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Efficient Motor Drive Control Methodology Based On High-power PWM with DC-link Suppression Techniques

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ABSTRACT: The harmonics interaction occurrence may give rise to the system resonance at certain motor speeds. It degrades the grid-side power quality and generates excessive torque ripples on the motor side. In this work the input source is AC voltage with some noises, here rectifier is used to reduce the voltage and pass it to next precedence. The active filters are used to analyze the incoming volts and filter the noise frequencies attached to it. Regulator receives the incoming voltage and produces the regulated DC output, which is the source for controller to generate pulses of PWM and control the Motor Driver to efficiently operate. The top to bottom investigation demonstrates that the DC-Join virtual impedance-based technique effectively empowers the dynamic interharmonics pay ability of high-power PWM flow source drives, which is not tended to in past inquires about. Also, recreations and tests show that, by taking after the choice of coefficient in the concealment technique examined in this framework, the dc-join virtual impedance-based strategy can successfully improve the weakening impact of dc connection in high-power PWM current-source drive frameworks in order to smother the reverberation because of the sounds collaboration under all reverberation conditions. For all this entire system is to enhance the attenuation effect of dc link in high-power PWM current-source drive systems and to reduce the noise in the DC-link, which helps the motor drive to perform more efficiently in all situations.

KEYWORDS: Motor, Motor Drive, PWM, Suppression, Harmonics, Virtual Impedance

I. INTRODUCTION

For high-power PWM current-source engine drives, the converter exchanging recurrence is ordinarily restricted to a couple of hundred Hertz to lessen the exchanging misfortunes, and the dc gag is minimized to a sensibly low esteem (<0.8 p.u.) to decrease the size, weight, and cost. A case topology of PWM current-source engine drive frameworks is appeared in Fig. 1. In such a powerful drive framework, the particular consonant disposal (SHE) plan is normally received, as it can alleviate the low-request music created by the PWM converters with a low exchanging recurrence. All things considered, with a little dc gag, the dc-join current music (particularly the lower-request music) produced by the present source rectifier (CSR) and the present source inverter (CSI) can't be constricted adequately.

The misshaped dc-join current will present interharmonics in both the network side and the engine side through the converters. The presented air conditioning side interharmonics will assist produce extra music in dc join through the CSR and the CSI. Subsequently, the procedure of sounds cooperation between the CSR and the CSI through the dc connection might present interharmonics at different frequencies. Since a three-stage capacitor is required to help the substitution of exchanging gadgets in PWM current-source framework as appeared in Fig. 1, it frames a LC reverberation in both the lattice side and the engine side with matrix side line inductance and engine side spillage inductance, individually. At the point when the engine works at specific speeds, the frequencies of the acquainted interharmonics can turn out to be close with the air conditioner side LC resounding recurrence that offers ascend to framework reverberation.

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With respect to sounds collaboration wonder in high-power PWM current-source drive frameworks, gives a careful examination of its era instrument and excitation of framework reverberation. As per the past methodologies, when the music connection results in the framework reverberation, huge interharmonics will be presented in network side line current, dc-join current, and engine side stator current, which causes poor lattice power quality, additional framework misfortunes, and aggregate harm or even quick disappointment of mechanical framework.

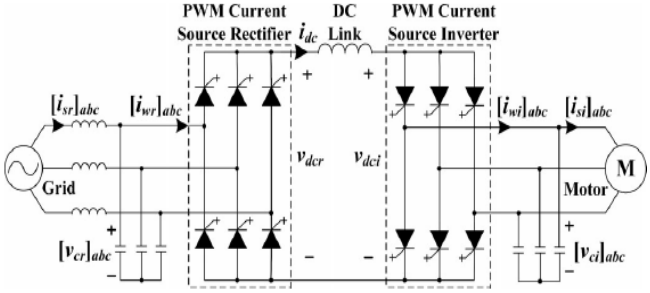

Fig.1. Typical Structure of PWM Current Source Drive

Right now, the for the most part utilized technique for framework reverberation concealment is through uninvolved damping, which includes extra expenses and misfortunes in framework and might irritate the size and weight of dc-connection stifle in high-influence current-source drives.

In this way, to keep away from the reverberation energized by the harmonics association, dynamic reverberation concealment is normal for the high-power PWM current-source drive frameworks. It requires the regularly utilized SHE plot as a part of high-power PWM drives to have the dynamic remuneration capacity of interharmonics. On the other hand, from one perspective, since the adjustment record of SHE plan is settled in a basic cycle, the proposed dynamic damping systems through directing the tweak list of Space-Vector-Modulation [SVM] based PWM converters can't be connected. Then again, the proposed routines with spotlight on the dynamic pay capacity of SHE adjusted converters, the particular harmonics pay PWM plan can understand the unfaltering state pay of the harmonics in the frameworks, yet can't alleviate the inter-harmonics came about because of the sounds communication.

To smother the reverberation brought about by the sounds cooperation in high-power PWM current-source drive frameworks, the essential thought of a dc-join virtual impedance-based dynamic concealment technique is exhibited. The dc-join virtual impedance, if planned and acknowledged legitimately, can repay the framework interharmonics through the SHE-adjusted PWM current-source converters, so that the reverberation energized by the harmonics connection is successfully smothered. As the viability of the virtual impedance profoundly subject to the outline and usage strategies, this framework extends the past study to completely explore the component of the dc-join virtual impedance-based strategy to understand the interharmonics remuneration ability of SHE modulated PWM current-source converters, and accomplish the dynamic concealment of reverberation brought about by the harmonics communication in high-power PWM current-source engine drive frameworks. In light of the examination, the choice guideline of the coefficient in the dc-join virtual impedance-based concealment technique is talked about as per diverse reverberation conditions. Broad re-enactments [experimental or simulative procedures] and trials are given in this framework to show that the determination of coefficient sureties compelling reverberation concealment under every motor speed.

A. DC-LINK VIRTUAL IMPEDANCE-BASED RESONANCE SUPPRESSION METHOD

As previously stated, to effectively stifle the reverberation created by the music association in high-power PWM current-source drives, a dc-join virtual impedance-based strategy has been proposed. In this part, the thought of virtual impedance is quickly checked on. As indicated by the underlying driver of sounds cooperation in high-power PWM momentum source drive frameworks is the feeble weakening impact of the little dc stifle on flow of harmonics [particularly bring down request harmonics]. In this manner, if the dc-join impedance could be expanded, the rectifier-side sounds and the inverter-side music will be decoupled so that the reverberation will be kept from being energized by the harmonic connection.

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Moreover, if the expansion of dc-connection impedance could be for all intents and purposes acknowledged through the criticism of dc-connection present as showed in Fig. 2, the extra costs/misfortunes and the irritation of size/weight included with the physical increment of impedance can be kept away from. In Fig. 2, vdcr ,vdci , and idc are the rectifier-side dc-join voltage, inverter-side dclink voltage, and dc-join present as appeared in Fig. 1, and Zdc is the genuine dc-join impedance. In light of the virtual dc-join impedance idea, the dc-join virtual impedance-based reverberation concealment technique can be delineated as the dash obstruct in a run of the mill speed control plan of PWM current-source drives appeared in Fig. 3. In such a pace control framework, the dc-join current is controlled through the CSR (by postponement edge α control) and the CSI is kept up with a most extreme balance record [to minimize the dc-join current in order to lessen losses]

The CSR is modulated with SHE scheme while the CSI adopts SHE at high motor speed and SVM at low motor speed. To realize the virtual dc-link impedance concept, the dc-link current harmonics are fed back to the rectifier-side firing angle θrec , through a compensation signal θcomp shown in Fig. 3. The resonant filter in the feedback channel is required to filter out the dc component and the high-frequency noise harmonics in idc so as not to affect the original speed control scheme. To viably apply this strategy, a top to bottom investigation on the instrument of dynamic remuneration taking into account the SHE-balanced PWM current-source converters and the acknowledgment of dc-connection virtual impedance to smother the reverberation in high-power PWM.

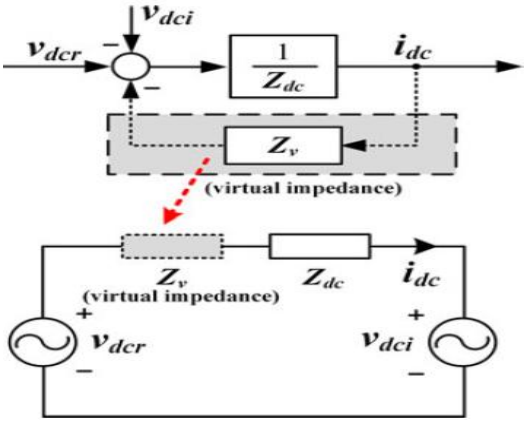

Fig.2. Virtual DC-Link Impedance

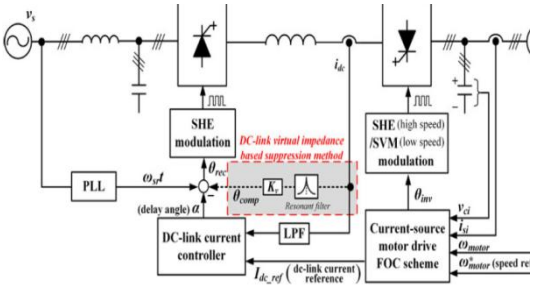

Fig.3. Suppression Method of DC-Link Impedance

B. ENABLED INTERHARMONICS COMPENSATION CAPABILITY OF SHE-MODULATED PWM CONVERTERS

According to past methodologies, to understand the dynamic reverberation concealment in view of the dc-join virtual impedance idea, the PWM converters should be prepared to do effectively repaying the dc-join current harmonic. As for the reverberation brought about by the harmonic connection, the frequencies of the presented dc-join current harmonics are regularly neither number numerous of matrix side essential recurrence nor engine side principal recurrence. Along these lines, the SHE-tweaked PWM converters in high-power PWM current-source drives are further required to have the interharmonics remuneration ability. Not-with-standing, the past investigates identified with the dynamic pay capacity of the SHE-adjusted PWM converters just concentrate on the pay of the harmonics with whole number various of air conditioning side crucial recurrence. In this area, the upside of the dc-join virtual impedance-based technique to empower the interharmonics pay capacity of SHE-regulated converters will be broke down in subtle element. It additionally gives the essentials to the investigation of dc-connection virtual impedance's acknowledgment talked about further.

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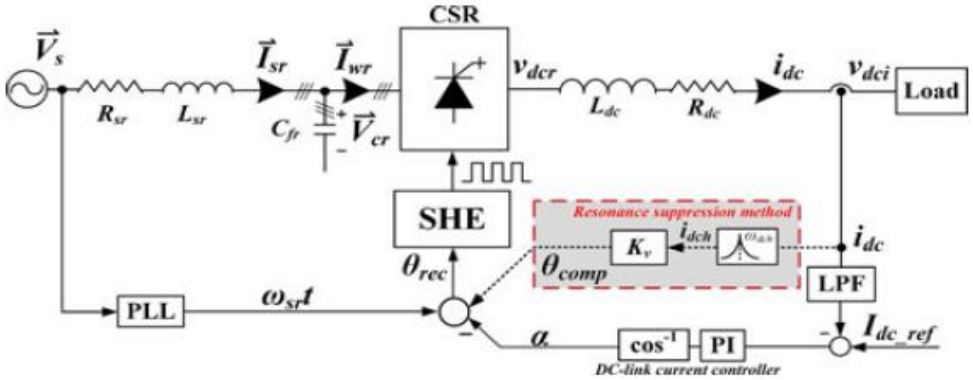

Fig.4. DC-Link in Current Control Loop in Speed Control Scheme Shown in Fig.3

C. RELATIONSHIP BETWEEN KV AND ZV UNDER DIFFERENT RESONANCE CONDITIONS

In estimation strategy for reverberation conditions in high-power PWM-current-source drives is proposed. It can precisely anticipate the engine side key recurrence [unfaltering state inverter working recurrence] at which the reverberation will be energized by the sounds collaboration, and the frequencies of the noteworthy dc-join current music brought about by the reverberation. In view of the data gave by the estimation method, the dc-join virtual impedance-construct strategy understands the lessening in light of comparing dc-join current harmonic in order to smother the reverberation created by the harmonics cooperation. The estimation strategy for framework reverberation conditions can be quickly represented and the flat hub speaks to the engine side major recurrence [characterized as ωsi], and the vertical hub is the recurrence of dc-connection harmonics. According to talked about the frequencies of the dc-join current sounds presented by the harmonic association are just identified with the PWM example of two converters and the motorside crucial frequencies. Since the SHE PWM example is logged off planned and altered amid online usage, the frequencies of the dc-join current harmonic (ωdch) are known under diverse engine side principal frequencies. The ωdch can be spoken to by the strong lines, and for the comfort of clarification, stand out of the lines is attracted, which speaks to one of the dc-join current harmonics. The four dash lines speak to the matrix side LC full recurrence [characterized as ωres G] in addition to/less the lattice side key recurrence [ωsr], and the engine side LC thunderous recurrence [characterized as ωres M] in addition to/less the engine side basic recurrence [ωsi]. They can be considered as the impression of air conditioning side thunderous recurrence to dc join through PWM process, and their cover can be ensured not to happen with the chose air conditioning side channel attributes.

II. RELATED WORK

In [1], "Investigation and suppression of harmonics interaction in high-power PWM current-source motor drives", the author Ye Zhang quoted on, for high-power PWM current-source drive frameworks, the mutilation of dc-connection current can't be overlooked because of the low converter exchanging recurrence and the relative little dc gag for decreased cost/weight. The twisted dc-join current may present interharmonics in the framework side and the engine side through the rectifier and the inverter, and might offer ascent to the framework reverberation at certain engine speeds. At the point when reverberation happens, huge interharmonics are presented in the drive framework, which will corrupt the lattice side force quality and produce the exorbitant torque swells on the engine side. In this paper, the music collaboration in a high-power PWM current-source drive framework is examined, and a technique for the framework reverberation estimation is proposed. Taking into account the estimation of reverberation conditions, a dc-join virtual impedance-based control system is created to relieve the reverberation came about because of the sounds collaboration. The examination of sounds collaboration, the proposed reverberation estimation strategy, and the dc-join virtual impedance-based concealment technique are confirmed through both reenactments and tests.

In [2], "DC-link current minimization for high-power current-source motor drives", the author Y. W. Li, M. Pande, N. R. Zargari, and B. Wu quoted on a misfortune diminishment and DC-join current minimization procedure for a powerful current-source inverter (CSI) encouraged drive is proposed. The proposed system comprises of an inverter most extreme tweak record control plan and a flux enhancement calculation. In particular, in the inverter balance file control, the CSI adjustment file is kept at the most extreme worth while the present source rectifier (CSR) is utilized to manage a lessened variable DC-join current, and in this way, to control the engine current size. This control plan can successfully decrease the DC-join current, and in the meantime, enhance the line-side and engine side waveforms. Then

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again, for the upgraded flux control, the relationship between the rotor flux and the DC-join current is initially explored completely. In light of this examination, the DC-join current from the most extreme inverter adjustment list control can be minimized further by advancing the rotor flux as indicated by framework variables, for example, the engine speed, the connected torque, and the engine side capacitor size. With the proposed dc current minimization methodology, the misfortunes in the semiconductor gadgets and the DC-connection can be decreased, and the drive current rating could be brought down. Both reproduction and test results on a 4.16-kV 600-hp CSI-bolstered drive framework are acquired to check the adequacy of the proposed methodology.

In [3], "Active damping control of a high-power PWM current source rectifier for line-current THD reduction" the author J.C.Wiseman and B.Wu quoted on, the utilization of dynamic damping to diminish the aggregate consonant mutilation (THD) of the line current for medium-voltage (2.3-7.2 kV) high-power pulsewidth-adjustment (PWM) current-source rectifiers is researched. The rectifier requires a LC channel associated at its data terminals, which constitutes a LC thunderous mode. The gently damped LC channel is inclined to arrangement and parallel resonances when tuned to a framework consonant either from the utility or from the PWM rectifier. These issues are generally tended to at the outline stage by legitimately picking the channel full recurrence. This methodology might bring about a restricted execution since the LC resounding recurrence is a component of the force framework impedance, which as a rule differs with force framework working conditions. In this paper, a dynamic damping control strategy is proposed for the diminishment in line current THD of high-power current-source rectifiers working at an exchanging recurrence of just 540 Hz. Two sorts of LC resonances are researched: the parallel reverberation energized by symphonious streams drawn by the rectifier and the arrangement reverberation brought on by consonant contamination in the source voltage. It is shown through reenactment and tests that the proposed dynamic damping control can adequately diminish the line-current THD created by both parallel and arrangement resonances.

In [4], "An active damping method using inductor-current feedback control for high-power PWM currentsource rectifier", the author F. Liu, B. Wu, N. R. Zargari, and M. Pande quoted on, Due to the inductor-capacitor filter, a pulse width modulation current-source rectifier (CSR) may experience LC resonance. A smaller ratio between the switching frequency and the resonant frequency of the CSR presents a challenge in designing active resonance damping methods in high-power applications. In this paper, different feedback states of filter inductor current and capacitor voltage are investigated to damp out the LC resonances. Besides proportional capacitor-voltage feedback (CVF), the derivative inductor-current feedback (ICF) provides an alternative approach for active damping and is comprehensively analyzed. Compared with the virtual-resistance (VR)-based active damping strategy, controller design is simpler in this method. Furthermore, the active damping method is able to damp the resonance under short-circuited dc-link conditions. The ICF-based active damping strategy works well for CSRs with low switching frequencies. Simulation and experimental results verify the feasibility and validity of the method.

III. SYSTEM ANALYSIS

A. Existing Work

In the past methodology, the DC link virtual impedance based method doesn't enables the active inter-harmonics compensation capability of high-power PWM current-source drives. For that the resonance value is going higher on the input voltages, which automatically leads the quality low and degrades the grid-side power quality and generates excessive torque ripples on the motor side. Producing inter-harmonics in the entire system, which causes the output DC voltages fluctuated as well as the motor will affected badly.

Demerits of Existing System

- In past approaches significant inter-harmonics is introduced in grid side line current, dc-link current, and motor-side stator current.
- It causes poor grid power quality, extra system losses, and cumulative damage or even immediate failure of mechanical system.
- Cost expensive approaches are required to avoid system resonance.
- Motor will affected badly, if power variation occurs.

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B. PROPOSED SYSTEM

In the proposed approach, the DC link virtual impedance based method enables the active inter-harmonics compensation capability of high-power PWM current-source drives. So that the resonance value is suppressed, which automatically leads the quality high and upgrades the grid-side power quality and reduces the unwanted ripples. Selective Harmonic Elimination (SHE) method is used here to eliminated the unnecessary harmonic occurrences, which leads the circuit lifetime so good.

Merits of Proposed System

- Cost efficient methodology
- Motor driver fully controlled based on the PWM and SHE methods, it automatically leads the good lifetime to motors.
- Load variations and Harmonic suppressions are eliminated.
- Comparatively best in performance.

IV. BLOCK DIAGRAM

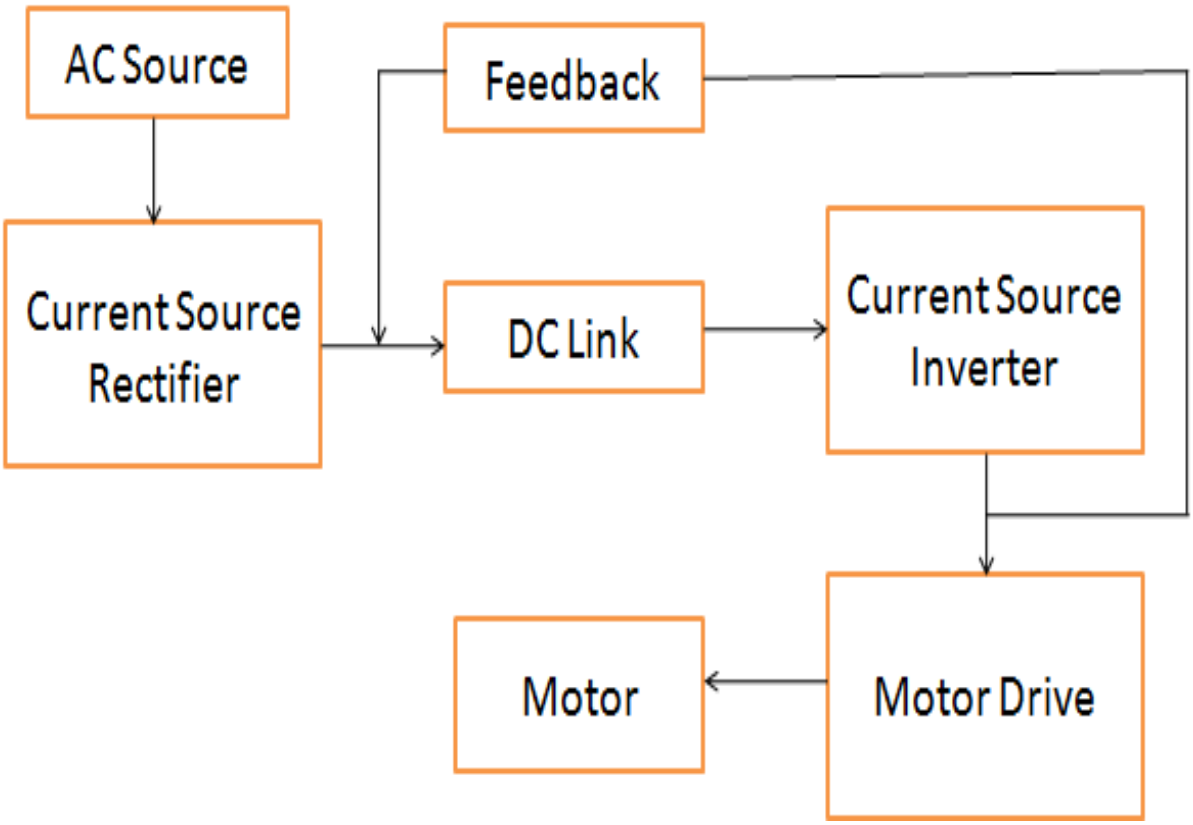

Fig.5. Block Diagram

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V. CIRCUIT DIAGRAM

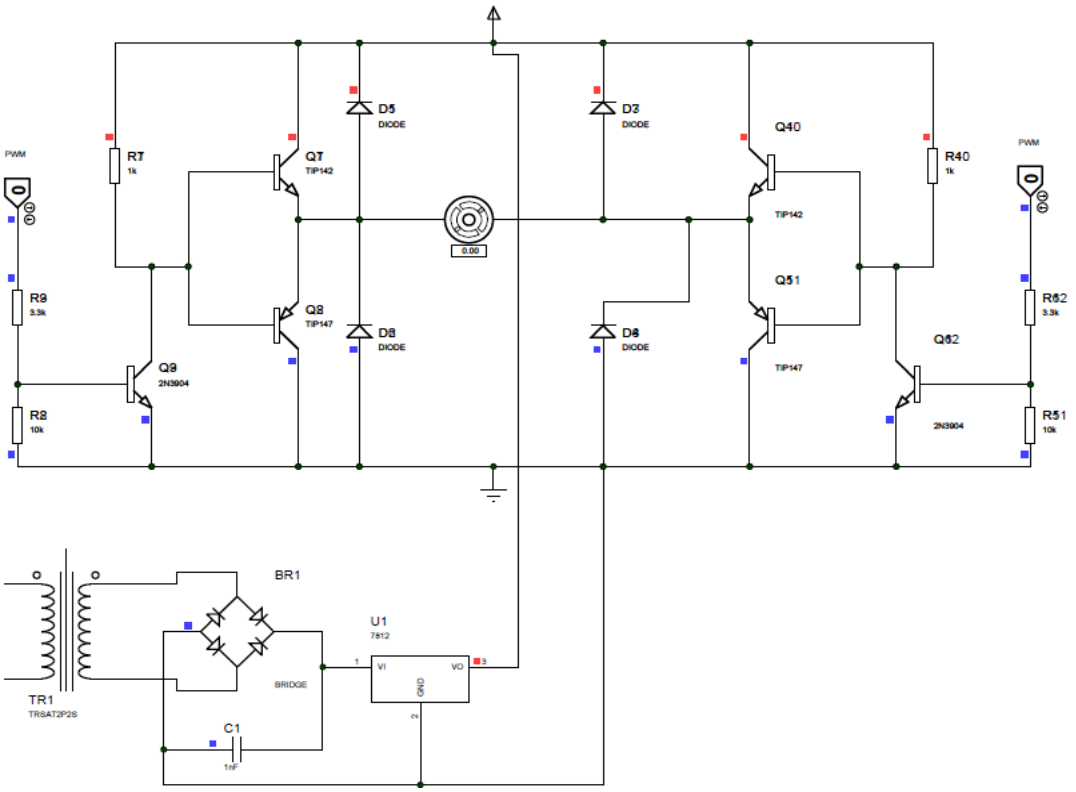

Fig.6. Circuit Diagram

VI. EXPERIMENTAL RESULTS

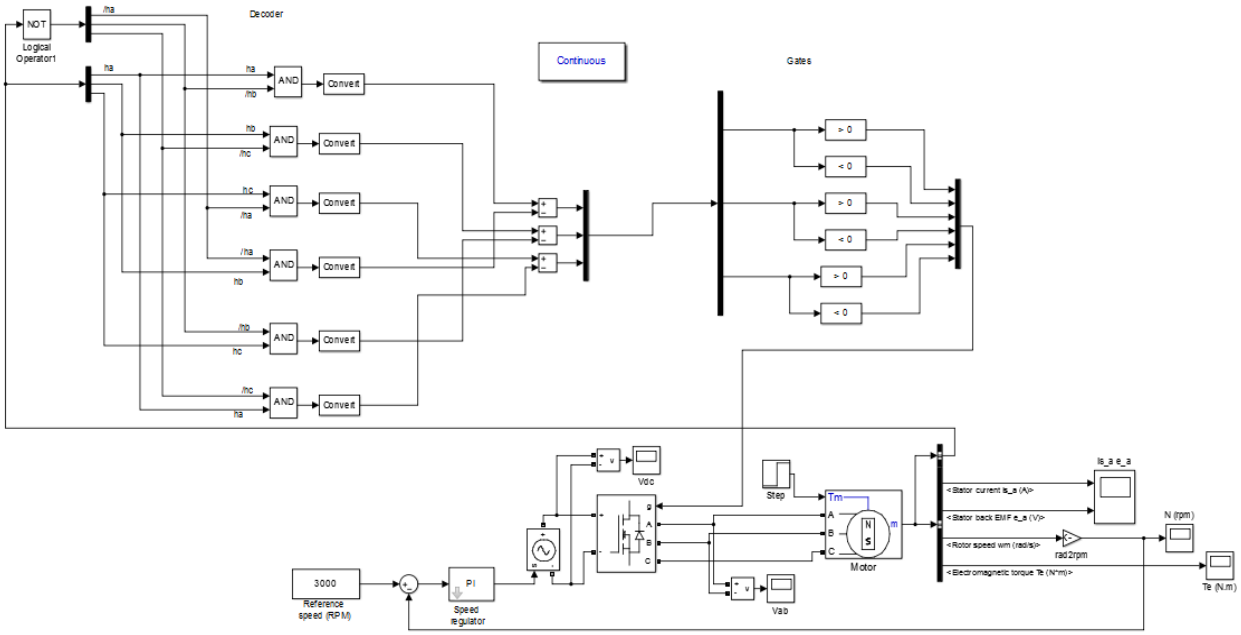

Fig.7. Overall Design

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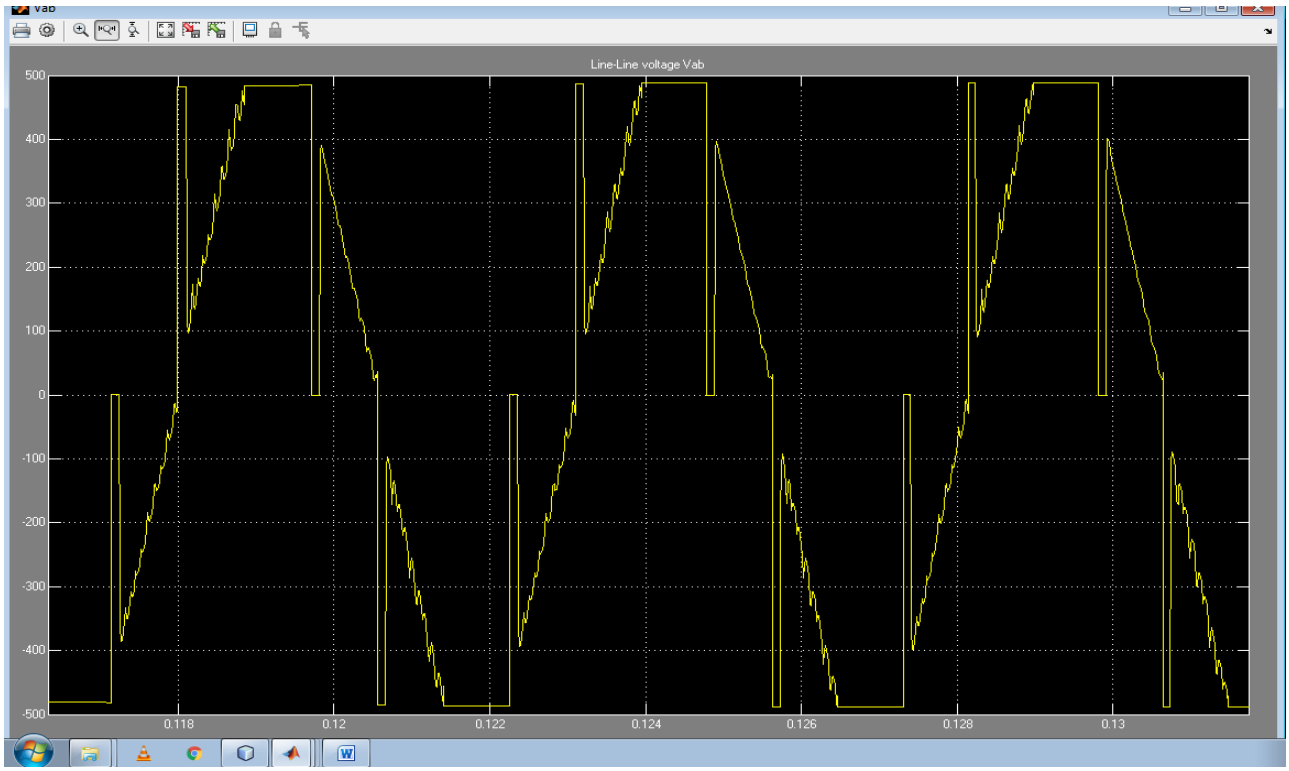

Fig.8. Line Voltage

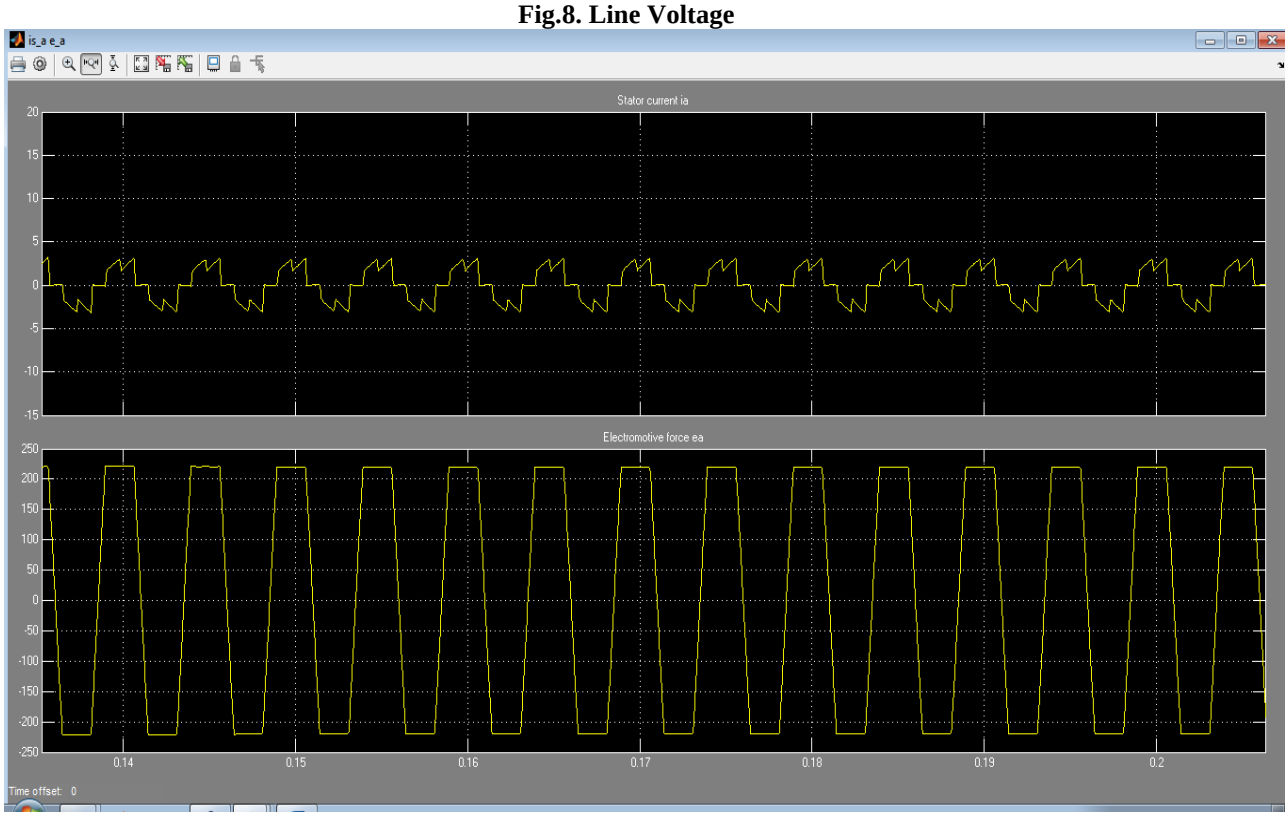

Fig.9.Stator Current and EMF

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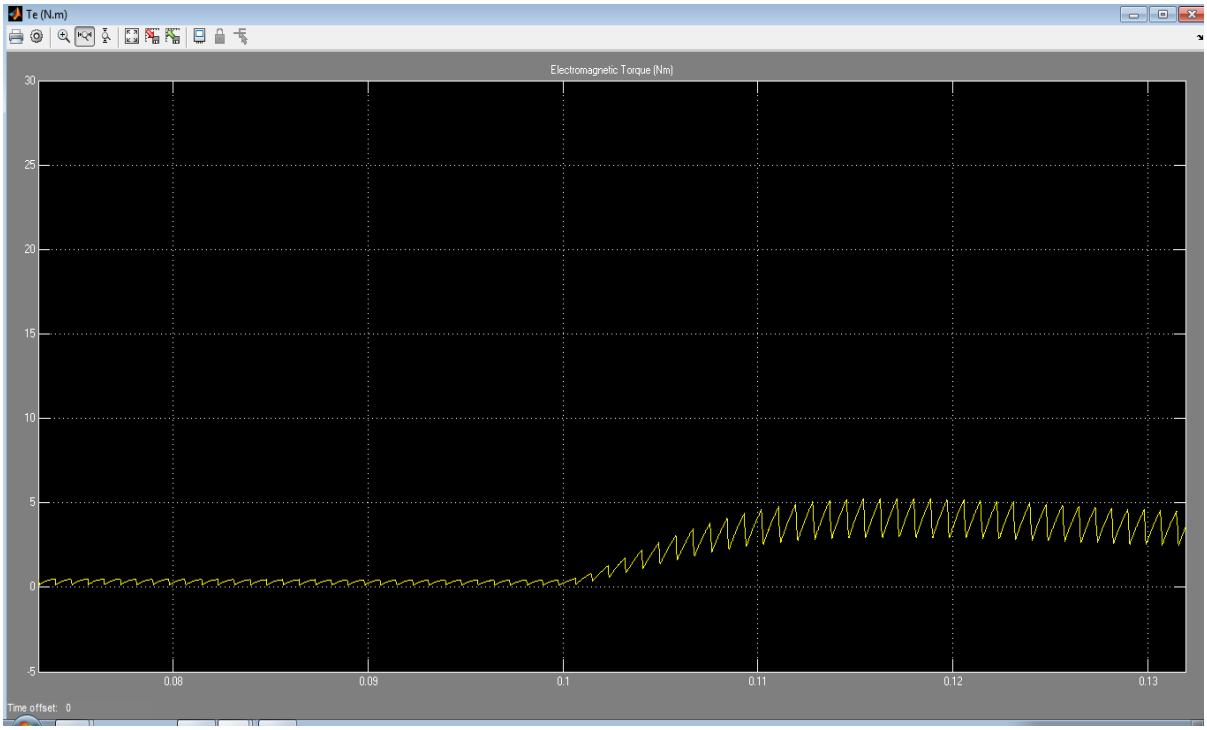

Fig.10. Electromagnetic Torque

VII. CONCLUSION

In this approach, an in-depth study of the dc-link virtual impedance-based resonance suppression method is presented. The mechanism of the interharmonics compensation capability of SHE-modulated PWM current-source converters enabled by the dc-link virtual impedance-based method is thoroughly investigated. Based on the investigation, more detailed analysis is provided on the realization of the dc-link virtual impedance. In addition, in order to enhance the attenuation effect of dc link on the harmonics interaction, the selection of coefficient in the suppression method is also discussed according to different resonance conditions in high-power PWM current-source drive systems. Simulation and experimental results demonstrate that, with the coefficient selected by following the analysis in this system, the dc-link virtual impedance-based method can effectively increase the attenuation effect of dc link on current harmonics so that reduces the harmonics interaction in PWM current-source drives through the dc link, and therefore, suppress the resonance resulted from the harmonics interaction.

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