Thyristor Controlled Series Capacitor based on TLBO

J. Berlin Rose, Agees Kumar

Abstract--- Thyristor Controlled Series Capacitor is main of the FACTS controller is an impedance compensation. The voltage power system should dependably in the reasonable range of ensure stability. A powerful technique of optimization is known as 'Teaching–Learning-Based Optimization'. The New approach depends upon the impact of teacher on the output of learners in the class. Teaching–Learning-Based Optimization (TLBO) algorithm is contrasted with various optimization algorithms; the results explain the best performance of TLBO method. Simulations will be carried out using MATLAB programming to check the execution of Thyristor Controlled Series Capacitor.

Keywords--- Teaching Learning based Optimization (TLBO), Thyristor Controlled Series Capacitor (TCSC).

I. INTRODUCTION

A method of TCSC can be able to adjust transmission system reactance adaptable to change the control system, and it's one of the most effective intends to improving the stability of control system. Voltage stability is required for the ideal functioning of the system; compensating devices are required for the compensation purposes.

TCSC is made to soggy power transmission in an interconnected network. In an interconnecting system, TCSC should be in control in reaction to an inter-area main distribution model, and impedance of the capacitance could switch high when the deviation of rotating speed is positive and to low when negative, so vibrations would come low quickly [1].

Thyristor Controlled Series Compensator (TCSC) and Static Var Compensator (SVC) are the two major industrially obtainable FACTS controllers. This paper introduces the formulation and common methodology of TTC calculation utilizing TCSC and SVC. The development of TTC utilizing TCSC and SVC is exhibited with a basic control network. Both thermal utmost main case and voltage limit prevailing case are investigated and the results explain that TCSC can improve TTC in the two cases while SVC can better TTC just in voltage governing case [2].

Whale optimization algorithm, Quasi-Opposition based differential evolution, Grey wolf Optimization and Quasi-Opposition based Grey wolf Optimization algorithm are utilized for reactive power arranging with devices of FACTS. Whale optimization algorithm is a nature-roused meta-heuristic algorithm similar to hunting performance of Humpback Whales. The current method shows less number of cycles which would not meet limited minima also produces promising characteristics of convergence [3].

The execution of FACTS devices can be brought out exceptionally relies upon the location and the parameters of these devices. In this paper, we suggest two Evolutionary Optimization Techniques, in particular Differential Evolution and Genetic Algorithm to choose the ideal location and the ideal parameter setting of TCSC which limit the dynamic power losses in the control system, and look at their exhibitions. The results are executed in the paper together with fitting discussion [4].

Optimal power stream with optimal spot and rating of TCSC is the efficient solution used to decide the electronic expense of operating the plant and direct the power stream in the power system. The load and the multifaceted of the power control network have had an affected need optimization of intensity operation [5].

ACS algorithm, a professional heuristic optimization technique, is utilized to locate the optimal spot and position of a TCSC device in changed bus system. The minimum bus-bar voltage, the general network dynamic and responsive power losses are seen to assess the system execution. This system act as by utilizing the proposed ACS and balanced with GA and PSO after allocating the TCSC [6].

TCSC is working at the midpoint of a system. A Global Positioning System clock is utilized to synchronize examining of current signals at two ends of the transmission system. This project manages the utilisation of consolidated fuzzy and wavelet changes for the observation, organisation and location of faults on Transmission system with and without TCSC which is practically independent of fault impedance and fault commencement angle of transmission system currents flows with FACTS devices [7].

This paper tends to use of an efficient and conservative technique in terms of improving voltage stability**.** In this paper, we satisfy stable energy system activity while avoiding costly funds. The proposed FACTS, we opt for applying a simple heuristic technique. It's give firm bases to the comparison of the proposed through and the comparative performing the IEEE 14-Bus system under EUROSTAG condition [8].

In that technique, Leven berg-Marquardt (LM) algorithm is utilized for fasted preparing. However, methods depending on artificial neural network (ANN) need expansive sets of information for preparing and testing. Additionally, ANN based technique needs retraining in the event of significant change in the system configuration [9].

In this project, reactive power compensation of IEEE 9 bus system using thyristor controlled series capacitor. Voltage change and collapses are significant point for EB, power system and over the globe.

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Better compensation of reactive power in an improved voltage and improving the power quality [10].

II. TOPOLOGY OF TCSC

The topology of TCSC is given in figure1.TCSC is utilized in control systems to powerfully organize the reactance of a transmission system so as to give adaptive load compensation. The advantages of TCSC are found in its capability to organize the measure the compensation of a transmission system and its capability of control in different modes. These attributes are very enviable since loads are frequently changing and can't always be anticipated. The TCSC empower damping of power oscillations between the regions, which otherwise have comprised a limitation on power exchange over the interconnector. TCSC structure operating the same way as FSC, however provide variable control the reactance consumed with the capacitor device. The fundamental structure of TCSC can be seen below:

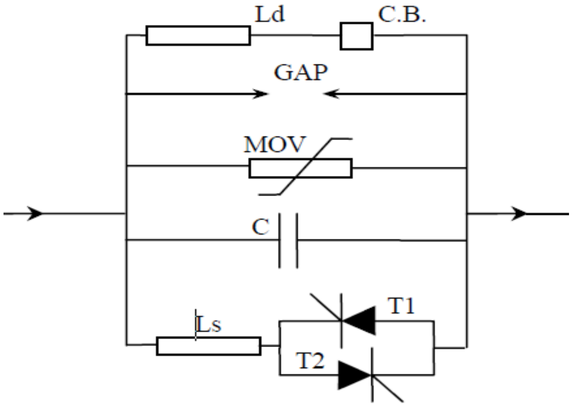

Fig. 1: Configuration of TCSC

III. OPERATION OF TCSC

TCSC contains four operating modes such as Capacitive mode, Blocking mode, Bypass mode and Inductive mode. Thyristor controlled series capacitor (TCSC) impedance has a capacitance and reactance of the inductor, where $jX_L(\alpha)$ is reactance of the inductive division and more on the firing angle (α) of thyristors. The various modes on operations are complete by this angle.

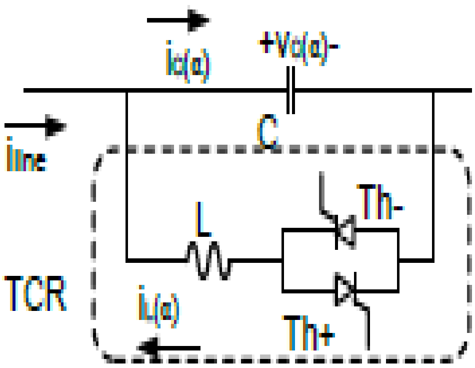

Fig. 2: Schematic Diagram of TCSC

$$_jX_{TCSC}(\alpha) = \frac{jX_L(\alpha) * (-jX_C)}{jX_L(\alpha) + (-jX_C)} \qquad (1)$$

Blocking Mode

While operating in blocking mode, thyristor switches to off position, so firing angle becomes 90 degree.

Bypass Mode

Thyristor valve is always on each period, so thyristors conduct for 180 degree in every cycle. TCSC impedance is equal the equation,

$$X_{TCSC} = \frac{X_L X_C}{X_L - X_C} \qquad (2)$$

Capacitive boost mode

As voltage of the capacitor acrosses the zero line, capacitor discharges, the current pulse was calculated during parallel inductive load. The capacitor peak voltage will be increased in relation to the charge passed through load of the thyristor. It makes the capacitor voltage to be added to the voltage caused by the line current.

Inductive boost mode

With this mode, the current in circulation in thyristor branch is higher compared to line current.

IV. TCSC AND POWER SYSTEM MODELLING

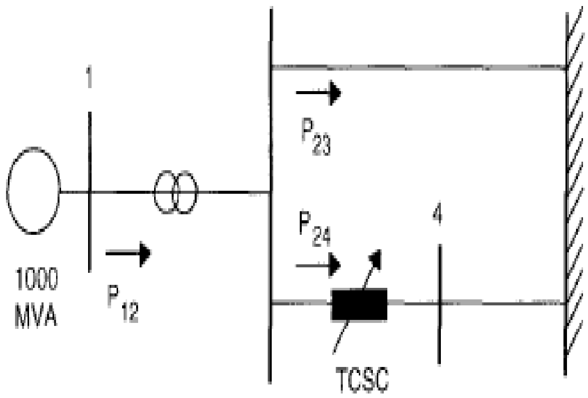

Fig. 3: Modelling of TCSC

The two operating points considered compare to generate the case of a line outage levels of 1200 MW or850 MW in the scope of line voltage. The repeated voltage controller is represented by the first-order transfer system, like given in the Appendix. The TCSC is located in line 2-4. TCSC is a parallel circuit; it's comprises capacitive inductance impedance X_C and inductive impedanceX_L.

V. TEACHING AND LEARNING BASED OPTIMIZATION

Motivated by classical teaching and learning process, a novel Teaching-Learning-Based Optimization (TLBO) is first introduced.

The brief account of the algorithm is given as follows. Let the two various teachers are T1 and T2, delivering a lecture with same substance to the similar value level learners in two various classrooms.

The distribution model is expected the obtained marks, however skewness may be found in real. The following expression gives Normal distribution,

$$f(X) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{-(x-\mu)^2}{2\sigma^2}} (3)$$

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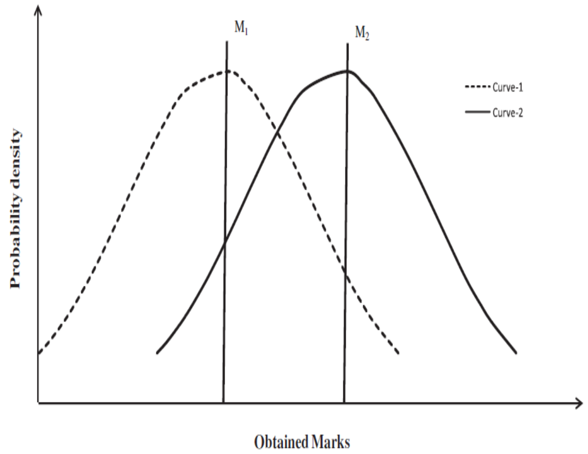

Fig. 4: Two different teachers and learners

VI. TEACHER PHASE

This algorithm based on population technique which begins with a lot of suspension known as population**.** A better teacher conveys information to the students with the aim of providing complete knowledge what they gained. Even though, it is not possible, a teacher can turn about the mean of a class to a particular level depending upon the observing nature of the class. It follows a method which depends upon lot of features.

Let M_i, taken as mean and T_i, taken as teacher at any iteration *i*. T_i will attempt to go mean M_i just before its own level, so now the introduced mean will be T_i assigned by $M_{new.}$ The active and the introduced mean written as,

$$Difference\text{-}Mean_i = r_i\,(M_{new} - T_F M_i)$$

T_F – Teaching Factor

$$T_F = round\ [1 + rand\ (0, 1)\ (2\text{-}1)\ ] \qquad (4)$$

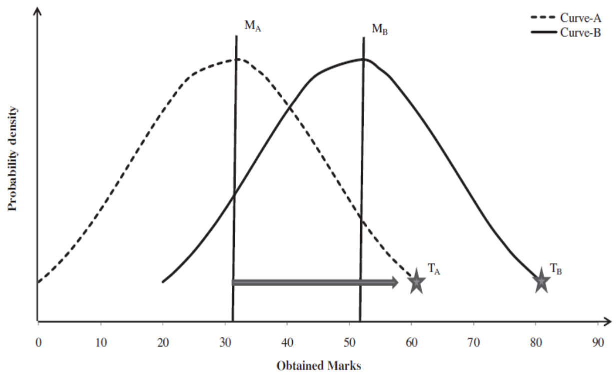

Fig. 5: Configuration of Marks distribution obtained bygroup of learners

VII. LEARNER PHASE

The learner grows his understanding on two various methods: first one is contribution from the teacher and other is interfacing from the learner. A person who learns, associates randomly with another learner by the help of combined consultation, presentations, formal communications and more. If the neighbour is learning more than him or her, the learner will give some extra information. Thereby, if different learners have great learning than he or she does, the neighbour learners also gain new ideas. Learner moderation is explained as,

For i = 1: Pn

$$Z_{new,i} = Z_{old,i} + r_i\,(Z_i - Z_j) \qquad (5)$$

$$Z_{new,i} = Z_{old,i} + r_i(Z_j - Z_i)(6)$$

VIII. IMPLEMENTATION OF TLBO

TLBO algorithm is presented by complex unconstrained and constrained optimisation problems. TLBO is explained with various constraints handling methods termed as the advantage of stochastic ranking, ε-constraint, self-adaptive consequences, group of constraint handling and feasible solutions

IX. RESULT

Simulation results of the proposed method are evaluated by fig6 and fig7.

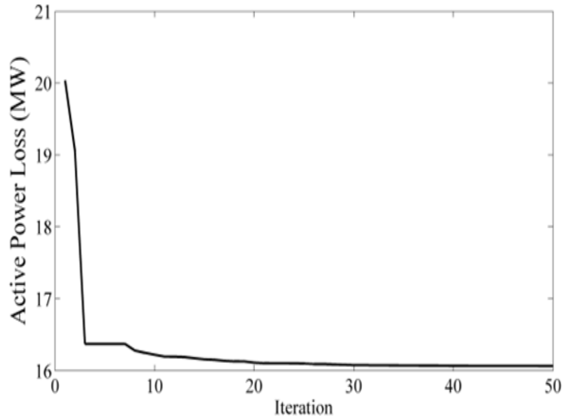

Fig. 6: Convergence of TLBO

Power loss minimization of the optimum control parameter settings of proposed method is given.

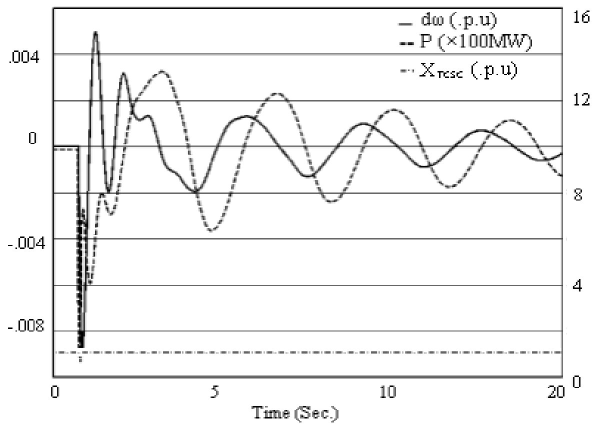

Fig. 7: Wave form of series compensation

The re-compensation degree of TCSC is reduced to series compensation.

X. CONCLUSION

In this paper suggest model of TCSC has been used to Teaching Learning Based Optimisation. The TCSC can be control the voltage of transmission system and increase the voltage of the power system. This model is also explained in frequency domain and it is concluded that accuracy is good at frequencies.

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