result without FACTS

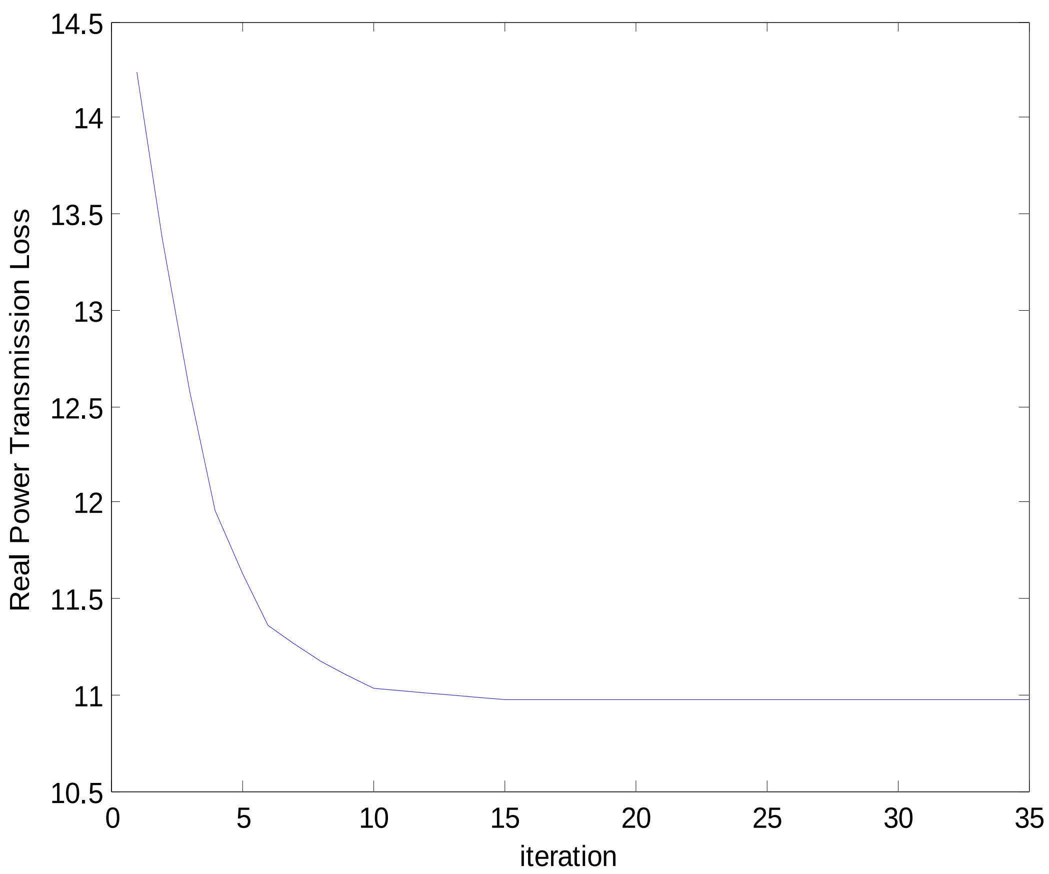

Figure.2. IEEE-14 bus wind farm with the TLBO without FACTS

Table 2 shows IEEE-14 bus wind farm with SVC using TLBO

Table .2. IEEE-14 bus wind farm with SVC using TLBO

Newton Raphson Load Flow Analysis								
Bus	V	Angle	Injection Pc,Qc		Load Pl,Ql		Generation Pg,Qg	
No	Pu	Degree	MW	MVar	MW	Mvar	MW	MVar
1	1.06	0	114.283	38.928	0	0	114.283	38.928
2	1.035	-2.3015	18.3	45.098	21.7	12.7	40	57.798
3	1.1	-5.1821	8.8	4.341	11.2	7.5	20	11.841
4	0.98	-8.3736	-94.2	10.231	94.2	19	0	29.231
5	1.14	-5.9149	0	8.726	0	0	0	8.726
6	1.1265	-5.9149	0	0	0	0	0	0
7	1.1902	-6.9388	-29.5	-16.6	29.5	16.6	0	0
8	0.9982	-3.3823	-7.6	-1.6	7.6	1.6	0	0
9	0.9689	-3.5761	36.2	87.731	47.8	-3.9	84	0
10	1.1697	-6.6716	0	-5.8	0	5.8	0	0
11	1.1325	-6.1235	-3.5	-1.8	3.5	1.8	0	0
12	1.0934	-5.9984	-6.1	-1.6	6.1	1.6	0	0
1.30E+01	1.0962	-6.2469	-13.5	-5.8	13.5	5.8	0	0
14	1.1328	-7.5088	-14.9	-5	14.9	5	0	0
Total			8.283	156.853	250	73.5	2.583	1.465
Total Loss				8.283	129.939			

Line FLow and Losses					
From	To	Line Flow		Line Loss	
Bus	Bus	Pik1	Qik1	Pik in MW	Qik inMVar
8	3	14.224	-25.458	0	1.991
9	6	21.778	-63.916	0	9.715
9	7	24.323	261.155	0	101.901
1	8	33.347	20.638	0.77	0.38
2	8	16.633	15.655	0.293	-0.863
4	9	-37.423	22.158	1.346	1.792
9	8	-26.496	-59.373	0.596	1.261
1	2	80.936	18.29	1.197	0.758
2	4	58.412	16.591	1.635	4.664
6	5	0	-8.623	0	0.103
2	9	22.994	30.383	0.821	0.612
6	7	21.778	-65.009	0	4.075
7	10	2.799	27.849	0.176	0.467
3	11	1.432	-18.549	0.272	0.569
3	12	6.562	-0.284	0.044	0.091
3	13	15.03	-4.275	0.133	0.263
7	14	13.802	18.807	0.488	1.039
10	11	2.623	21.582	0.283	0.664
12	13	0.418	-1.975	0.008	0.007
13	14	1.807	-12.32	0.221	0.449
Total Loss				8.283	129.939

Figure no 3 shows the graphical representation of losses and effect of SVC

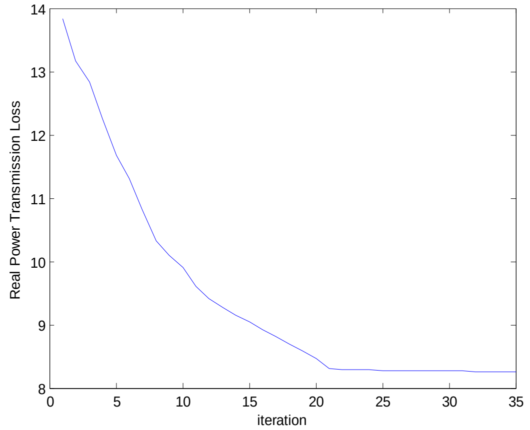

Figure.3. IEEE-14 bus wind farm with SVC using TLBO

Table 3 shows the result of TLBO method without SVC at IEEE 30 bus system

Table.3. IEEE-30 bus wind Farm using TLBO

Newton Raphson Load Flow Analysis								
Bus	V	Angle	Injection Pc,Qc		Load Pl,Ql		Generation Pg,Qg	
No	Pu	Degree	MW	MVar	MW	Mvar	MW	MVar
1	1.06	0	122.53	-16.872	0	0	122.53	-16.872
2	1.055	-2.4413	18.3	4.94	21.7	12.7	40	17.64
3	1.04	-5.3814	20	-4.215	0	30	20	25.785
4	1.112	-12.1842	-30	22.326	30	0	0	22.326
5	1.06	-5.7501	-9.42	19.665	9.42	19	0	38.665
6	1.101	-10.2835	0	20.965	0	0	0	20.965
7	1.0717	-9.1828	21.226	0	0	0	21.226	0
8	1.0577	-10.561	-5.8	-2	5.8	2	0	0
9	1.0743	-10.2835	-11.2	-7.5	11.2	7.5	0	0
10	1.111	-10.6033	0	0	0	0	0	0
11	1.0382	-5.1272	-7.6	-1.6	7.6	1.6	0	0
12	1.0396	-6.7359	-22.8	-10.9	22.8	10.9	0	0
13	1.0387	-5.6669	0	0	0	0	0	0
14	1.0605	-11.0886	-6.2	-1.6	6.2	1.6	0	0
15	1.0571	-11.1357	-8.2	-2.5	8.2	2.5	0	0
16	1.0603	-10.6647	-3.5	-1.8	3.5	1.8	0	0
17	1.0533	-10.7933	-9	-5.8	9	5.8	0	0
18	1.0454	-11.6062	-3.2	-0.9	3.2	0.9	0	0
19	1.0415	-11.7003	-9.5	-3.4	9.5	3.4	0	0
20	1.0448	-11.4702	-2.2	-0.7	2.2	0.7	0	0
21	1.049	-10.9973	-17.5	-11.2	17.5	11.2	0	0
22	1.0506	-10.9867	0	0	0	0	0	0
23	1.0522	-11.4211	-3.2	-1.6	3.2	1.6	0	0
Newton Raphson Load Flow Analysis								
Bus	V	Angle	Injection Pc,Qc		Load Pl,Ql		Generation Pg,Qg	
No	Pu	Degree	MW	MVar	MW	Mvar	MW	MVar
26	1.0677	-11.4591	-3.5	-2.3	3.5	2.3	0	0
27	1.0425	-4.278	-2.4	-1.2	2.4	1.2	0	0
28	1.0405	-6.2363	0	0	0	0	0	0
29	1.0929	-11.6433	-2.4	-0.9	2.4	0.9	0	0
30	1.0824	-12.3862	-10.6	-1.9	10.6	1.9	0	0
Total			5.136	-17.693	198.62	126.2	2.038	1.085
Total Loss				5.136	10.537			

Line FLow and Losses					
From	To	Line Flow		Line Loss	
Bus	Bus	Pik1	Qik1	Pik in MW	Qik inMVar
11	9	40.706	3.903	0	3.675
13	7	33.558	-3.916	0	2.105
13	8	17.396	3.479	0	1.523
28	10	22.964	-8.923	0	2.08
1	2	77.834	-16.49	1.074	0.263
1	27	44.696	-0.382	0.804	1.039
2	5	30.417	-10.123	0.426	-0.546
2	11	29.897	0.037	0.458	-0.619
2	13	34.746	-1.728	0.63	-0.136
3	28	7.268	-3.688	0.035	-2.206
5	12	20.57	10.088	0.22	-0.57
7	4	30	-19.973	0	2.352
7	8	24.784	13.952	0	0.775
8	17z	6.517	3.051	0.015	0.039
8	20	9.447	2.36	0.079	0.177
8	21	13.992	5.833	0.071	0.154
8	22	6.425	1.89	0.029	0.06
9	6	0	-20.457	0	0.508
9	14	7.37	2.316	0.064	0.132
9	15	16.078	6.155	0.17	0.335
9	16	6.057	4.714	0.048	0.101
10	29	6.17	1.631	0.073	0.137
10	30	7.067	1.616	0.136	0.257
11	13	22.416	-7.617	0.061	-0.271
13	3	-12.714	0.104	0.018	-0.423
13	12	2.451	-0.63	0.001	-0.872
13	28	15.78	-7.973	0.048	-0.532
14	15	1.107	0.583	0.003	0.003
15	18	5.593	2.94	0.038	0.078
15	23	3.219	0.961	0.01	0.02
16	17	2.509	2.813	0.01	0.024

Line FLow and Losses					
From	To	Line Flow		Line Loss	
Bus	Bus	Pik1	Qik1	Pik in MW	Qik inMVar
23	24	0.009	-0.66	0.001	0.001
24	25	-5.902	-6.32	0.127	0.222
25	10	-9.568	-8.9	0.159	0.303
25	26	3.539	2.358	0.039	0.058
27	11	41.493	-2.621	0.21	0.148
29	30	3.698	0.594	0.028	0.053
Total Loss				5.136	10.537

Figure 4 shows the graphical representation of IEEE 30 bus system without SVC

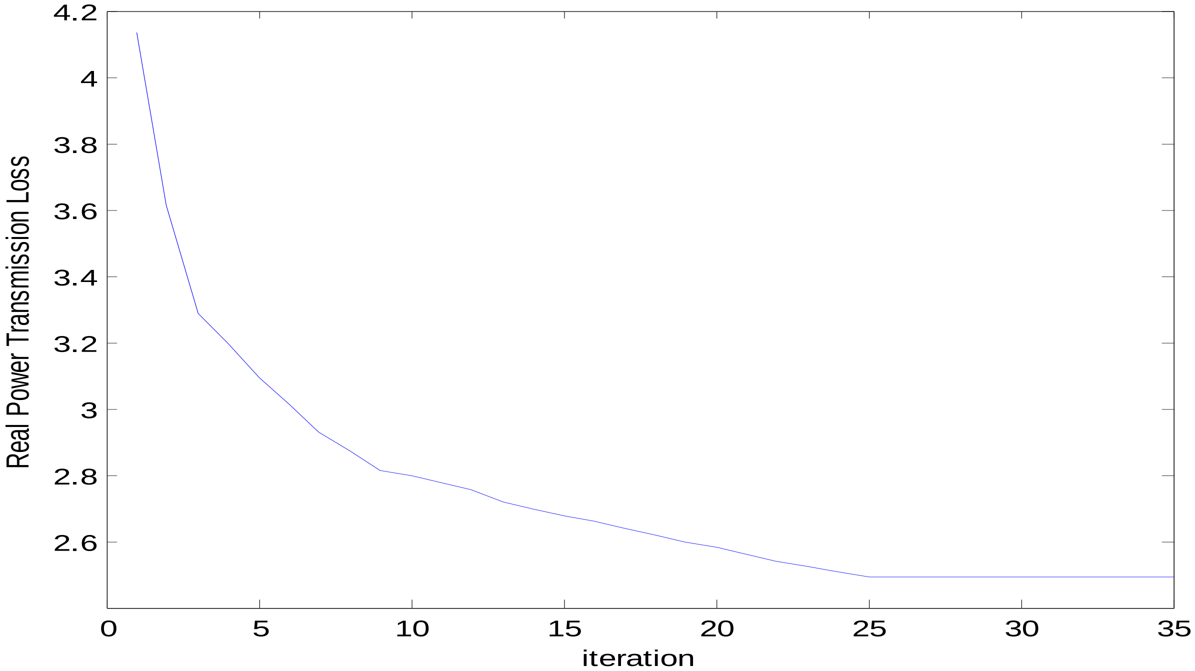

Figure.4. IEEE-30 bus wind farm using TLBO without SVC

Table no 4 shows the result of TLBO with SVC at IEEE 30 bus system

Table.4. IEEE-30 bus wind farm with SVC using TLBO

Newton Raphson Load Flow Analysis								
Bus	V	Angle	Injection Pc,Qc		Load Pl,Ql		Generation Pg,Qg	
No	Pu	Degree	MW	MVar	MW	Mvar	MW	MVar
1	1.06	0	57.407	-48.571	0	0	57.407	-48.571
2	.075	-1.4357	18.3	41.805	21.7	12.7	40	54.505
3	1.06	-2.2181	20	-26.443	0	30	20	3.557
4	1.132	-6.811	-30	9.02	30	0	0	9.02
5	1.06	-4.086	-9.42	4.994	9.42	19	0	23.994
6	1.121	-4.9177	0	13.409	0	0	0	13.409
7	1.1168	-3.9817	0	0	0	0	0	0
8	1.124	-3.166	78.2	32.312	5.8	2	84	0
9	1.1043	-4.9177	-11.2	-7.5	11.2	7.5	0	0
10	1.1445	-5.9129	0	0	0	0	0	0
11	1.0639	-2.517	-7.6	-1.6	7.6	1.6	0	0
12	1.0441	-4.9459	-22.8	-10.9	22.8	10.9	0	0
13	1.0659	-2.6351	0	0	0	0	0	0
14	1.0941	-5.4445	-6.2	-1.6	6.2	1.6	0	0
15	1.0957	-5.3281	-8.2	-2.5	8.2	2.5	0	0
16	1.1063	-4.4355	-3.5	-1.8	3.5	1.8	0	0
17	1.1138	-3.7333	-9	-5.8	9	5.8	0	0
18	1.0943	-5.1752	-3.2	-0.9	3.2	0.9	0	0
19	1.0964	-4.9145	-9.5	-3.4	9.5	3.4	0	0
20	1.1026	-4.5269	-2.2	-0.7	2.2	0.7	0	0
21	1.1135	-3.7546	-17.5	-11.2	17.5	11.2	0	0
22	1.1143	-3.8091	0	0	0	0	0	0
23	1.0967	-5.3377	-3.2	-1.6	3.2	1.6	0	0
24	1.1058	-5.0415	-8.7	-6.7	8.7	6.7	0	0
25	1.1246	-5.7338	0	0	0	0	0	0
26	1.1087	-6.0761	-3.5	-2.3	3.5	2.3	0	0
27	1.0636	-2.1177	-2.4	-1.2	2.4	1.2	0	0
28	1.0679	-3.0035	0	0	0	0	0	0
29	1.1269	-6.8921	-2.4	-0.9	2.4	0.9	0	0
30	1.1168	-7.5904	-10.6	-1.9	10.6	1.9	0	0
Total			2.787	-35.975	198.62	126.2	2.014	0.559
Total Loss				2.787	-5.829			

Line FLow and Losses					
From	To	Line Flow		Line Loss	
Bus	Bus	Pik1	Qik1	Pik in MW	Qik inMVar
11	9	19.983	1.147	0	0.839
13	7	13.753	-13.916	0	0.67
13	8	2.06	-4.721	0	0.122
28	10	16.184	-11.081	0	1.252
1	2	36.55	-40.718	0.491	-1.537
1	27	20.857	-7.854	0.193	-1.509
2	5	27.117	1.084	0.302	-1.111
2	11	13.285	1.555	0.09	-1.829
2	13	13.956	-0.015	0.098	-1.844
3	28	5.845	-7.217	0.04	-2.297
5	12	17.395	7.189	0.149	-0.754
7	4	30	-7.427	0	1.593
7	8	-16.247	-7.16	0	0.278
8	17	17.314	6.896	0.089	0.232
8	20	16.07	4.436	0.206	0.46
8	21	20.164	6.457	0.123	0.266
9	14	5.241	1.872	0.031	0.065
9	15	8.203	3.066	0.042	0.082
9	16	-4.661	1.079	0.018	0.037
10	29	6.164	1.618	0.068	0.129
10	30	7.059	1.601	0.128	0.241
11	13	3.83	-6.563	0.006	-0.49
13	3	-14.095	18.927	0.06	-0.299
13	12	5.563	2.289	0.009	-0.667
13	28	10.401	-6.822	0.022	-0.661
14	15	-0.99	0.207	0.002	0.002
15	18	-0.898	1.157	0.002	0.004
15	23	-0.132	-0.467	0	0
16	17	-8.179	-0.758	0.045	0.106
18	19	-4.1	0.253	0.009	0.018
19	20	-13.609	-3.166	0.055	0.11
21	22	2.541	-5.009	0.003	0.006
22	24	12.937	-2.909	0.163	0.254
23	24	-3.333	-2.067	0.017	0.035
24	25	0.725	-6.706	0.07	0.122
25	10	-2.881	-9.182	0.08	0.153
25	26	3.536	2.354	0.036	0.054
27	11	18.264	-7.545	0.045	-0.346
29	30	3.696	0.59	0.026	0.05
Total Loss				2.787	-5.829

Figure.5. shows the result of TLBO using SVC

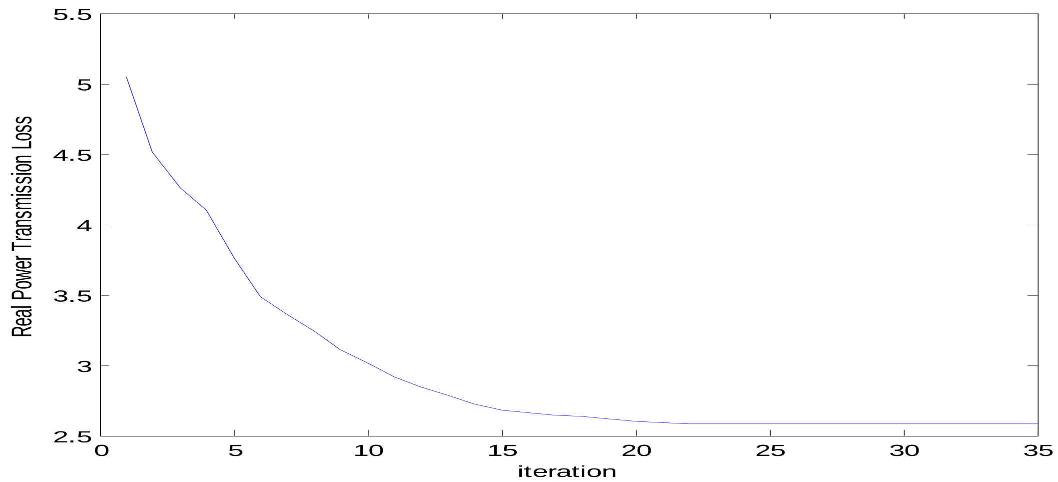

Figure. 5. IEEE-30 bus wind farm with SVC using TLBO Comparative Results

Table.5. Real Power Transmission loss

S.No.	Standard bus	Wind unit usingTLBO	Wind with SVCUsing TLBO
1	IEEE-14	10.973	8.598
2	IEEE-30	5.136	2.787

From the table 6 it is observed that IEEE-14, and IEEE-30, with wind farm and SVC using the TLBO optimization technique, reduced the real power transmission loss.

Table.6.Reactive Power Transmission loss

S.No.	Standard bus	wind unit usingTLBO	wind with SVCUsing TLBO
1	IEEE-14	128.979	130.134
2	IEEE-30	10.537	-5.829

IV. CONCLUSIONS

A new efficient optimization method, called 'Teaching–Learning-Based Optimization (TLBO)'. This method works on the effect of influence of a teacher on learners. Like other nature-inspired algorithms, TLBO is also a population-based method and uses a population of solutions to proceed to the global solution. Teaching–learning-based optimization (TLBO) has been presented in order to determine the transmission loss and voltage profile of the given power system. The algorithms discover minimum losses in the best location of the bus where wind unit- is connected with SVC by optimizing the objective function. The minimization of real power and reactive power transmission loss and improved the voltage profile are considered as an object function. From the result it is evident that transmission loss are reduced in the wind with SVC as compare to without optimization and wind unit. From the result it is also showed that the voltage of the bus after convergence. The performance of the proposed algorithms named TLBO has proven through to obtain result. The proposed algorithms are effective and beneficial for the utilities in decision making. For optimal power generation of wind turbine many methods can be adopted. Among all the methods available for optimal power generate-on the optimization is best because this method is not parameter dependent. So this method places an import role in this field. There are numerous optimization techniques are available some of them namely Genetic Algorithm (GA), Big Bang Crunch Optimization (BBCO), Heuristic Annealing (HA) etc. Apart from these methods we can use Artificial Neural Network (ANN), Fuzzy Logic (FL), and Wavelet Transform.

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