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Fuzzy Based Sensor Less Parameter Estimation And Current Sharing Strategy In Two-Phase And Multiphase IPOP DAB DC-DC Converters

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ABSTRACT: A sensorless current-sharing strategy for two-phase and multiphase input-parallel output-parallel (IPOP) DC-DC converters is proposed here. A dual-active-bridge (DAB) DC-DC converter is chosen as the basic DC-DC converter. With this strategy in two-phase IPOP DAB DC-DC converters, the parameter mismatches between phases are estimated by perturbing the duty cycle in one phase and measuring the changes of duty cycles in both phases, then the duty cycles are adjusted to compensate the mismatches, thus achieving current sharing without current sensor. With this strategy in multiphase IPOP DAB DC-DC converters, by perturbing the duty cycles in (N - 1) out of N phases in turn and measuring the changes of duty cycles, respectively, the parameter mismatches among phases are estimated. According to the mismatches, a set of variables, which are proportional to the per-phase output currents, are calculated. Then with a current-sharing regulator, parameter mismatches are compensated, thus achieving current sharing without current sensor. The validity and feasibility of the proposed fuzzy based sensorless current-sharing strategy are verified through simulation results.

I. INTRODUCTION

Multiphase DC–DC converters, due to the advantages of relatively high power rating what's more, control thickness, just as diminished current swell with multiphase interleaving control, are getting an ever increasing number of utilizations. For a multiphase DC–DC converter, it is commonly alluring that each stage shares the heap current similarly, with the goal that the segments have equivalent warm burdens which limit part appraisals. Something else, current irregularity may prompt crumbling of framework unwavering quality and even inference of framework soundness. In a perfect world, parameters of stages are intended to be indistinguishable; in this manner, the heap current is consequently shared. Under genuine condition, be that as it may, part parameter mistakes, segment resistances, and some different impacts definitely bring about parameter crisscrosses among stages, so additional current-sharing control is required to remunerate these bungles. Numerous current-sharing control methodologies have been proposed and broke down to keep up fitting current or power dissemination among the converters working in parallel. These methodologies can be commonly grouped into two fundamental classifications, for example hang control and dynamic current-sharing methodology. Hang control approach, by controlling the limited identical yield obstruction of each stage, manages its yield trademark to acknowledge current sharing among stages. Dynamic current-sharing methodology, ordinarily including expert slave plan and equitable plan, for the most part utilizes current sensors to test yield current of each stage, at that point contrasts per-stage yield current sign and current-sharing transport signal, creating current mistake signals which are put into current-sharing controller to repay contrasts of yield flows.

A programmed current-sharing system is depicted in. In this paper, by diminishing parameter crisscrosses among stages somewhat, rough current imparting to worthy current contrasts among stages is accomplished utilizing normal obligation cycle control methodology.

This strategy must be utilized where parameter bungles of stages are 10%. With ongoing advancement of computerized control framework, some novel sensor less current-sharing procedures are proposed. These systems needn't bother with any present sensor or extra circuit, and simply require estimation of the yield voltage. These techniques use strategies dependent on annoyance of obligation cycle to assess the parameter bungles and change the obligation cycles to remunerate the jumbles, in this way acknowledging current sharing. Be that as it may, every one of these techniques are grown distinctly for multiphase buck DC–DC converters. As of late, the double dynamic scaffold (DAB) DC–DC converter , because of the upsides of bidirectional power stream, galvanic detachment, high effectiveness, and delicate exchanging, turns out to be increasingly more alluring in electric vehicle applications , vitality stockpiling framework, and micro grid applications. Besides, multiphase DAB DC–DC converters, for example, IPOP DAB , input-arrangement yield parallel (ISOP) DAB , and even three phase DAB , are required in high-control applications. For IPOP DAB DC–DC converters, so as to repay parameter bungles between/among stages, a novel sensor less parameter estimation and current-sharing procedure is proposed in this paper. As appeared in Fig.1, multiphase IPOP DAB DC–DC converters comprise of N periods of DAB DC–DC converters, input paralleled, and yield paralleled. The topology of a DAB DC–DC converter and its working chief are first broke down in detail in Section 2. In Section 3, the sensor less current-sharing procedure guideline for two-stage IPOP DAB DC–DC converters is introduced, and the technique to evaluate parameter confuses between two stages is portrayed in detail. In Section 4, the sensor less current-sharing procedure for multiphase (no not as much as stage 3) IPOP DAB DC–DC converters, including parameter estimation, current estimation, and sharing.

1.2 LITERATURE SURVEY

This project explores the origin of the DC current-sharing problem of parallel-converter systems and the dual problem of voltage partaking in arrangement converter frameworks. The two issues might be considered by inspecting the yield plane (yield current versus yield voltage) of a specific converter. It is demonstrated that severe current source conduct is superfluous for good current partaking in parallel-converter frameworks.

Besides, a wide class of converters whose yield voltage is load-subordinate, i.e., those that have a moderate estimation of yield opposition, all show great voltage-and current-sharing attributes. Such converters are frequently reasonable for a/spl times/b varieties of converters that can meet a huge scope of intensity transformation prerequisites. The yield planes of broken mode PWM converters just as customary and cinched arrangement resounding converters are analyzed in detail. A straightforward little sign model of the secluded converter framework is created. Test affirmation of burden sharing and the little sign model is given for the braced arrangement resounding converter and the arrangement full converter for different setups of four converters.

II. DC-DC CONVERTERS

A DC-DC converter with a high step-up voltage, which can be utilized in different applications like car headlights, power module vitality change frameworks, sun oriented cell vitality transformation frameworks and battery reinforcement frameworks for uninterruptable power supplies.Theoritically, a dc-dc help converter can accomplish a high advance up voltage with a high successful obligation ratio.But,in useful, the progression up voltage increase is limited by the impact of intensity switches and the proportionate arrangement resistance(ESR) of inductors and capacitors.

For the most part a customary lift converter is utilized to get a high-advance up voltage gain with a huge obligation proportion. In any case, the proficiency and the voltage increase are confined because of the misfortunes of influence switches and diodes, the identical arrangement obstruction of inductors and capacitors and the invert recuperation issue of diodes. Because of the spillage inductance of the transformer, high voltage stress and power dispersal affected by the dynamic switch of these converters. To decrease the Voltage spike, a resistor-capacitor – diode censured can be utilized to constrain the voltage weight on the dynamic switch

BUCK-BOOST CONVERTERS

A basic buck-boost converter is shown in Fig. The average input current of this converter can be found according to its input current waveform.

The equation gives the average current at the time interval (t)

$$I_{1,\,avg}(t) = D^3 T_s / 3L\, V_1(t)$$

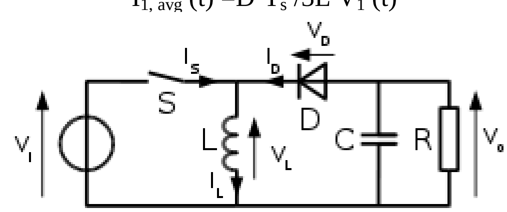

Fig: 1. Buck –Booster Converter

III. FUZZY

In recent years, the number and variety of applications of fuzzy logic have increased significantly. The applications range from

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consumer products such as cameras, camcorders, washing machines, and microwave ovens to industrial process control, medical instrumentation, decision support systems, and portfolio selection. To understand why use of fuzzy logic has grown, you must first understand what is meant by fuzzy logic.

Fuzzy logic has two different meanings. In a narrow sense, fuzzy logic is a logical system, which is an extension of multivalve logic. However, in a wider sense fuzzy logic (FL) is almost synonymous with the theory of fuzzy sets, a theory which relates to classes of objects with un sharp boundaries in which membership is a matter of degree. In this perspective, fuzzy logic in its narrow sense is a branch of FL. Even in its more narrow definition, fuzzy logic differs both in concept and substance from traditional multivalve logical systems.

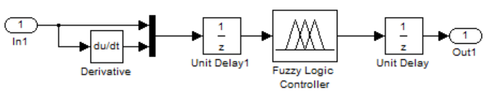

Fig.2 Fuzzy interference system

IV. PI controller

The general block diagram of the PI speed controller is shown in Figure 5.1

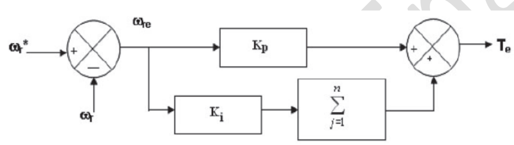

Fig.3. Block Diagram of PI Speed Controller

The output of the speed controller (torque command) at *n*-th instant is expressed as follows:
$Te(n)=Te(n-1)+Kp\_\omega re(n)+Ki\omega re(n)$ (10)
Where Te (n) is the torque output of the controller at the *n*-th instant, and *Kp* and K*i*.
The proportional and integral gain constants, respectively.A limit of the torque command is imposed as

The gains of PI controller shown in can be selected by many methods such as trial and error method, Ziegler–Nichols method and evolutionary techniques-based searching. The numerical values of these controller gains depend on the ratings of the motor.

V. PROJECT DISCRIPTION AND CONTROL DESIGN

A Novel DABDC–DC converter A DAB DC–DC converter, as appeared in Fig. 6.1 is a bidirectional DC–DC converter which comprises of two H-spans, associated through a high-recurrence transformer. As inquired about in , DAB DC–DC converter has the benefits of moving force in the two bearings, higher power thickness with its moderately little size, and less power misfortune because of its capacity of zero-voltage-exchanging. The principle waveforms of working DAB DC/DC converter are appeared in Fig 4.2b. For straightforwardness, the single-stage move (SPS) technique is utilized to control the converter in this paper. Assume that the power moves from the left H-extension to the privilege as of now, in the left H-connect, the exchanging sign of P1 and P4 are indistinguishable, around with obligation cycles of half, and the exchanging sign of P2 and P3 are indistinguishable, corresponding to that of P1 and P4 . Likewise in the correct H-connect, yet with the exchanging sign of S1 and S4 slacking that of P1 and P4 , a stage moving point φ. Characterize proportion of the stage moving point φ to half exchanging period edge as the obligation cycle of a DAB DC/DC converter, which can be communicated as d = φ π (1) where φ ∈ 0, π , d ∈ 0, 1 . With all these control flag, the transformer's essential voltage vp , which is a rectangular wave with its sizes of ±Vin, just as optional voltage versus , a rectangular wave with its sizes of ±Vo , are produced as showed in Fig 4.2b. By controlling the stage moving edge φ, the voltage vL of the spillage inductor of the transformer, just as the spillage inductor current iL and the dynamic power moved through the DAB converter, are controlled. As indicated by , the dynamic power moved through DAB under SPS control is composed as
P = nVinVod 1 − d 2L fs (2)
where n is the transformer proportion, and n = n1 :n2 , Vin the information voltage, Vo the yield voltage, L the spillage inductance, and fs the exchanging recurrence.
In this manner, the yield normal current of DAB is
Io = P Vo = nVind 1 − d 2L fs (3)
Obviously, the bends of P and Io regarding d are symmetrical about d = 0.5. Along these lines, it is satisfactory to assume d ∈ 0, 0.5 so as to streamline the control. Likewise, inside this changing scope of d, the larger d is, the larger P and Io are.

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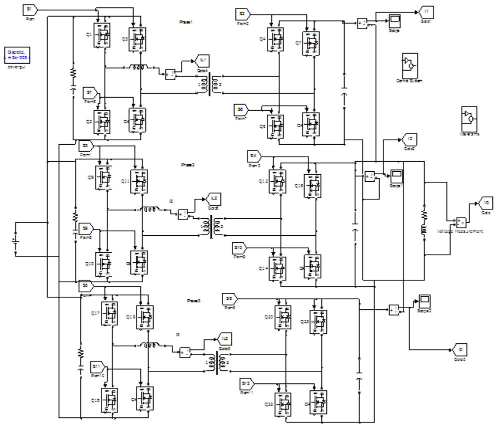
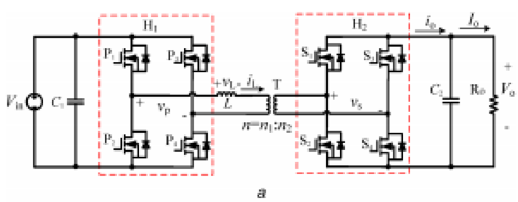


Fig4 : Topology of multiphase IPOP DAB DC–DC converter



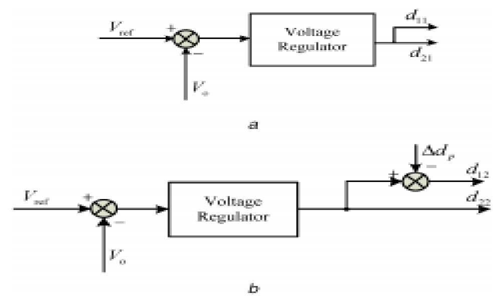


Fig5: Control diagram of the first two stages in two-phase IPOP DAB DC–DC converters (a) Common duty cycle control arrange, (b) Common obligation cycle with bother organize

Current-sharing principle

According into two-phase IPOP DAB DC–DC converters, the output current Io1 and Io2 in two stages are Io1 = n1Vind1 1 − d1 2L1 fs (4) Io2 = n2Vind2 1 − d2 2L2 fs (5) where n1 , L1 , and d1 are the turns proportion, spillage inductance, and obligation cycle in the main stage, while n2 , L2 , and d2 are those in the subsequent stage. As appeared in (4) and (5), Io1 in the main stage is equivalent to Io2 in the subsequent stage, gave that the parameters of the two stages are indistinguishable and the obligation cycles are the equivalent. In reasonable circumstance, in any case, parameter jumbles of the two stages are inescapable. So as to accomplish perfect current sharing, distinctive obligation cycles d1 and d2 are required to repay the present contrast brought about by parameter confounds. To accomplish perfect current sharing, so that Io1 = Io2, and let the obligation cycle of the second stage d2 = d1 + δd, the following condition should be satisfied:

The stage parameter proportion that represents the parameter jumbles between stages. Δd is the obligation cycle contrast between two stages when current sharing is accomplished. Accepting that (X1/X2) > 1, d1 is delivered by voltage controller, and d2 is created by (9), if d1 somewhat increments because of some bother, Io1 and d2 will expand, at that point Io2 builds in light of d2 .

The expansion in Io1 and Io2 prompts the increment in the yield voltage. A short time later, with the shut circle voltage guideline, d1 is acclimated to diminish, so the yield voltage remains stable. The underlying increment in d1 is discouraged. This negative criticism instrument adds to keeping up framework working at enduring state. Then again, in the event that (X1/X2) < 1, d2 decreases with d1 expanding, at that point the framework will lose its strength. In this way, it is crucial to ensure that the obligation cycle contrast Δd is determined dependent on the obligation cycle of stage with bigger stage parameter. A system to acknowledge it will be shown in Section 4.2. When the stage parameter proportion is accessible, with the obligation cycle of one stage, which is delivered by voltage controller, the obligation cycle of the other stage can be determined by (9), and current sharing is then accomplished.

Estimation of parameter befuddles

The strategy to appraise the stage parameter proportion X1/X2 is depicted beneath. Right off the bat, the two-stage IPOP DAB DC–DC converters are constrained by a typical obligation cycle produced by a voltage controller. The control schematic graph at this stage is appeared in Fig6.3a. After the framework achieves consistent express, the obligation cycles of the two stages are D as

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appeared in the condition beneath d11 = d21 = D (12) Also, the yield current of the two stages are Io11 = n1VinD 1 − D 2L1 fs (13) Io21 = n2VinD 1 − D 2L2 fs Next, the obligation cycle of the principal stage is irritated by subtracting a little steady balance Δdp from the yield of voltage controller, while the obligation cycle of the subsequent stage continues as before with the yield of the voltage controller. The control schematic outline at this stage is appeared in Fig6.3b. After the framework achieves new relentless express, the yield of voltage controller switches from common duty cycle D to D′, and D

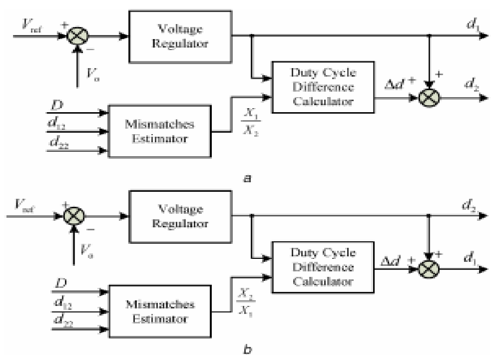


Fig6: Control diagram of the third stage in two-phase IPOP DAB DC– DC converters (a) With the primary stage as ace and the second as slave, (b) With the subsequent stage as ace and the first as slave

VI.SIMULATION RESULTS

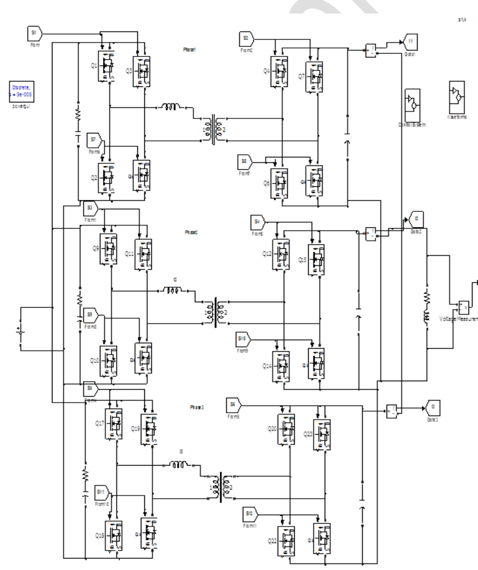
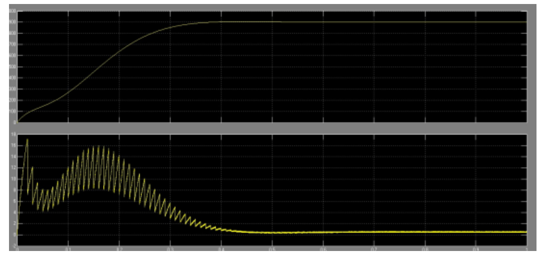
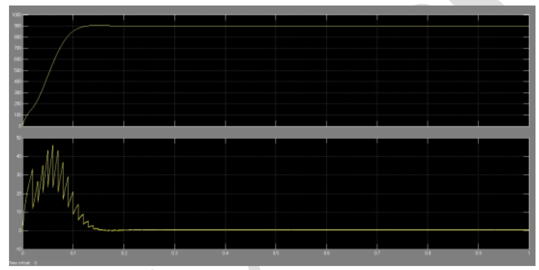


Fig7: Topology of multiphase IPOP DAB DC–DC converter



(a)



(b)

Fig.8. DAB DC/DC converter principle (a) PI Topology, (b) Fuzzy waveforms

VII.CONCLUSIONS

In this project proposes a novel sensorless parameter estimation also, current-sharing methodology in two-stage or potentially multiphase IPOP DAB DC–DC converters. Reenactment and exploratory model of a 30–70 V, 20 kHz, three-stage IPOP DAB DC–DC converter are executed. The accompanying ends can be drawn from the investigation with the proposed sensorless current-sharing technique: I. With the proposed methodology, current-sharing between/among stages is accomplished under various stage parameters; consequently, the dependability of two-stage or potentially multiphase IPOP DC–DC converters is upgraded. ii. This current-sharing methodology can be actualized with no present sensors, along these lines more practical contrasted and those sensor-required current-sharing methodologies. iii. The sensorless current-sharing procedure can likewise be a back-up plan for accomplishing the current-sharing during sensor disappointment, hence improving the reliability.

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