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HIGH EFFICIENCY & HIGH PERFORMANCE CONVERTER/INVERTER SYSTEM CONFIGURATIONS FOR HEV/EV TRACTION DRIVES

By

Craig B. Rogers

Advisor: Dr. Fang Z. Peng

ABSTRACT

Hybrid and electric vehicles are becoming increasingly important as the cost of available resources increase and as pollution and green house gasses become more pressing concerns. Hybrid and electric vehicles offer a means to increase efficiency and decrease pollution and green house gasses.

Whether the hybrid system is a series or series/parallel system, the vehicles discussed in this work use an internal combustion engine (ICE), an AC electric generator, a passive/active rectifier/inverter, power storage, a traction motor inverter, and a traction motor/brake. In this research, these components have been studied. Their operating points, effectiveness, efficiencies, general behavior, and modes of control have been studied with the desire to exploit these characteristics in a manner that is more efficient than that presently being used. Based upon these device characteristics, this work shows that the ideal operating voltage levels of (1.) the generator and generator inverter (GI), (2.) the battery pack, and (3.) the traction inverters (TI) and traction motors are different from each other. However, the traditional series hybrid power electronics topology uses a DC-Link that is common with both the GI and the TI. This
forces the voltage level present at the GI to be at all times equal to that at the TI which is not ideal. This research has sought to develop a means to decouple these voltages and to allow the voltage levels to be controlled so that the hybrid vehicle’s components can be operated in a more efficient manner. Several topologies have been proposed in this work and analyzed in terms of the extent to which the decoupling is enabled and to the extent that greater efficiencies can be realized. Experimental results have been obtained to demonstrate the concept and to validate the analytical methods used in this study. Based upon this, the most effective of these topologies has been chosen, further analyzed, and its operating states explained.

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