University of Colorado
TECHNOLOGY TRANSFER OFFICE

Grid-Interactive Electric Vehicle DC-Link Photovoltaic Charging System

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Background

The transportation sector currently accounts for 70% of petroleum consumption and more than a third of green house gas emissions in the US. Studies have shown that major reductions in GHG emissions can be accomplished by transitioning to battery powered automobiles. However, the large battery systems required could be problematic due to high cost in combination with limited specific energy, safety issues, as well as limited cycle and calendar life.

A DC-to-DC converter takes a direct current from one voltage level and stores it to later converted to a direct current at a different voltage level. Efficient operation of large battery systems like those of battery powered automobiles require relatively high DC voltage. Because a single battery cell has a fairly low voltage, the need for higher voltage is commonly resolved by placing a large number of battery cells in series. However, this method is often problematic, in that a battery is only as good as its weakest cell and there are too many inconsistencies between individual cells for the system to be reliable. Therefore there is a need for each cell in the string to include protection devices to prevent catastrophic failures due to overcharge, excessive discharge, or excess temperature.

Technology

A research team at the University of Colorado at Boulder led by Dragan Maksimovic has developed high-performance digital control for high-frequency switched-mode DC-DC power converters. Each low-voltage DC-DC converter is controlled separately to precisely monitor the individual cell and the individual cell charging or discharging current accordingly. This novel system also utilizes the direct current from a photo-voltaic (solar) panel during conversion to eliminate loss of energy and create a new, more dependable battery system that can be used for a multitude of applications including battery-powered automobiles.

Advantages

The approach is based on distributed battery cell management and controls using ultra high-efficiency, low-cost low-voltage power electronics, leading to substantial improvements in reliability, specific energy and power, cycle life, safety and cost of battery systems.

Key Document

"High-Reliability Battery Systems." Manuscript in preparation; available under CDA.