Electrical Motor/Generator Drive with Improved Inverter

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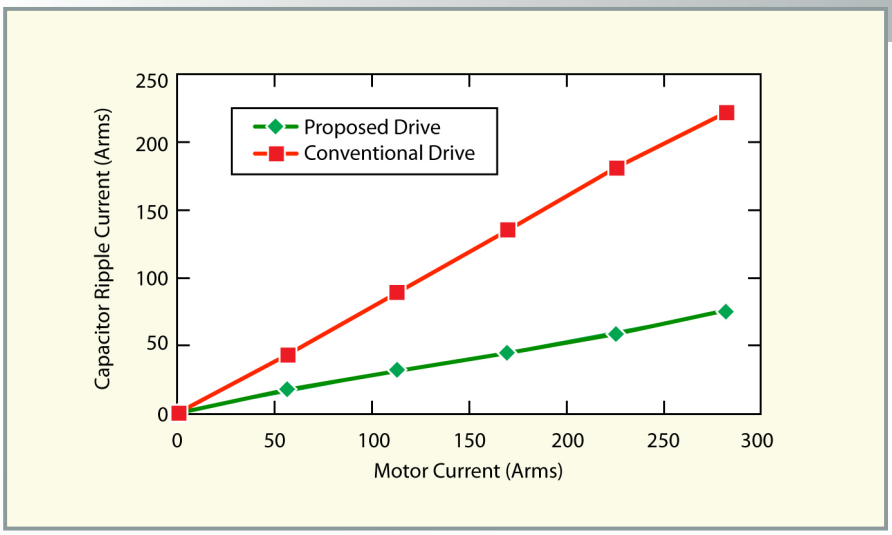

Technology Summary

In hybrid electric vehicle (HEV) motors, power inverters with bulky, high performance direct current (DC) bus capacitors are needed to absorb ripple currents and protect the battery. Researchers at ORNL invented an electrical motor drive apparatus with an improved inverter that reduces the size and cost of high performance capacitors and eliminates the need for liquid cooling. This inverter significantly reduces DC bus ripple currents; it is also more efficient in the elevated temperatures of an HEV engine.

Conventional capacitors lose ripple current capability as the temperature increases inside the engine compartment. The ORNL invention is based on a segmented drive system. It reconfigures the inverter switches and motor stator winding connections to allow multiple independent drive units. Simple alternated switching and optimized pulse width modulation schemes further reduce or eliminate the capacitor ripple current.

The system includes a battery, a DC bus filter capacitor connected in parallel with the battery, an inverter with pairs of switches connected in parallel with the DC bus filter capacitor, and a motor/generator with two windings for each stator. Each winding set is connected to a pair of the inverter switches. Each pair of switches forms an inverter bridge that is connected to one set of the stator windings, so that an independent drive unit is formed for each stator winding set. To complete the apparatus, a controller and a gate driver turn the inverter switches on and off in each drive unit, minimizing the ripple currents in the DC capacitor.

Advantages

- Substantially reduces the bus capacitance
- Reduces inverter volume and cost
- Reduces battery losses and improves battery operating conditions by eliminating battery ripple current
- Significantly reduces the motor torque ripples and reduces switching losses
- Increases inverter reliability
- Enables inverters for high temperature, in-engine operation

Potential Applications

- HEV automotive propulsion
- Industrial motor drives

Patent

Gui-Jia Su, *Electrical Motor/Generator Drive Apparatus and Method,* U.S. Patent Application 12/887,110, filed September 25, 2009.

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