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# Reliability Improvement of a Grid Connected PV Inverter with TLBO Controller

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**Abstract:** As the technology is growing rapidly, a new optimization algorithm was developed every day. This paper presents the methodology to improve the performance of grid connected convertor for the RES system based on Teaching and Learning Based Optimization (TLBO). In the present work, TLBO algorithm is used to optimized the parameter of PI controller for improving power performance of Grid connected convertor on a distribution system. The whole the Grid Connected PV System control technique is modelled in the MATLAB / SIMULINK environment. Finally, this paper shows how the power quality of a grid system is improved with the use of TLBO tuned PI controllers and thereby Reliability.

**Keywords:** TLBO, THD, PI, GRID

## 1. Introduction:

Today, the energy sector is the crucial element of organization for the well-being of nations, but it is also vital to economic growth. The power sector is the most diversified industry in India. In India, power sources are mostly classical for generations and the demand for non-conventional generations are also increasing. [1-2]

The quality of power must in fact be produced because of this importance of power generation. But there are several problems of power quality due to the variety of loads. For the energy sector and for power engineers, the quality of power is therefore a difficult task. Various methods for the compensation of power quality have been implemented since last days. [3-4]

The TLBO Grid Converter is used in this article as a compensator for the improvement of the quality of power. A shunt compensator is for the Grid Converter (STATCOM) when the STATCOM input is PV System. The paper presents Teaching and Learning Based Optimizing (TLBO) Converter in a Grid Tied PV System controlling technique. New optimization technique for tuning the PI controller is proposed in the direction of STATCOM. Finally, this paper shows improvements in power quality by reducing THD using a PI Controller for a Grid Converter tuned for teaching and learning (TLBO). [5]

## 2. Teaching and Learning Based Optimization (TLBO):

Authors Rao et al. in the year 2012 inspired teaching and learning processes depend on class room Teaching and Learning process. This optimization based on class room Teaching and

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Learning process i.e. a population-based meta-heurist search algorithm such as GA, ACO, GWO etc. The optimization approach focused on class room Teaching and Learning process is a simple mathematical framework to resolve various objectives of optimization.

This paper focuses on a class room Teaching and Learning process optimization algorithm. The planned TLBO algorithm overcomes the disadvantages of the conventional heuristic challenges, such as local optimal capture and the lack of efficient mechanisms to deal with constraints. According to our optimization algorithm based on our T&L, students can get content knowledge in two ways: I instructor interplay (called as the teacher phase) and ii). The students are named as a population in this algorithm. As student's subjects, the design variable is called. The best student is called a Teacher.

A. *Teacher Phase:*

The teacher always learns the teacher's knowledge. The teacher seeks by his instruction to improve the mean outcome of the school. The best student is that once teachers ' knowledge is equal, teachers are able to reach their understanding. But it's not practically possible because not all students are smarter. The next thing is.

The teacher at every $i^{th}$ ($T_i$) iteration make it possible to transfer mean ($M_i$) to its own level of intelligence, hence $T_i$ chosen as $M_n$. The best student is therefore regarded as an instructor.

The difference between the actual mean result of each subject and the respective teacher's result for each subject is indicated by,

$$Diff = r * (M_n - T_f M_i) \quad (1)$$

In the above equation Tf is known as teaching factor and is given as follows

$$T_f = round[1 + rand(0,1) \times (2 - 1)] \quad (2)$$

This disparity shifts the current approach to the following

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

Where $X_{new,i}$ is the updated value of $X_{old,i}$. Accept $X_{new,i}$.

B. *Learner phase:*

Information for the student phase is that teacher in the learning phase develops information in two ways: one is the educator who acquires knowledge. And another means sharing information between the contact of the learner.

This phase is as follows

Learners $X_i$, $X_j$ are to be selected randomly such that i not equal to j

$$X_{new,i} = X_{old,i} + r \times (X_i - X_j) \; if \; f(X_i) < f(X_j)$$

$$X_{new,i} = X_{old,i} + r \times (X_j - X_i) \; if \; f(X_i) > f(X_j) \quad (4)$$

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Repeat the until $X_{new,i}$ gets the best value.

### 3. TLBO Topology for Grid Converter:

The algorithm-based control technique for Converter in Grid Tied PV System, is proposed in this paper TLBO. Below is the block diagram. New optimization technology for tuning the PI controller is proposed for the control of STATCOM. The MATLAB simulates a 100 KW PV Grid system.

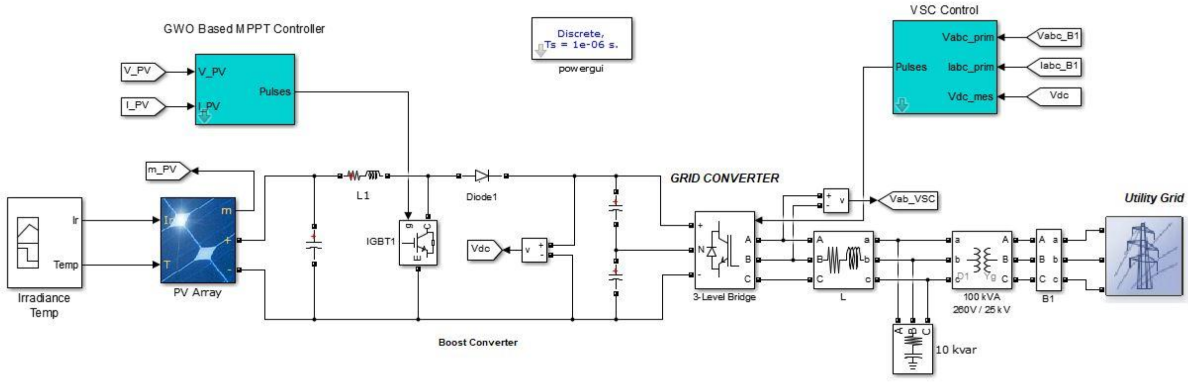


Fig. 1: Proposed Model of TLBO based grid converter

The Grid Converter structure is similar to three phase inverters. In the grid converter, IGBTs are used as switches. Because the IGBTS switches are completely controlled. There are six total IGBTs, i.e. 2 switches are used for each arm. A grid converter has a total of 3 arms.[16-20]

The model is connected to a 100 KW PV module with 5 KHz 500 V Boost conversion which enhances the PV module voltage to 500 V regardless of any changes, it maintains the constant 500 V. The 500 V voltage converter in this model 3 level is a Grid converter. A constant 500 V DC voltage for the boost converter comes in the grid converter. The Grid converter is connected via 100 KVA transformer to the utility grid.

### 4. Results and Discussion:

The proposed model in tested in Three Cases with Variable Irradiance and Temperature. The Two different cases are shown below.

Case 1: PSO based Grid Converter.

Case 2: TLBO based Grid Converter.

All the two cases are tested with the variable Irradiance and Temperature i.e

- Pmpp @ 1000 $W/m^2$, 25 deg= 100.7 kW @ 273.5 V

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- Pmpp @ 250 $W/m^2$, 25 deg= 24.4 kW @ 265.1 V
- Pmpp @ 1000 $W/m^2$, 50 deg= 92.9 kW @ 250.2 V

**Case 1: PSO based Grid Converter:**

In this case, the gain values of the PI controller are used using the PSO optimized algorithm. With the use of the optimized PI controller value, we can therefore say that the controller is tuned to PSO algorithm because the value of the gain is tuned to PSO algorithm values. The results below are displayed.

The figure below shows the variable irradiance, temperature variable. Mean power, mean voltage, duty period. Mean power. In the mean energy, oscillations occur in the mean voltage and duty cycle. The maximum power at 1000 w / m2 is 100.7 kW. The power at 250 w / m2 and the output power at the photovoltaic panels is 273.5 V. The maximum output power is 24.4 kW and, in that situation, the output power of the photovoltaic panel is 265.1 V.

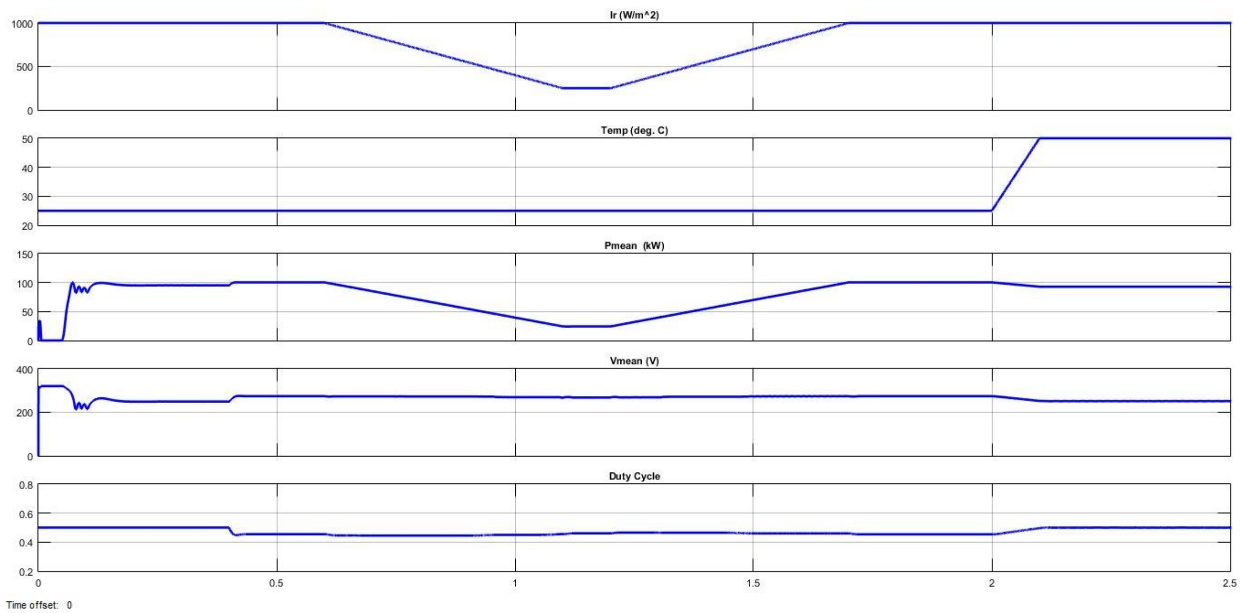


Fig. 2: Variable Irradiance, Variable Temperature. Mean Power, Mean Voltage, Duty cycle of proposed model

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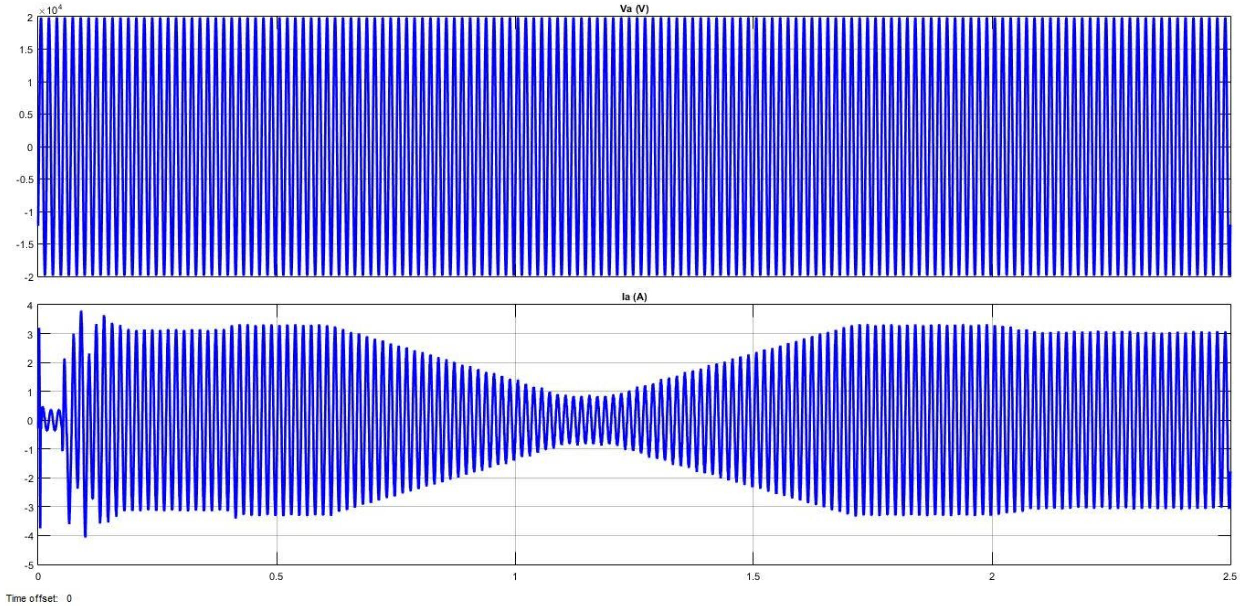


Fig. 3: Grid Voltage and Grid Current for the proposed model

The above figure shows that grid voltage is constant even though the variable Irradiance and Variable Temperature.

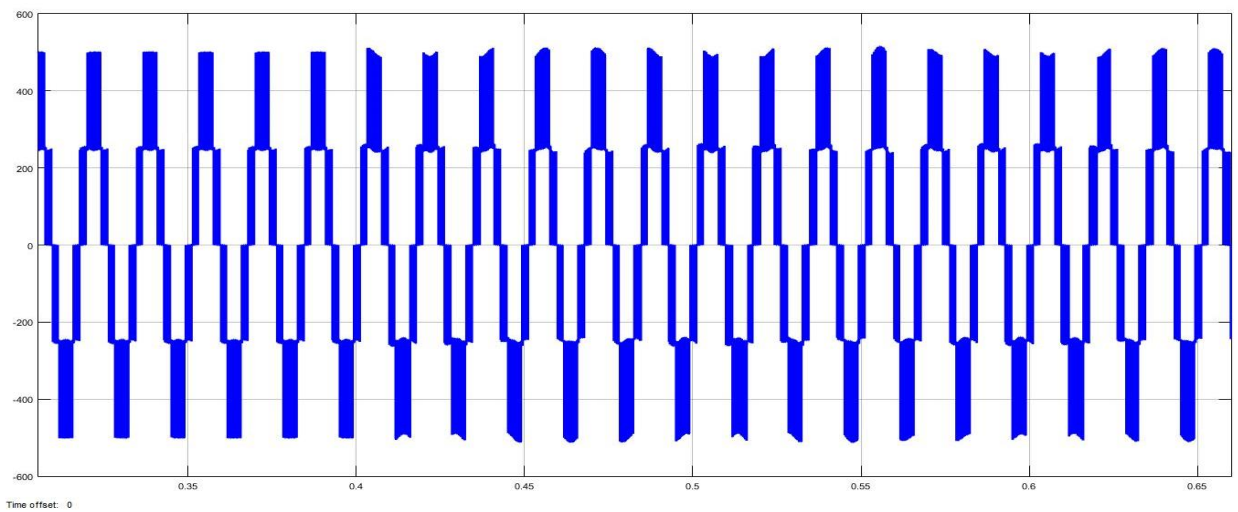


Fig. 4: Grid Converter Output Voltage

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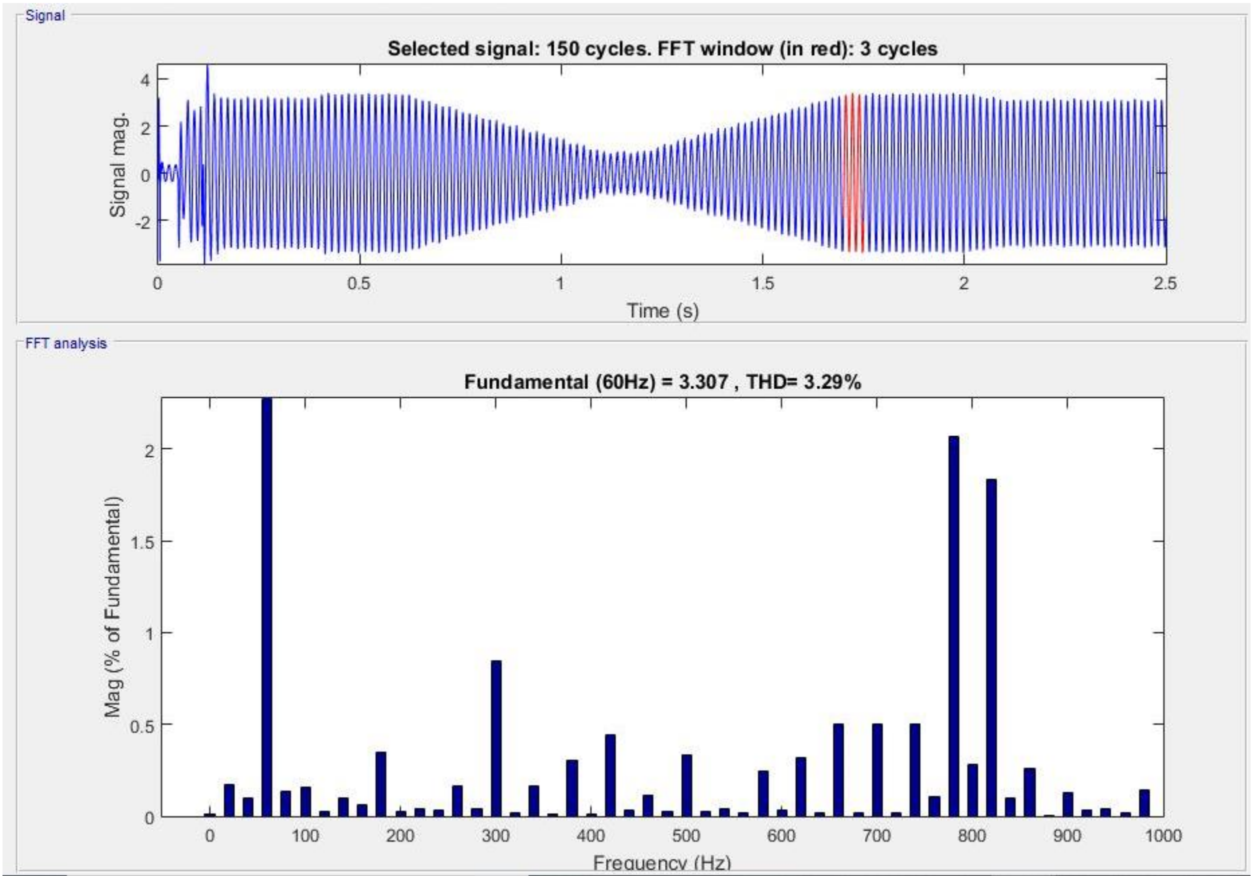


Fig. 5: THD analysis of PSO based Grid Converter.

The THD in this case is 3.29%.

**Case 2: TLBO based Grid Converter:**

The gain values of the PI controller are utilized in this case with the support of TLBO control scheme. Thus, we can assume that the controller is set up with the Teaching and Learning Based Optimizing (TLBO), since the gain values for the PSO-Algorithm are specified values. The PI controller provides the optimized performance. The findings are shown below.

Variable irradiance, variable temperature, shown in the following figure. Mean energy, mean voltage, cycle of service. Mean power. Mean power oscillates with medium voltage and work cycle. With a maximum output of 1000 W / m2, a maximum power of 25 deg is 100,7 KW and a PV power of 273,5 V in this condition. 25 deg is 24,4 KW with a maximum output of 250 W / m2, and the power of the PV module is 265,1 V in this case. At the power of 1000 W / m2, a maximum of 50 deg is 92,9 kW, and the PV module output in this condition is 250,2 V.

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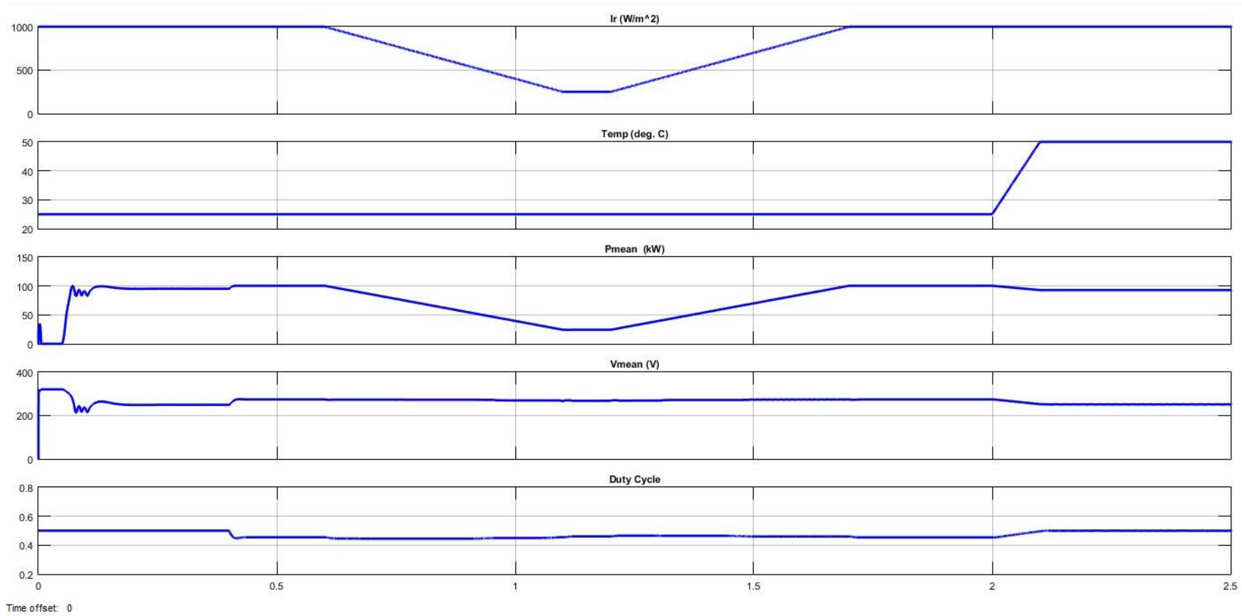


Fig. 6: Variable Irradiance, Variable Temperature. Mean Power, Mean Voltage, Duty cycle of proposed model

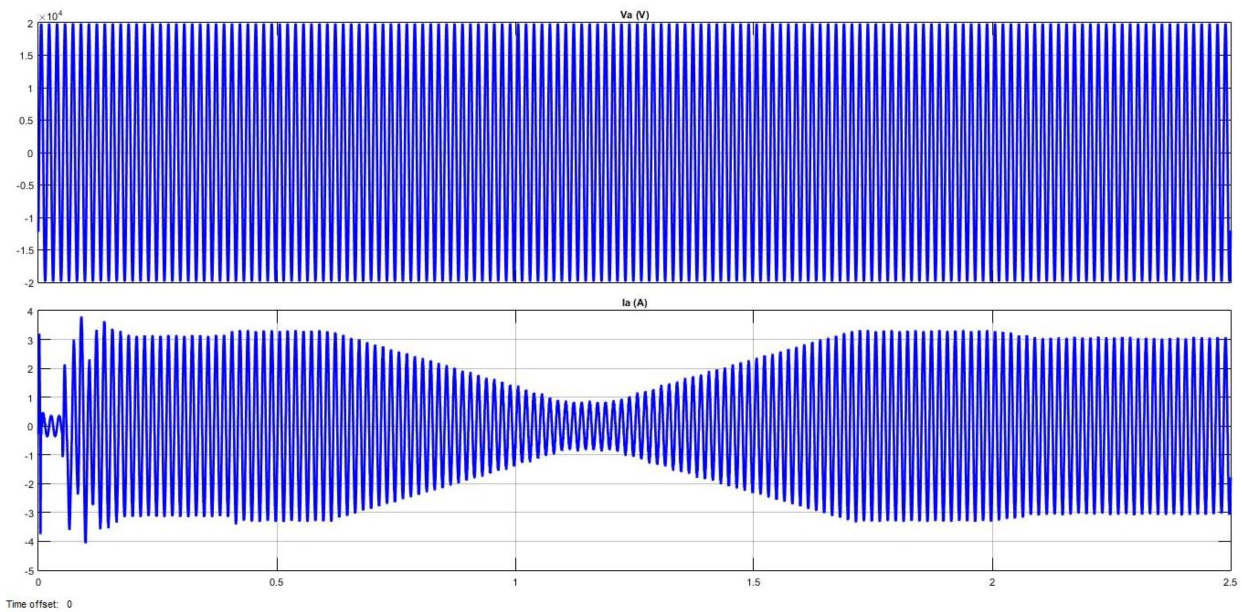


Fig. 7: Grid Voltage and Grid Current for the proposed model

The above figure shows that grid voltage is constant even though the variable Irradiance and Variable Temperature.

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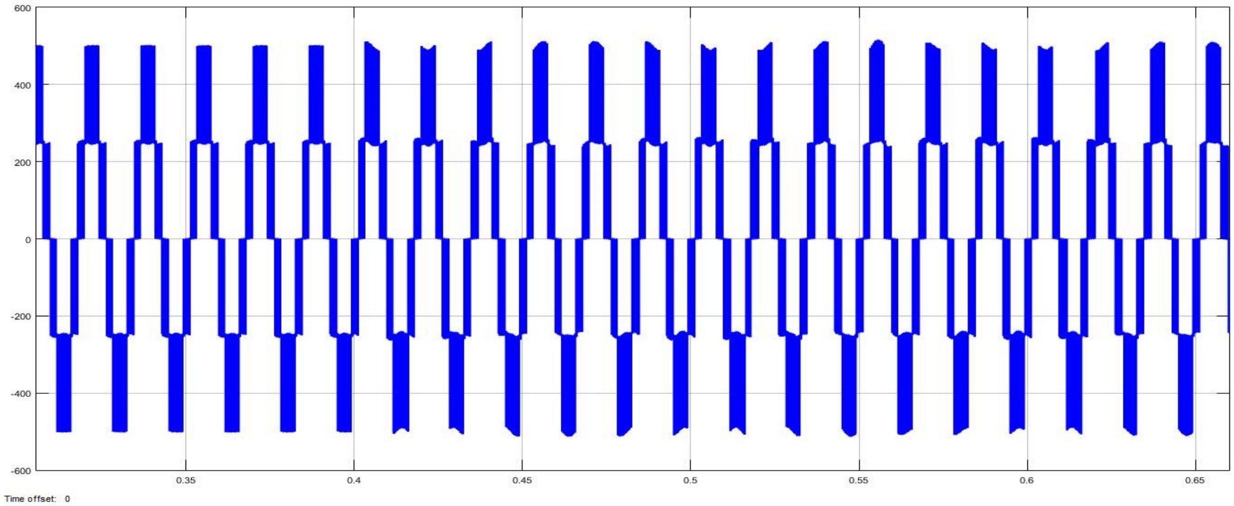


Fig. 8: Grid Converter Output Voltage

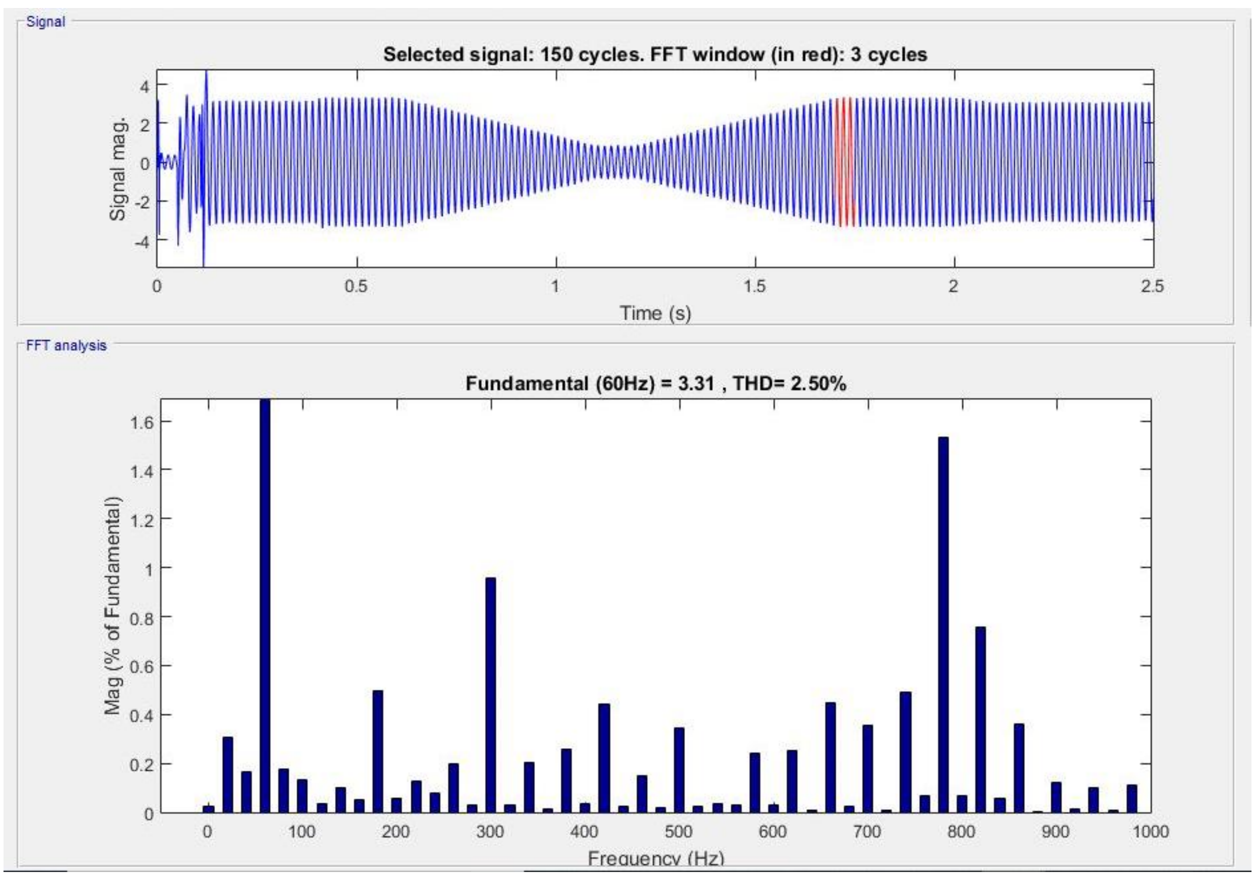


Fig. 9: THD analysis of TLBO based Grid Converter.

The THD in this case is 2.50%.

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Comparison Table: I

| Case | Mode | THD |
|---|---|---|
| 1 | PSO based Grid Converter | 3.29 % |
| 2 | TLBO based Grid Converter | 2.50 % |

The above comparison shows that with the proposed Teaching and Learning Based Optimization (TLBO) based grid converter a mark reduction in THD from 3.29 per cent to 2.50 per cent has been seen this shows the significant improvement in power quality and thereby Reliability.

## 5. Conclusion:

The Grid Converter Tuned PI Controller is based on the teaching and learning basis optimization (TLBO) using the MATLAB / SIMULINK featured in this article. The results showed that the TLBO technology is the best tuning technology for the PI controller. The results of the TLBO technique. We can clearly observe that THD has fallen from 3.29% to 2.5% in the THD analysis. It increases the Reliability performance by decreasing the THD by using the TLBO based PI Control Scheme for a Grid Converter.

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