

A Superior AC-AC Powertrain Association for HEVs: Comes about because of Demonstrating and Reproduction

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Abstract. Hybrid electric cars use AC/AC power trains, which are addressed extensively in this paper (HEV). With this connection, a 4QC auxiliary converter for autonomous and hybrid operation modes is no longer needed, and its function is taken care of by a smaller 0-5 matrix converter. Streamlining the connection might also contribute to a more efficient HEV drive train. Autonomous and hybrid modes of operation need a 3 5 M C matrix converter, which is utilized for traction, while the 3 5 M C matrix converter for AC is required for hybrid mode.

1. Introduction

HEVs have a significant impact on the automotive industry, the economy, and transportation and traffic services (hybrid electric vehicles). Front-end converter system with DC-voltage interconnect is used in [1], [2], [3], and [4]. An induction motor drive active front end of a VSI converter with a matrix converter (M C) has been shown to have lower semiconductor losses at full load than the active front end (AFE) in this study. M C's device current rating may be reduced by a third with similar thermal stress, [5] and [6]. [5] and [6]. Although the M C has a little higher passive component count and a slightly higher rating overall, the removal of a large smoothing capacitor is noticeable in [7]. A matrix converter-equipped AC/AC power train was developed to boost HEVs' energy efficiency [7, 8]. Because each traction motor has three phases, it is not feasible to connect two traction motors to a single direct traction converter. AB, VSI, Traction Motors (1, 2), Vehicle Control System (VCS), and Motors Control (MCON) are all traction system components (traction).

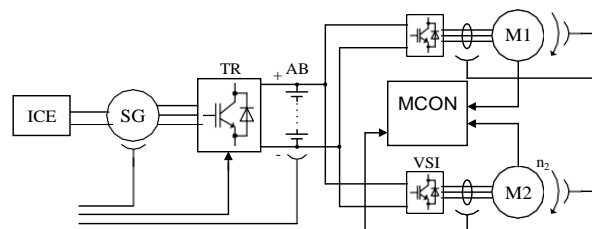


Fig. 1: All-wheel drive HEV with an electronic differential and two VSI converters

2. Power train that is Direct AC/AC.

The AC/AC hybrid power train of this hybrid electric vehicle (HEV) provides the vehicle's power (Fig. 2). It has been proven that a three-phase generator and five-phase motor, implying a [3 5] direct converter, are a reasonable compromise between traction generators and motors with varying numbers of phases in [4] and [5]. A hybrid mode in which both the internal combustion engine (ICE) as well as the battery pack are employed may be used, as can a pure electric mode.

When designing a 4QC converter, keep in mind that two Traction Motors' nominal traction power should be taken into account for complete autonomous HEV operation (e.g., traction) (TM).

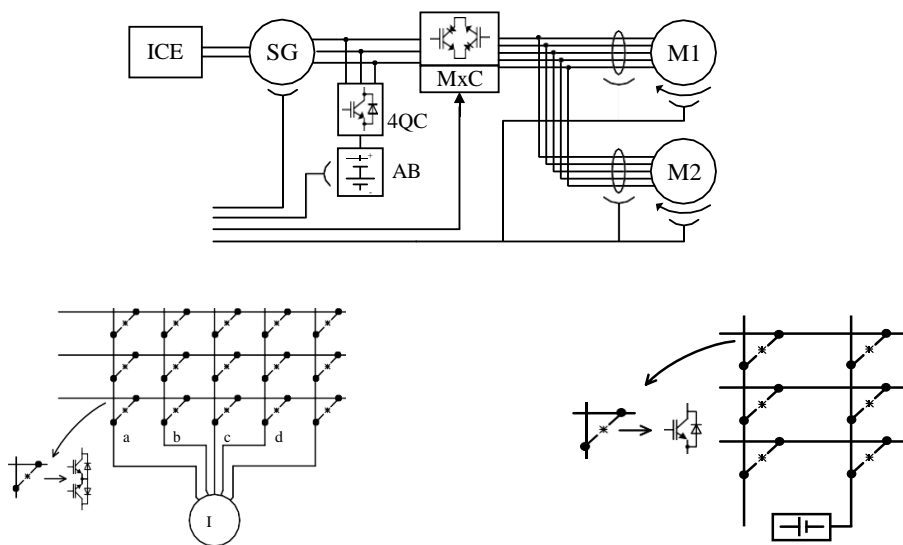


Fig. 2: With two traction motors and independent operation of the M C converters, the direct AC/AC series HEV has one M C converter/one auxiliary 4QC converter as well as two traction motors (a).

3. A new and improved AC/AC power system

Operation modes for the unique streamlined AC/AC power train presented in Fig. 4 are as follows:

| | |
|-----------------------------------|-------------------------------|
| 1. traction drive/brake: /1 | ICE-SG-ACAC-5PIM |
| 2. // | 5PIM-ACAC-SG-ICE (Fig. 3(a)), |
| 3. traction drive/brake/charging: | AB-ACAC-5PIM |
| 4. // | 5PIM-ACAC-AB (Fig. 3(b)), |
| 5. starting-up/charging: | AB-ACAC-SG-ICE |
| 6. // | ICE-SG-ACAC-AB (Fig. 3(a)). |

Fig. 3 depicts a number of possible operating models for a new streamlined AC/AC power train.

4. Computer-Aided Design

For the ICE model, DC motors with a distinct excitation mechanism were used. Using the works [8], [12], [13], and [14], the replacement model's control mechanism is laid up. There is just one traction motor in use in these simulations, and it is controlled independently of the other. Different traction operating modes are shown schematically in Figure 6, which displays numerous different AC/AC converter setups.



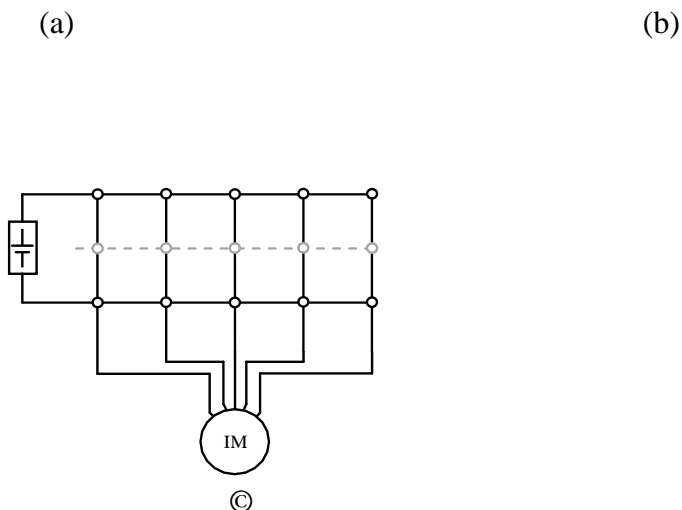


Fig. 6: There are three distinct ways to power the traction drive: using ICE/braking into ICE, using an AB Accu-Battery/braking (charging) into an AB, and using ICE to start the traction drive while the AB Accu-Battery is charging the AB. The M C converter is configured in each of these three ways.

Basically, there are three options:

| | |
|---|---|
| 1 | traction drive powered by ICE/braking into ICE (Fig. 6(a)), |
| 2 | traction drive powered by AB Accu-Battery/braking (charging) into AB (Fig. 6(b)), |
| 3 | start-up of ICE powered by AB Accu-Battery/charging of AB by ICE (Fig. 6(c)). |

5. Simulation Results

Simulated with the use of a new, streamlined drive train:

| | |
|---|--|
| a | It has an ICE-powered traction drive and start-up, and it has an Accu-Battery starter powered by Accu-Battery for the HEV. |
| b | A traction motor powered by an alternator (AB) Accumulating power from Accu-Battery AB by braking. |

Start-up and Traction Drive of HEV

Idling at a rate of around 150 radians per second. Once the traction motor has been inactive for three seconds, it is attached to the synchronous generator and a 3 5 matrix converter. Demands for traction motor or HEV dictate the speed of the ICE (and/or the SG). It is therefore necessary to adjust the speed of this control. Using this method, we were able to get the results shown in Figure 8. Data from the 5PIM traction motor and generator waveforms are given in Figure 9.

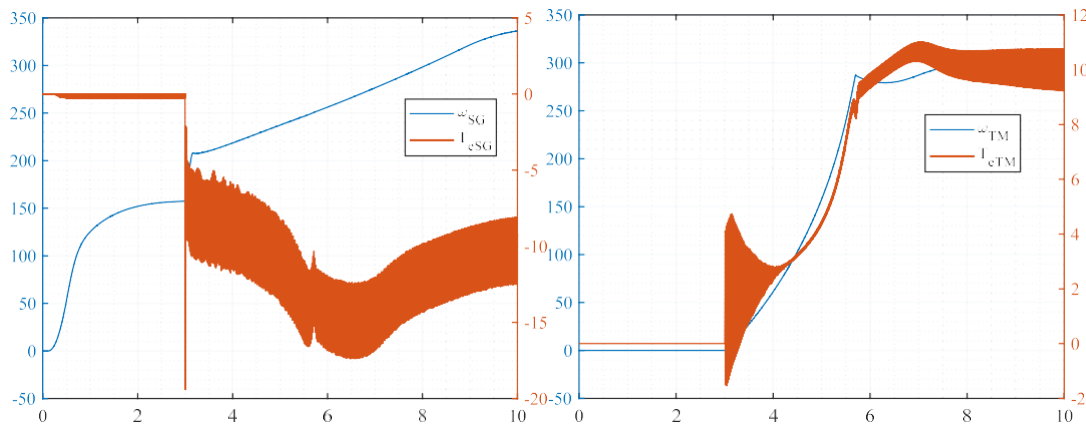


Fig. 8: In-depth analysis of the starting-up speed and torque waveforms of the SG a) and TM b).

1. Conclusion

Figure 2 depicts an AC/AC HEV powertrain. For a good compromise between the differing numbers of phases of both the generator and the traction motor, a [3 5] direct converter has been presented in [4] and [5]. In addition to pure electric and pure engine modes, the AC/AC power train may also be used in a hybrid mode, where the car is pushed by ICE and accu-battery energy in simultaneously.

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