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Active Harmonic Current Controlling Using H-Infinitive Controller

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***Abstract* — In this paper cascaded current – voltage control technique proposed for DC-AC converters in distribution generation (DG) units. The main objective of the proposed controller is to improve the power quality by injecting a clean sinusoidal current to the grid even in the presence of local non-linear loads. This proposed controller consisting of inner voltage control loop and outer current control loop with both the controllers is designed by using H-infinitive repetitive control strategy. By this proposed controller, the THD value reduced and improved tracking *performance*. In order to verify the improvement of performance, the simulation results of the proposed controller compared with current control strategy in the conventional controller is done by using the MATLAB/Simulink.**

***Key words*— Distributed generation, H-infinity controller, power quality, Total harmonic distortion, cascaded current-voltage controller.**

I. INTRODUCTION

Now a days, Renewable Energy Sources (RES) such as solar, wind are becoming more popular to generate power.This renewable energy based power generation generates DC power output. So an inverter is needed to convert DC energy from renewable energy sources into AC electrical energy. These renewable energy sources (RES) are connected to grid through grid connected PWM inverters which supply active and reactive powers to main grid. These inverters are either be connected in standalone (or) in grid connected mode. In case of grid connected mode, the output voltage of inverter should be same (or) it should be less than grid voltage and frequency should be same as that of grid frequency. In general, the loads connected to Distribution generation units are non-linear in nature. These can introduces power quality problems in the system. The harmonics occurred in the system due to the presence of non-linear loads. Due to this the Total Harmonic Distortion in the local load voltage and in the grid current is high. But it needs to be maintained low according to Industrial Regulation. Hence active and passive filtering methods have been developed to reduce these harmonics. But these are not favorable due to cost concerns. Several feedback current control methods used to obtain low THD value. But these are not favorable due to steady state fundamental current tracking errors. In order to obtain good performance and low THD value for the inverter local load voltage and grid current, H-infinitive Repetitive control technique is proposed. This H-infinity repetitive controller improves the power quality and tracking performance. It contains the inner voltage controller loop and outer current controller loop. The voltage controller is responsible for the power quality of the inverter local load voltage and power distribution and synchronization with the grid. The current controller is responsible for the power quality of the grid current, power exchanged with the grid and for the over current protection. When the inverter is connected to the grid, both the controllers are active and when the inverter is not connected to the grid then the inverter is under zero current reference. The inner voltage control loop takes the reference from the outer current control loop. The H-infinitive repetitive control strategy is used to design the controllers. This repetitive control technique is perfectly tracking the periodic signals and rejects the periodic disturbances in dynamic systems. The internal model acts as infinite dimensional by connecting a delay line into a feedback loop. This closed loop system helps to deal with larger number of harmonics.

II. CONVENTIONAL HARMONIC COMPENSATION METHOD

Fig:1 shows the configuration of single phase distribution generation(DG) unit connected to the grid through inverter bridge and coupling choke(L_f and R_f).It consists of grid interfacing inductor with a circuit breaker. Local load is connected at POC.These loads are nothing but unbalanced or non-linear loads. Due to the presence of non-linear loads harmonics will occur in the system. In order to improve the power quality of the grid currents, the harmonic components of local load current should be absorbed through DG unit regulation.POC harmonic voltage compensation also necessary to maintain POC voltage quality. Due to the interaction of DG harmonic current and POC harmonic voltage, some steady-steady DG power offsets will occur when the system is in open loop.

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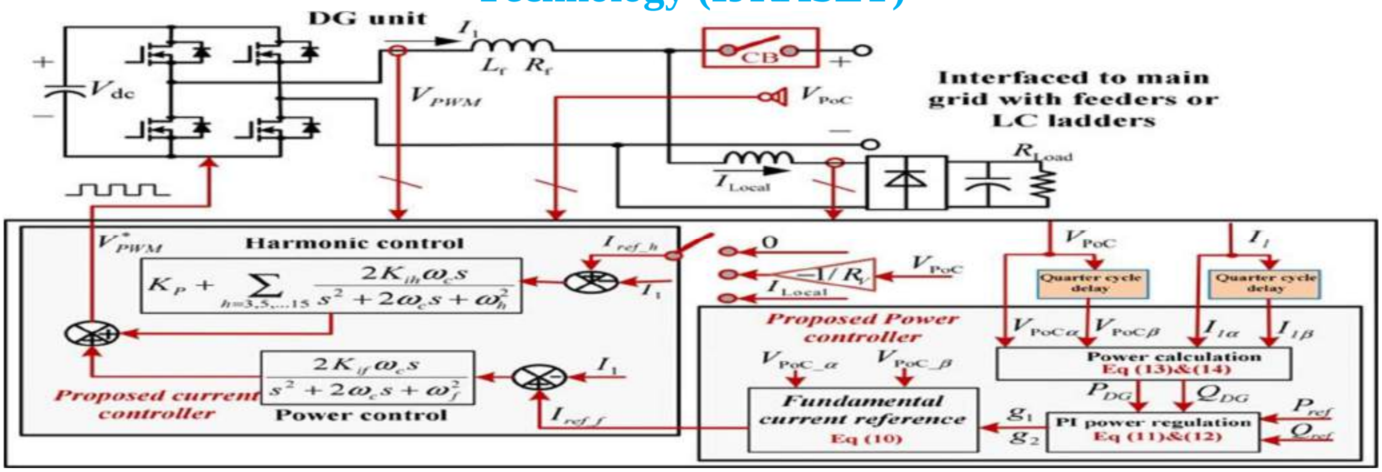

Fig:1 configuration of single phase distribution generation(DG) unit connected to the grid through inverter bridge and coupling choke(L_f and R_f).

Hence closed loop power control technique is used to achieve accurate power control performance in current controlled DG units. The current reference consists of two parts. The first one is the fundamental current reference can be determined in simple closed loop power control technique is

$$I_{ref\text{-}f} = g_1 V_{POC\alpha} + g_2 V_{POC\beta} \quad (1)$$

Where g_1 and g_2 are the gains which are adjustable and used to control real and reactive power respectively and $V_{POC\alpha}$ is the non filtered POC voltage expressed in the $\alpha - \beta$ reference frame and $V_{POC\beta}$ is it's orthogonal component.

The gains can be regulated as follows

$$g_1 = (K_{P1}+K_{I1}/S)\left(\frac{1}{\tau s+1} P_{ref} - P_{DG}\right) + P_{ref}/E^{*2} \quad (2)$$

$$g_2 = (K_{P2}+K_{I2}/S)\left(\frac{1}{\tau s+1} Q_{ref} - Q_{DG}\right) + Q_{ref}/E^{*2} \quad (3)$$

Where K_{P1} and K_{P2} are proportional control parameters, K_{I1} and K_{I2} are integral control parameters, P_{ref} and Q_{ref} are real and reactive power references, E^* is the nominal voltage magnitude of DG unit and τ is the time constant of first order low pass filter. P_{DG} and Q_{DG} are measured DG power with low pass filtering as

$$P_{DG} = \frac{1}{2(\tau s+1)}(V_{POC\alpha} I_{1\alpha} + V_{POC\beta} I_{1\beta}) \quad (4)$$

$$Q_{DG} = \frac{1}{2(\tau s+1)}(V_{POC\beta} I_{1\alpha} - V_{POC\alpha} I_{1\beta}) \quad (5)$$

Where $I_{1\alpha}$ is the non-filtered DG current in $\alpha - \beta$ reference frame and $I_{1\beta}$ is its orthogonal component.

From equation (1), the fundamental current reference will be distorted if POC voltage has some ripples. In order to avoid this drawback, an improved proportional and resonant controller with two control branches is written asWc

Branch1:Power control Branch2:harmonic control

$$V^*_{PWM} = \frac{2K_{if}w_c s}{S^2+2w_c s+W_f^2}.(I_{ref\text{-}f} - I_1) + \left(K_P + \sum_{h=3,5,\ldots,15} \frac{2K_{ih}w_c s}{S^2+2w_c s+W_h^2}\right).(I_{ref\text{-}h} - I_1)$$

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Branch1:Power control Branch2:harmonic control

$$= G_f(s) \cdot (I_{ref-f} - I_1) + G_h(s) \cdot (I_{ref-h} - I_1) \quad (6)$$

The fundamental current reference in equation (1) is regulated by power control branch in equation (6) and harmonic components in I_{ref-f} can be automatically filtered by using fundamental resonant controller in this branch. The harmonic current reference I_{ref-h} is regulated by harmonic control branch, where only harmonic resonant controllers used in this branch. In order to avoid non characteristic harmonics exist in the system, a small proportional gain K_p is used to ensure superior harmonic current tracking. The local load current (or) POC voltage is directly used as the input of the harmonic control branch. If harmonic reference current is set to zero, then the DG current is treated as ripple free in the harmonic control branch.

In summary harmonic current reference in equation (6) can have three options as follows

$$Iref\_h = \begin{cases} I_{local}, & \text{Local nonlinear load compensation} \\ -Vpoc/Rv, & \text{Feeder resonance voltage compensation} \\ 0, & \text{DG harmonic current rejection} \end{cases} \quad (7)$$

The output of harmonic control branch contains some fundamental components due to the proportional gain K_p when the local load current (or) POC voltage are directly taken as input of harmonic control branch. Then these fundamental components make the interference with power control branch and produces fundamental current tracking with some steady state error.

III. PROPOSED CONTROL SCHEME

In the conventional harmonic compensation method, the stability can be low and it has some steady state error. In order to eliminate the impacts of steady-state fundamental current tracking errors in the DG units, H-infinity control technique can be used. In order to maintain the low THD value for the inverter local load voltage and grid current , the proposed controller consists of two loops; An inner voltage loop is used to regulate the inverter local load voltage and an outer current loop is used to regulate the grid current. This technique can deal with large number of harmonics, this leads to low harmonic distortion and improved tracking performance. It can deal with high disturbance rejection and gives high stability and good performance. According to the control theory of cascaded control, the dynamics of outer loop is designed to be slower than inner loop. The two loops are separately designed. The outer loop controller should be designed by taking the assumption that inner loop is in steady state; i.e, $U_o = U_{ref}$ .These two controllers can be designed by using H-infinitive repetitive control because of high performance in reducing THD. The block diagram of hysteresis control is shown in figure 2. It consists of plant P and it has two inputs, one is external input *w* and that includes reference signal and disturbances, and another is manipulated variables *u*. Plant P has two outputs, one is error signal *z* that we want to minimize, and another one is measured variables *v*, that we use to control the system. *v* is used in *K* to calculate the manipulated variable *u*. Note that w,u,z and v are generally vectors , whereas **P** and **K** are matrices.

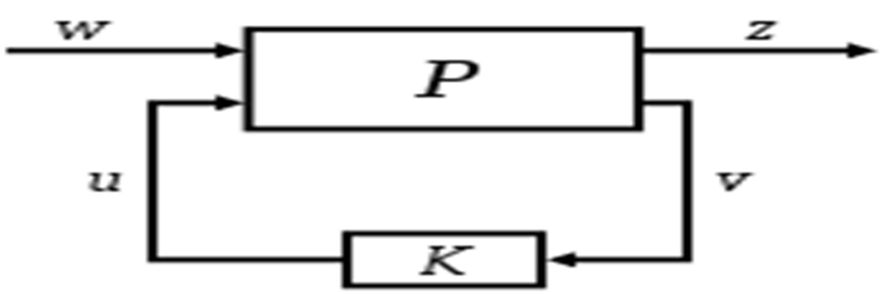

Fig.2.General block diagram of H^∞ control scheme

The proposed controller is shown in figure3 and it consists of two loops one is inner voltage controller loop and another is outer

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current controller loop. The voltage controller can be used to generate and dispatch power to the local load and to synchronize the inverter with grid. If the inverter is synchronized with grid then the voltage and frequency are easily determined by the grid. The current controller can be used for over current protection and it can exchange clean current with grid even in the presence of non-linear loads. Here the current controller is normally included in the drive circuits of inverter. The PLL's can be used to determine the phase of the grid voltage, which is needed to generate I_{ref}. In this H-infinity control, the output of current controller is added to the grid voltage. This can be used for synchronization mechanism.

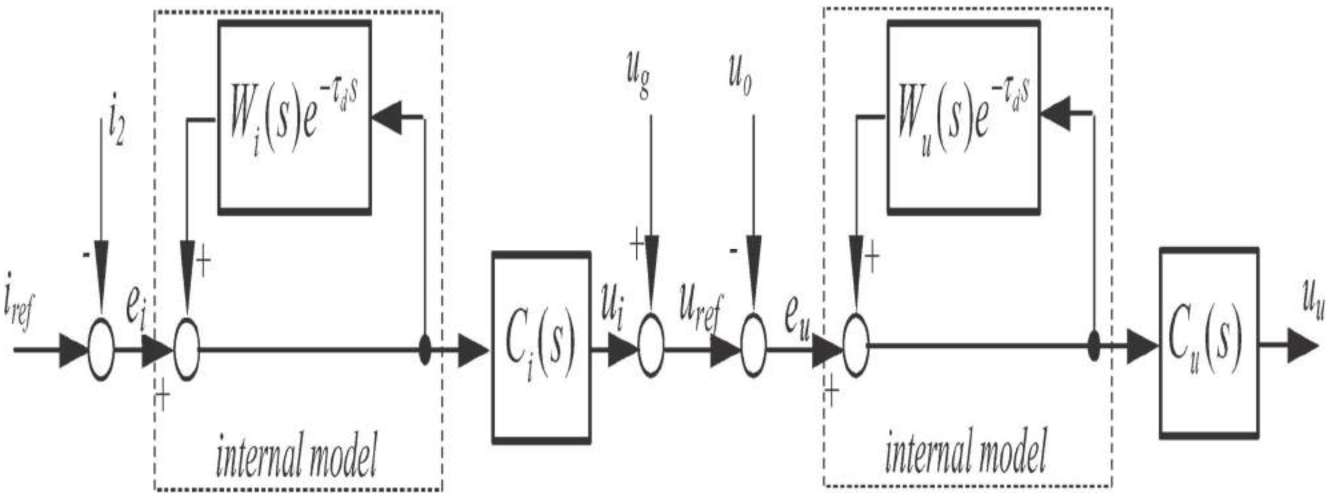

Fig.3.Proposed cascaded current-voltage controller for inverters where both adopt H^{∞} control strategy

IV. DESIGN OF VOLTAGE CONTROLLER

The voltage controller can be designed with H-infinity controller using repetitive control strategy. In this the amount of delay used in the internal model is equal to the period of the external signals.

A. State Space Model Of Plant P_V

The control plant for voltage controller is shown in figure 4. It consists of an inverter bridge with PWM block and LC filter(L_f and R_f).The PWM block and inverter bridge can be ignored while designing the controller because these can be designed by using average voltage approach with the limits of DC link voltage. Then the average value of U_f over a sampling period is equal to U_v.

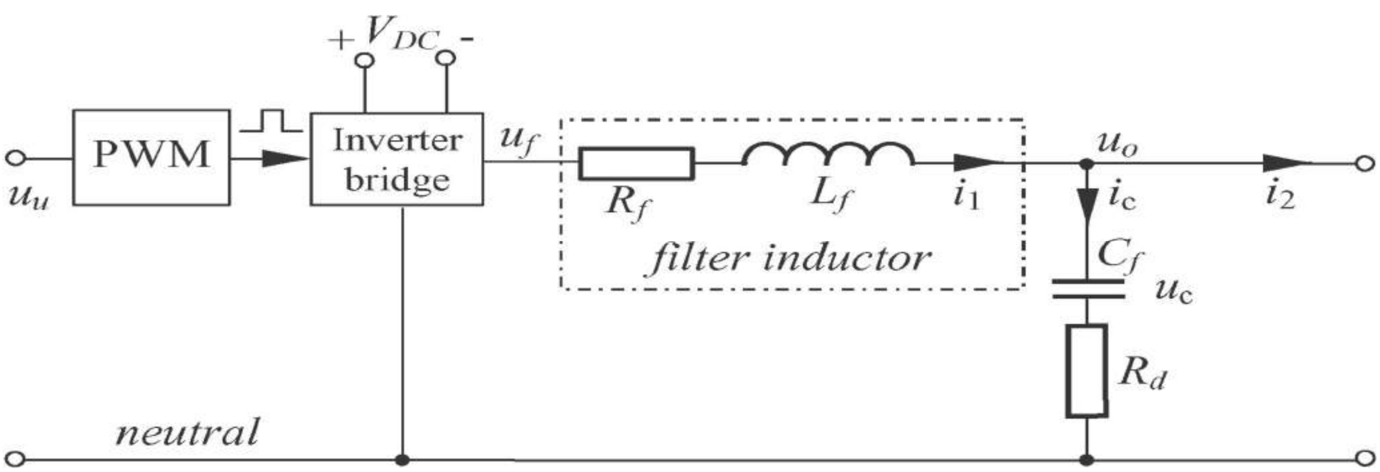

Fig.4.Control plant for inner voltage controller

Here the filter inductor current I_f and capacitor voltage V_c are taken as state variables. Therefore $X_v = [\ I_1 \quad V_c\ ]^T$ and grid current

I_2 and voltage reference V_{ref} are taken as external input $W_v = [\ I_2 \quad V_{ref}]^T$ and U_v is taken as control input. Then the tracking error e_v nothing but output signal from plant is written as $e_v = V_{ref} - V_o$ where V_o is the inverter local load voltage and $V_o = V_c + R_d\ (\ I_1 - I_2\ )$.Then the state equation of the plant is written asn

$$X_v^{\cdot} = A_v X_v + B_{v1} W_v + B_{v2} U_v \qquad (8)$$

and the output equation can be written as

$$Y_v = C_{v1} X_v + D_{v1} W_v + D_{v2} U_v \qquad (9)$$

Where

$$A_v = \begin{pmatrix} \frac{-(R_f + R_d)}{L_f} & \frac{-1}{L_f} \\ \frac{1}{C_f} & 0 \end{pmatrix}$$

$$B_{v1} = \begin{pmatrix} \frac{R_d}{L_f} & 0 \\ \frac{-1}{C_f} & 0 \end{pmatrix} \qquad B_{v2} = \begin{pmatrix} \frac{1}{L_f} \\ 0 \end{pmatrix}$$

$$C_{v1} = \begin{pmatrix} -R_d & -1 \end{pmatrix} \qquad D_{v1} = \begin{pmatrix} R_d & 1 \end{pmatrix} \qquad D_{v2} = 0$$

Then the plant transfer function is

$$P_v = \left(\begin{array}{c|cc} A_v & B_{v1} & B_{v2} \\ \hline C_{v1} & D_{v1} & D_{v2} \end{array}\right)$$

B. Standard H^∞ Problem Formulation

To make sure that this internal voltage loop is stable, it is formulated to minimize the H^∞ norm of the transfer function $T_{Zv,Wv} = F_l(P_v,C_v)$ from $W_v = [U_v \ \ W_v]^T$ to $Z_v = [Z_{v1} \quad Z_{v2}]^T$. This can be done after opening the local positive feedback loop of internal model and introducing the weighting parameters ξv and μ_v. The formulation of H^∞ control problem for voltage controller is shown figure5.

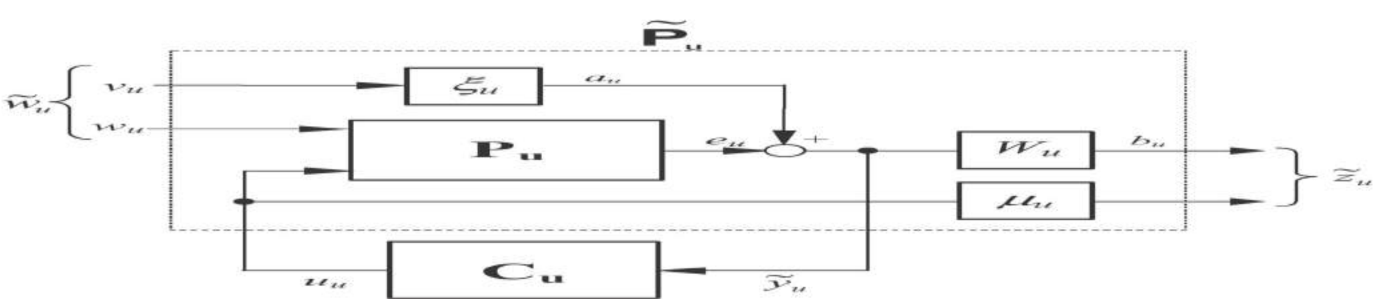

Fig.5. H^∞ control problem formulation for the voltage controller

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Then the closed loop system can be represented as

$$\begin{pmatrix} Z_v \\ Y_v \end{pmatrix} = P_v \begin{pmatrix} W_v \\ U_v \end{pmatrix}$$

$$U_v = C_v Y_v$$

Where P_v is the generalized plant and C_v is the voltage controller.

This generalized plant P_v consists of original plant with low pass filter $W_v = \begin{pmatrix} A_{wv} & B_{wv} \\ C_{wv} & D_{wv} \end{pmatrix}$, Which is the internal model of repetitive control.

Where ξv and μ_v are the weighting parameters and play a vital role in guaranteeing the stability of the system. Then the generalized plant P_v is written as

$$P_v = \left(\begin{array}{cc|cccc} A_v & 0 & 0 & B_{v1} & B_{v2} & \\ B_{wv} C_{v1} & A_{wv} & B_{wv} \xi v & B_{wv} D_{v1} & B_{wv} D_{v2} & \\ \hline 0 & D_{wv} C_{v1} & C_{wv} & D_{wv} \xi v & D_{wv} D_{v1} & D_{wv} D_{v2} \\ 0 & 0 & 0 & 0 & \mu_v & \\ C_{v1} & 0 & \xi v & D_{v1} & D_{v2} & \end{array}\right) \quad (10)$$

By using the $h_{in}f_{syn}$ function in MATLAB , the controlled C_v can be found from the generalized plant P_v using H^{∞} control theory.

V. DESIGN OF CURRENT CONTROLLER

As said earlier, for the designing of the current controller, let us assume that the inner voltage is in steady state i.e, $U_o = U_{ref}$. The figure 6 shows the control plant for the outer current loop controller. It consists of grid interface inductor. This controller also designed by using repetitive control theory like as voltage controller. The formulation of the H^{∞} control problem is same as voltage controller as shown in figure 5 but with a different plant P_i and subscript u is replaced with i.

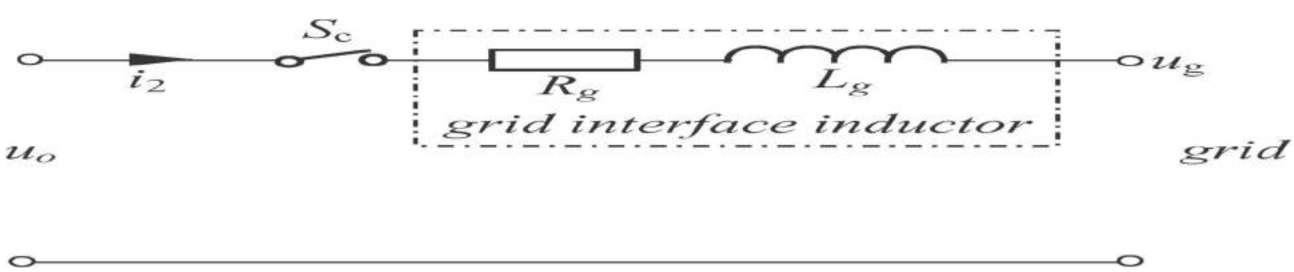

Fig.6. Control plant for outer current controller

A. State Space Model Of Plant P_i

Here it is assume that $U_o = U_{ref}$ then $U_o = U_g + U_i$ or $U_i = U_o - U_g$. Where U_i is the voltage drop across grid inductor. Here the same voltages will appear on both sides of grid inductor L_g, then the grid voltage can be ignored while designing the controller. It is very

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important feature of current controller. For the design process, the U_i is considered as output.

Here the grid current i_2 is taken as state variable and current reference I_{ref} is taken as external input $W_i = [I_{ref}]$ and U_i is taken as control input. The tracking error nothing but output signal from plant is taken as $e_i = I_{ref} - I_2$.Then the state equation of the plant P_i is

$$X_i^{\cdot} = A_i X_i + B_{i1} W_i + B_{i2} U_i$$

And the output equation can be written as $Y_i = e_i = C_{i1} X_i + D_{i1} W_i + D_{i2} U_i$

Where $A_i = \frac{-R_g}{L_g}$ $B_{i1} = 0$ $B_{i2} = \frac{1}{L_g}$ $C_{i1} = -1$ $D_{i1} = 1$ D_{i2}

Then the transfer function of the plant P_i is

$$P_i = \left(\begin{array}{c|cc} A_i & B_{i1} & B_{i2} \\ \hline C_{i1} & D_{i1} & D_{i2} \end{array}\right)$$

B. Standard H^∞ Problem Formulation

The formulation of H^∞ problem for the current controller is same as voltage controller. Then the generalized plant can be written as

$$P_i = \left(\begin{array}{cc|ccc} A_i & 0 & 0 & B_{i1} & B_{i2} \\ B_{wi} C_{i1} & A_{wi} & B_{wi} \xi i & B_{i1} D_{i1} & B_{wi} D_{i2} \\ \hline D_{wi} C_{i1} & C_{wi} & D_{wi} \xi i & D_{wi} D_{i1} & D_{wi} D_{i2} \\ 0 & 0 & 0 & 0 & \mu_i \\ C_{i1} & 0 & \xi i & D_{i1} & D_{i2} \end{array}\right) \quad (11)$$

The selection of weighting parameters ξi and μ_i and low pass filter $W_v = \begin{pmatrix} A_{wi} & B_{wi} \\ C_{wi} & D_{wi} \end{pmatrix}$ can be done same as voltage controller.

By using the $h_{in}f_{syn}$ function in MATLAB , the controlled C_i can be found from the generalized plant P_i using H^∞ control theory.

VI. DESIGN EXAMPLE

Let us take an example that designing a controller for a system consisting of Inverter Bridge, three phase LC filter, three phase grid interfacing inverter and a step up transformer. This inverter bridge consisting of two independent three phase inverters; one inverter is used to generate stable neutral line for three phase inverter. These three phase voltages were connected to the grid through the circuit breaker and transformer. Here three separate controllers can be used for the three phases. The control structure for the three phase system consists of PLL(phase locked loop) was used to provide the phase information needed to generate three phase current references from the I_d and I_q using dq-abc transformation.

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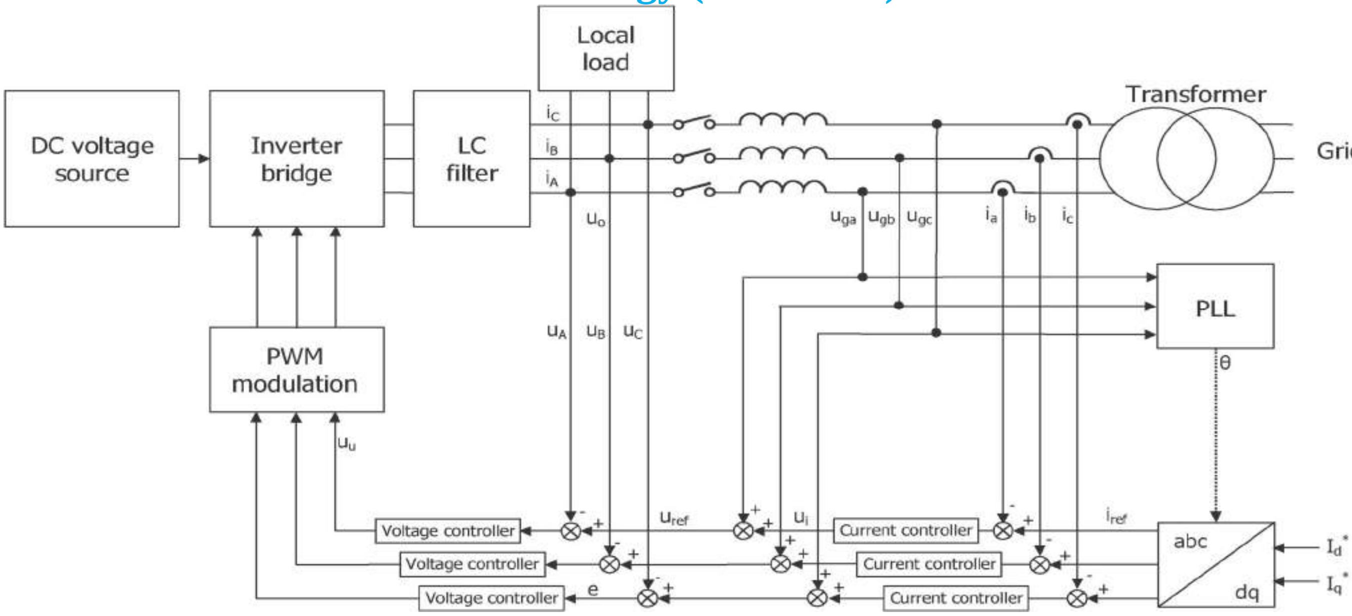


Fig.7.Block diagram for grid connected three phase inverter using the proposed strategy

The parameters of the inverter and grid are shown in table 1.In general the low voltage system has the more impact of noises and disturbances than high voltage system. Hence it is easily applied to inverters at high voltage and high power ratings.

TABLE 1: PARAMETERS OF THE INVERTER

Parameter	Value	Parameter	Value
L_f	150μH	R_f	0.045Ω
L_g	450μH	R_g	0.135Ω
C_f	22μF	R_d	1 Ω

A. Design of the H^∞ voltage controller

For the parameters shown in table ,the weighting function and the weighting parameters chosen for frequency f = 50Hz are

$W_v = \begin{pmatrix} -2555 & 2550 \\ 1 & 1 \end{pmatrix}$ and $\xi_v = 100$ and $\mu_v = 1.85$.Then the H^∞ voltage controller to minimize the H^∞ norm can be written as

$$C_v(s) = \frac{-748.649(S^2+6954S+3.026*10^8)}{(S+2550)(S^2+7969S+3.043*10^8)}$$

and it can be reduced to

$$C_v(s) = \frac{748.649}{S+2550}$$

The performance can not be degraded after cancellation of nearest poles and zeros.

B. Design of the H^∞ current controller

For the parameters shown in table ,the weighting function and the weighting parameters chosen for frequency f = 50Hz are

$W_v = \begin{pmatrix} -2555 & 2550 \\ 1 & 1 \end{pmatrix}$ and $\xi_v = 100$ and $\mu_v = 1.8$.Then the H^∞ current controller to minimize the H^∞ norm can be written as

$$C_i(s) = \frac{177980833.6502(S+300)}{(S+4.334*10^8)(S+2550)}$$

The performance can not change after changing the factor $(S+4.334*10^8)$ as $4.334*10^8$ and reduced controller is

$$\mathbf{C_i(s)} = \frac{748.649}{S+2550}$$

VII. SIMULATION RESULTS

The H-infinitive controller was implemented in different compensation modes and these results are compared with the results of conventional method to prove the reduction of harmonics.

1) *Responses in DG harmonic current rejection mode:* In this compensation mode the harmonic reference current I_{ref-h} is taken as zero i.e; I_{ref-h}= 0.The parameters used in the simulation are shown in Table.2.In this real and reactive powers are set at 600W and 200VAR respectively. The performances occurred in the harmonic current rejection mode is shown in figures 8,9,10,11 and 12.By observing these performances the harmonics occurred in the dg current and grid current using conventional controller are 1.54% and 31.59% respectively. These harmonics are reduced in the dg current and grid current to 0.01% and 1.62% respectively by using H-infinitive controller.

TABLE 2 :PARAMETERS OF THE SYSTEM

System parameter	Value
Grid voltage	230/50Hz
DG filter	L_f = 6.5mH,R_f = 0.15 Ω
Grid feeder	L_g = 3.4mH,R_g = 0.15 Ω
LC ladder with five identical LC filter	L = 1.0mH,C = 25μF for each LC filter
Switching frequency	10KHz
DC link voltage	550V
Real power control k_{p1},k_{I1}	k_{p1} = 0.00001,k_{I1} = 0.001
Reactive power control k_{p2},k_{I2}	k_{p2} = 0.00001,k_{I2} = 0.001
LPF time constant τ	0.0322Sec
Proportional gain K_p	48
Resonant gains K_{ih}	1500(h=f);900(h=3,5,7,9);600(h=11,13,15)
Resonant controller band width ω_c	4.1rad/s
R_v(for POC harmonic voltage compensation)	5 Ω

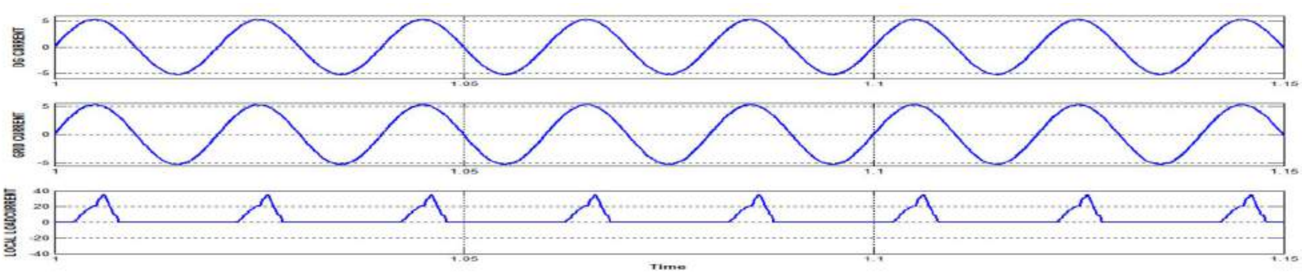


Fig 8: DG current, grid current and local load current of DG unit during DG harmonic rejection mode in the conventional control method

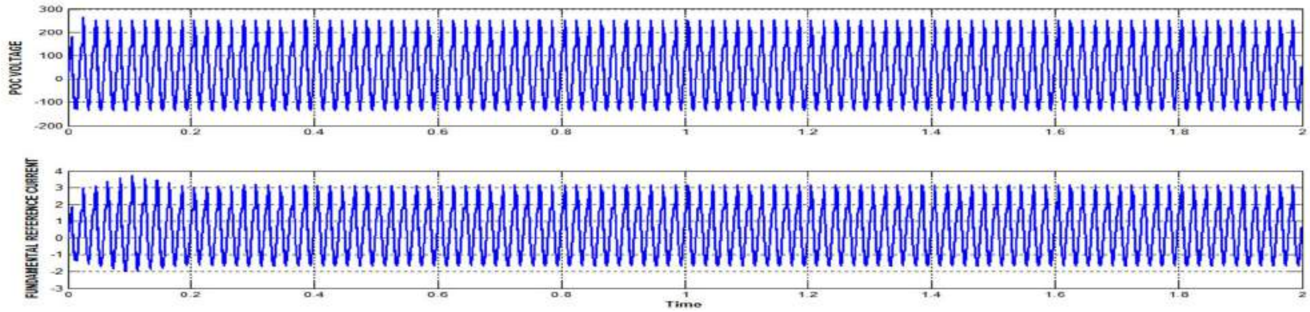


Fig 9: POC voltage and fundamental reference current of DG unit during DG harmonic rejection mode in the conventional control method.

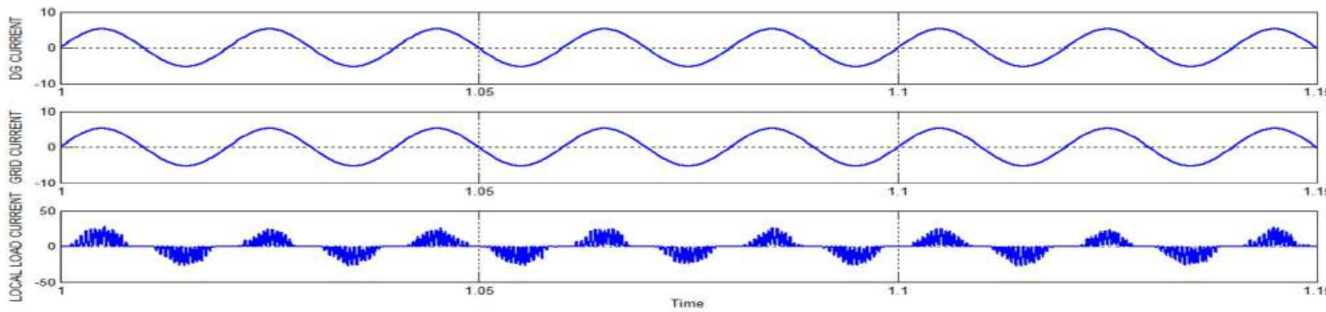


Fig10: DG current, grid current and local load current of DG unit during DG harmonic rejection mode using H-infinitive controller

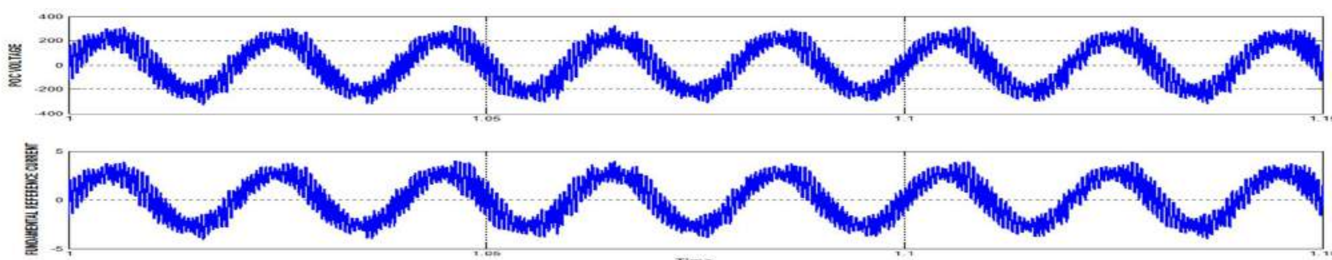
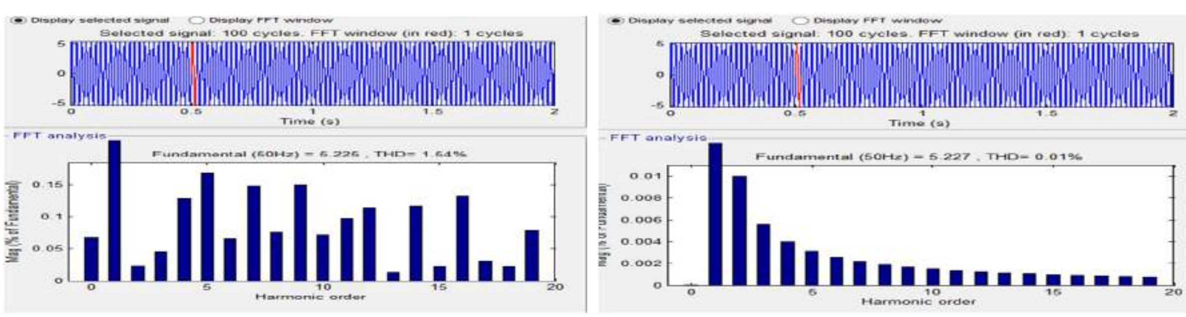


Fig 11: POC voltage and fundamental reference current of DG unit during DG harmonic rejection mode using H-infinitive controller.

Conventional controller H-infinitive controller



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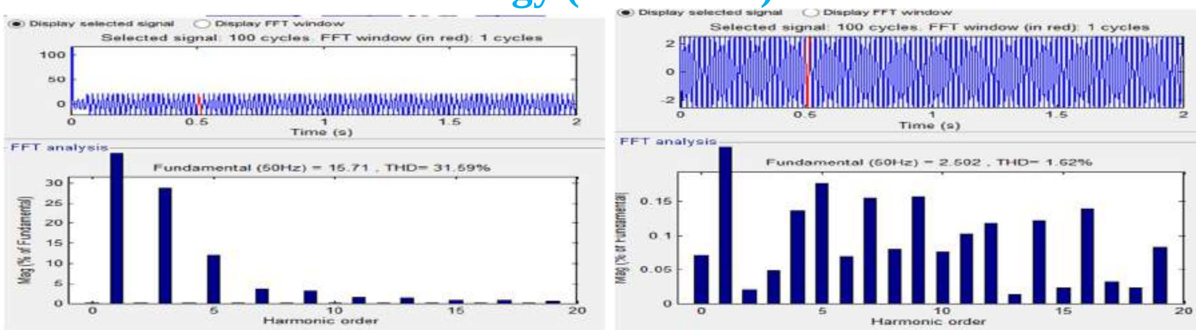

Fig 12:THD in the DG harmonic rejection mode(a)DG current (b)Grid current

2) *Responses in Local non-linear load compensation mode:* In this compensation mode, the harmonic reference current is taken as local load current i.e; $I_{ref\text{-}h} = I_{local.}$ The performances occurred in the local non-linear load compensation mode is shown in figures 13,14,15,16 and 17.By observing these performances the harmonics occurred in the dg current and grid current using conventional controller are 1.53% and 1.53% respectively. These harmonics are reduced in the dg current and grid current to 0.01% and 0.01% respectively by using H-infinitive controller.

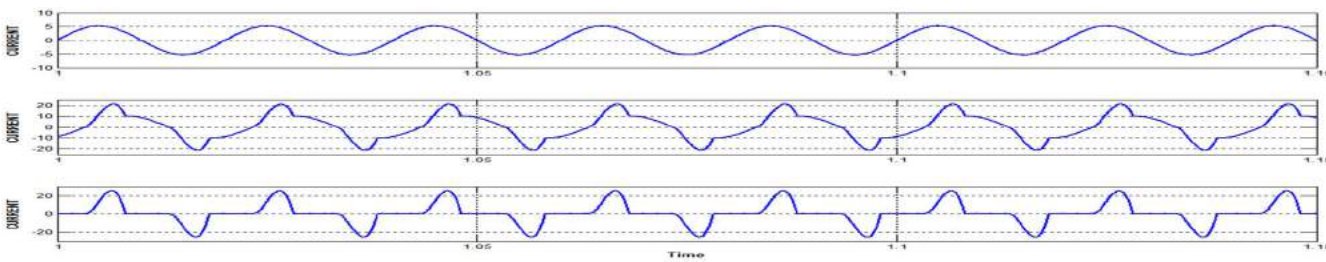

Fig 13: DG current, grid current and local load current of DG unit during local non-linear load compensation mode in the conventional control method.

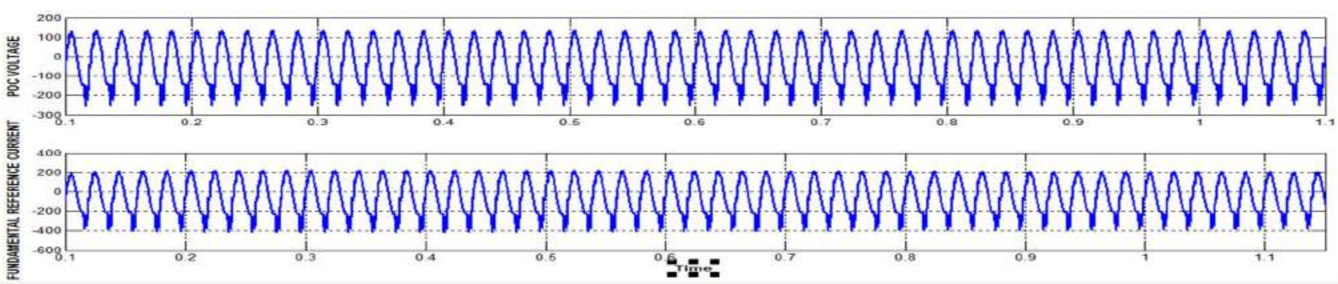

Fig 14: POC voltage and fundamental reference current of DG unit during local non-linear load compensation mode in the conventional control method.

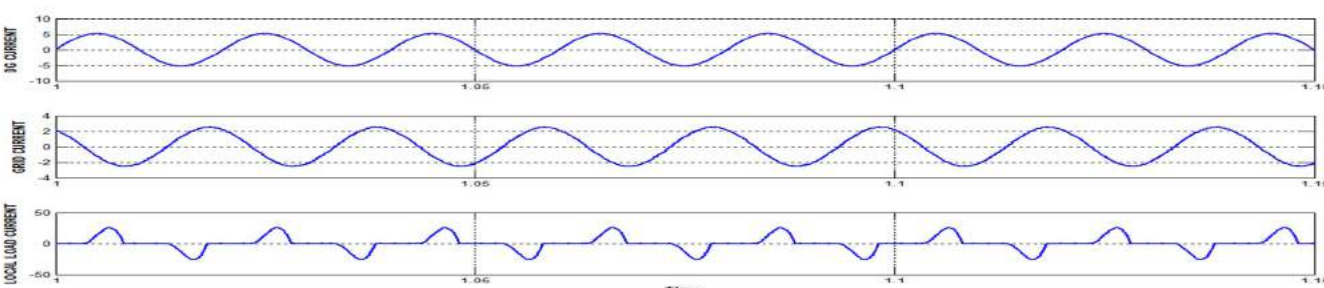

Fig 15: DG current, grid current and local load current of DG unit during local non-linear load compensation mode using H-infinitive controller.

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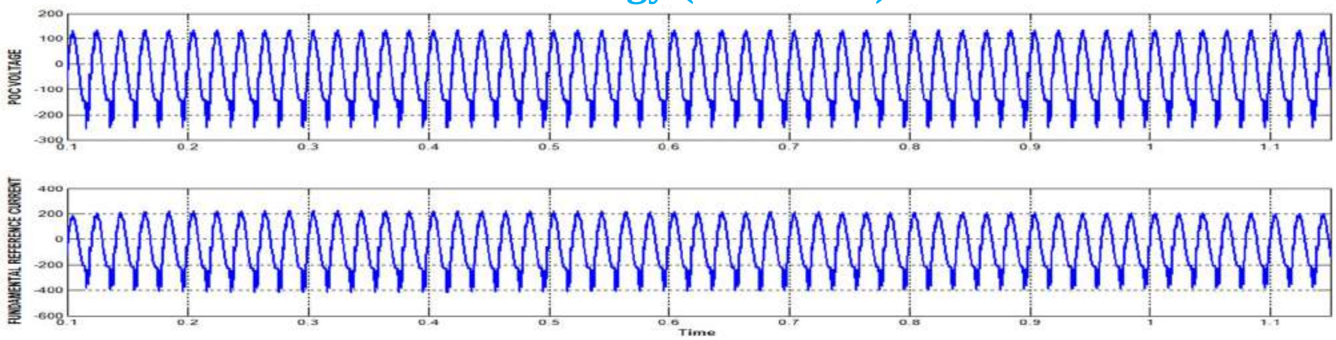

Fig16: POC voltage and fundamental reference current of DG unit during local non-linear load compensation mode using H-infinitive controller.

Conventional controller H-infinitive controller

(a)

(b)

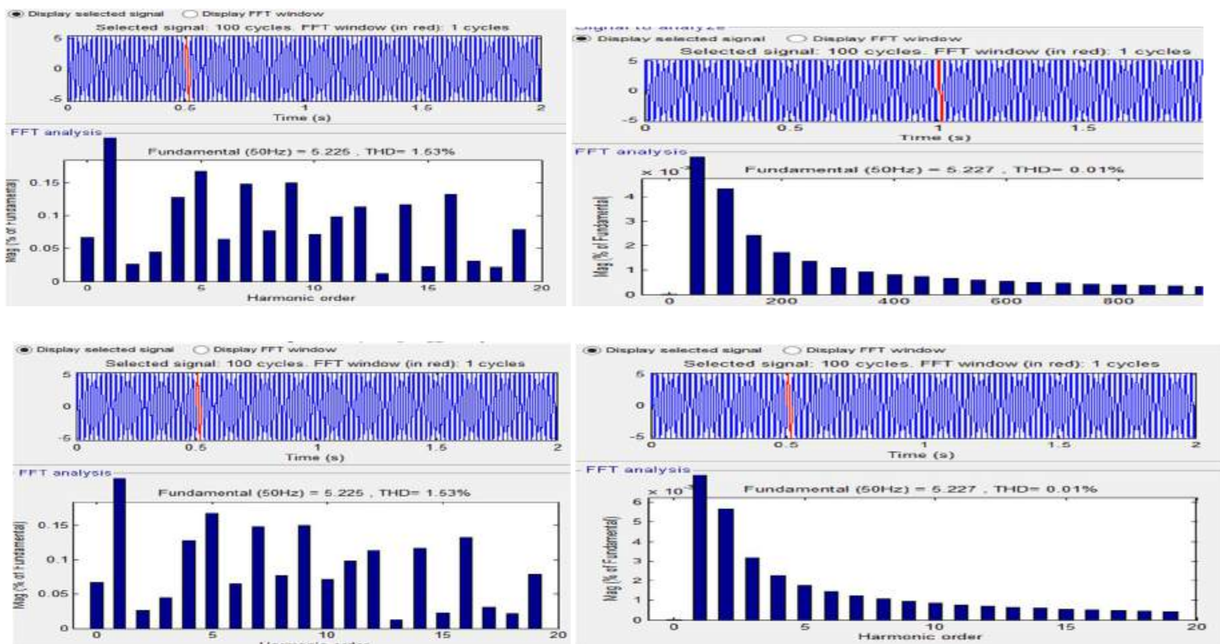

Fig 17:THD in the local non-linear load compensation mode (a)DG current (b)Grid current.

3) *Responses in Feeder resonance voltage compensation mode:* In this compensation mode, the harmonic reference current is taken as $I_{ref\text{-}h} = -V_{poc}/R_v$. The performances occurred in the feeder resonance voltage compensation mode is shown in figures 18,19,20,21 and 22. By observing these performances the harmonics occurred in the dg current and grid current using conventional controller are 1.64% and 9.15% respectively. These harmonics are reduced in the dg current and grid current to 0.41% and 8.98% respectively by using H-infinitive controller.

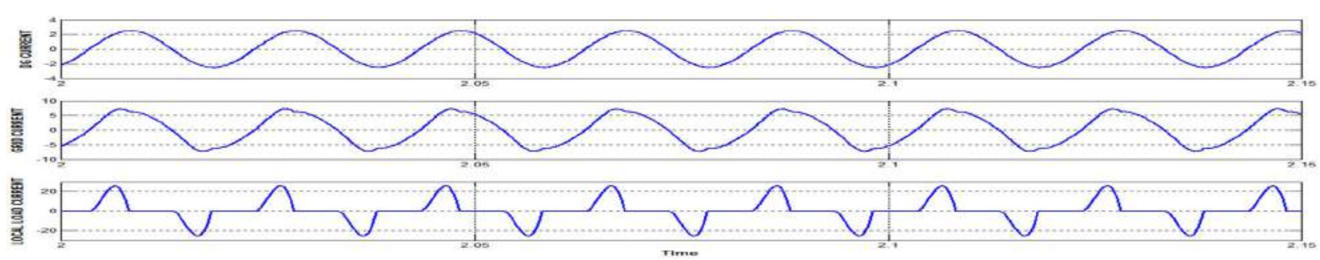

Fig 18: DG current, grid current and local load current of DG unit during feeder resonance voltage compensation mode in the

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conventional control method.

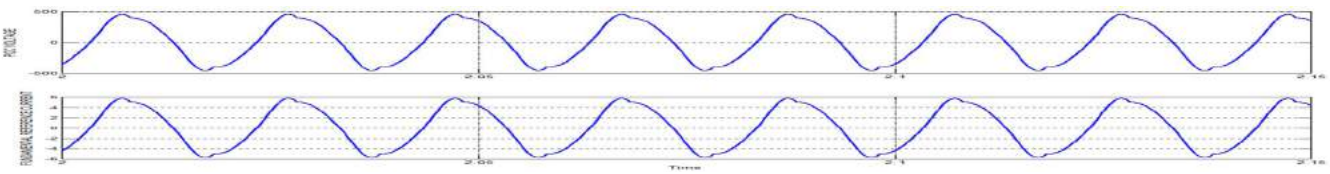

Fig 19: POC voltage and fundamental reference current of DG unit during feeder resonance voltage compensation mode in the conventional control method.

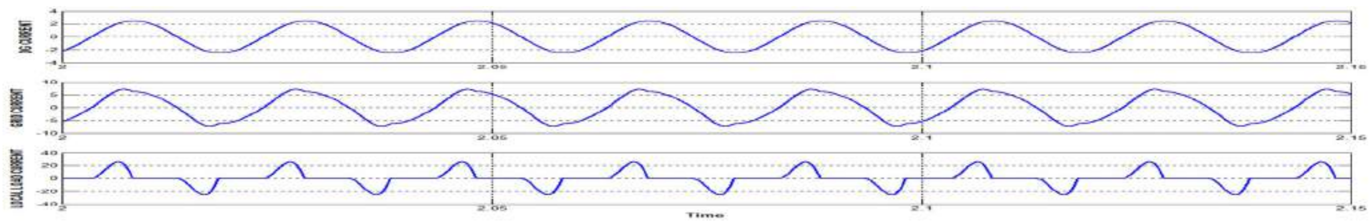

Fig 20: DG current, grid current and local load current of DG unit during feeder resonance voltage compensation mode using H-infinitive controller.

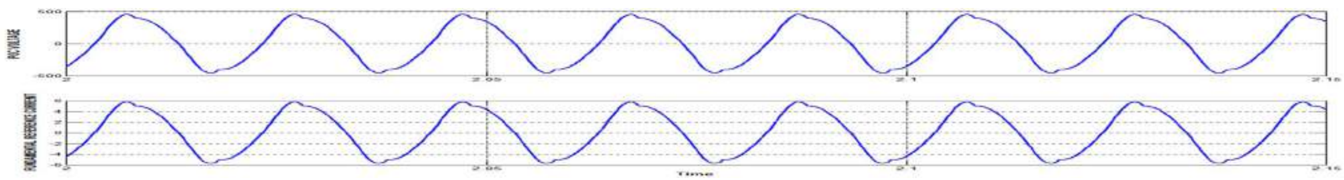

Fig 21: POC voltage and fundamental reference current of DG unit during feeder resonance voltage compensation mode using H-infinitive controller.

Conventional controller H-infinitive controller

(a)

(b)

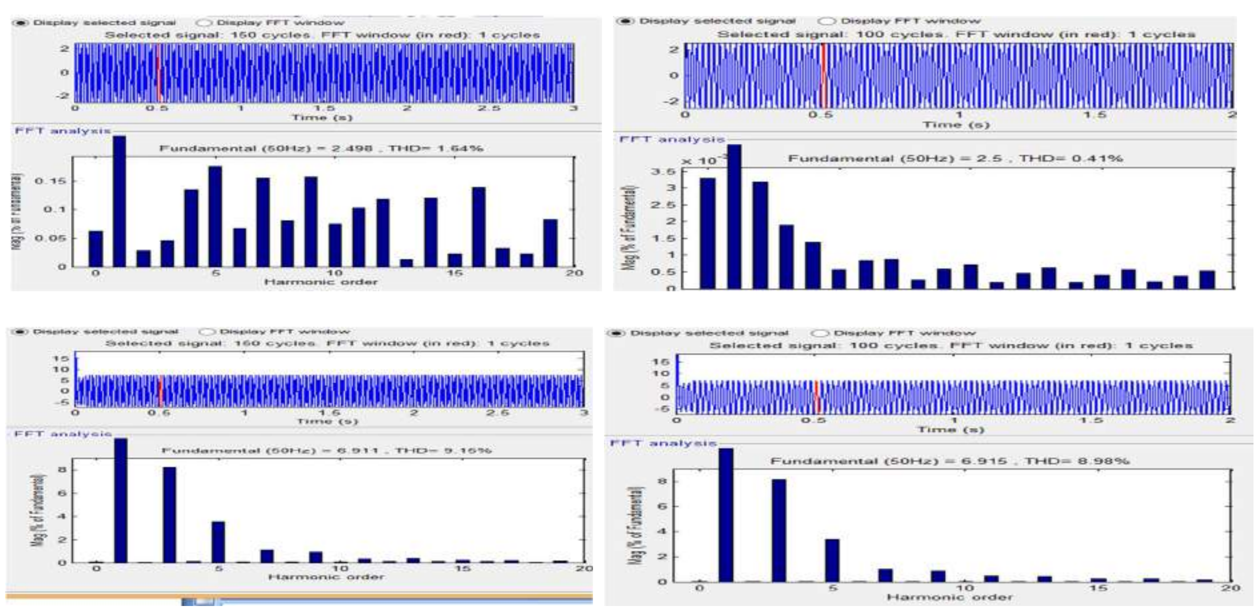

Fig 22:THD in the feeder resonance voltage compensation mode (a)DG current (b)Grid current.

VIII. CONCLUSION

In this paper, H-infinitive repetitive controller is used in the grid connected DG units. This proposed controller verifies the feasibility by comparing with the conventional method .The H-infinitive controller consists of inner voltage loop and outer current loop with its excellent performance in reducing THD of both inverter load voltage and grid current .This proposed controller guarantees the low THD value, high stability and it increases the tracking performance, is done by using the MATLAB/Simulink**.**

REFERENCES

[1] Jinwei He,Yun Wei Li, Frede Blaabjerg, and Xiongfei Wang," Active Harmonic Filtering Using Current-Controlled, Grid-Connected DG Units With Closed-Loop Power Control",IEEE TRANSACTIONS ON POWER ELECTRONICS, VOL. 29, NO. 2, FEBRUARY 2014

[2] Qing-Chang Zhong, and Tomas Hornik ," Cascaded Current–Voltage Control to Improve the Power Quality for a Grid-Connected Inverter With a Local Load" IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 60, NO. 4, APRIL 2013

[3] T. Hornik and Q.-C. Zhong, "H∞ repetitive voltage control of grid connected inverters with frequency adaptive mechanism," IET Proc. Power Electron., vol. 3, no. 6, pp. 925–935, Nov. 2010.

[4] R. I. Bojoi, L. R. Limongi, D. Roiu, and A. Tenconi, "Enhanced power quality control strategy for single-phase inverters in distributed generation systems," IEEE Trans. Power Electron., vol. 26, no. 3, pp. 798–806, Mar. 2011.

[5] George Weiss, Qing-Chang Zhong, Tim C. Green, and Jun Liang, "H^∞ Repetitive Control of DC-AC Converters in Micro grids " , IEEE TRANSACTIONS ON POWER ELECTRONICS, VOL. 19, NO. 1, JANUARY 2004.

[6] Tomas Hornik and Qing-Chang Zhong, "A Current-Control Strategy for Voltage-Source Inverters in Microgrids Based on H∞ and Repetitive Control", IEEE TRANSACTIONS ON POWER ELECTRONICS, VOL. 26, NO. 3, MARCH 2011.

[7] F.Blaabjerg, Z.Chen, and B.S.Kjaer, "Power electronics as efficient interface in dispersed power generation systems", IEEETrans.Power Electron., Vol.19, No.5, pp.1184-1194, Sep 2004.

[8] M.Supujitha Sukumar , R. Madhusudhan Rao," Power Quality Improvement in Microgrids By Repetitive Cascaded Current -Voltage Control With Load Using Hybrid Voltage Source", IJSRE Volume 2 Issue 11 November 2014 Page 2300.

[9] L.Asiminoaei,F.Blaabjerg,andS.Hansen,"Detectioniskey—Harmonic detection methods for active power filter applications," IEEE. Ind. Appl. Mag., vol. 13, no. 4, pp. 22–33, Jul./Aug. 2007.

[10] C. Lascu, L. Asiminoaei, I. Boldea, and F. Blaabjerg, "High performance current controller for selective harmonic compensation in active power filters," IEEE Trans. Power Electron, vol. 22, no. 5, pp. 1826–1835, May 2007.

[11] C.Lascu,L.Asiminoaei,I.Boldea,and F. Blaabjerg," Frequency response analysis of current controllers for selective harmonic compensation in Active power filters,"IEEETrans.PowerElectron,vol.56,no.2,pp.337– 347, Feb. 2009.

[12] T. Hornik and Q.-C. Zhong, "H∞ repetitive current controller for gridconnected inverters," in Proc. 35th IEEE IECON, 2009, pp. 554–559.

[13] Q.-C. Zhong, J. Liang, G. Weiss, C. Feng, and T. Green, "H∞ control of the neutral point in 4-wire 3-phase DC–AC converters," IEEE Trans. Ind. Electron., vol. 53, no. 5, pp. 1594–1602, Nov. 2006.

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