Control and Design of Software-Defined Power Electronics for Electric Vehicle Energy Conversion System

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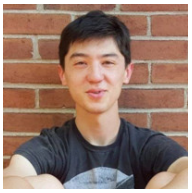

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About Us:

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SUMMARY

We introduce a software-defined architecture for the purpose of improving the electric vehicle energy conversion system. The proposed structure is composed of three layers for the interfaces with various types of electrified loads/sources and the corresponding control functions, such as single/three-phase grid, battery, motor and DC supplies.

ABSTRACT

We introduce a software-defined architecture for the purpose of improving the electric vehicle energy conversion system. The proposed structure is composed of three layers for the interfaces with various types of electrified loads/sources and the corresponding control functions, such as single/three-phase grid, battery, motor and DC supplies. The merits of the designed architecture include the reconfigurability to be suitable for different types of EV applications, all non-isolated topologies with common mode noise attenuation capability, improved efficiency and dynamic performance by VFSS and MPC of the elementary power module, high accuracy and robustness of the multi-layer control without being influenced by the parametric modeling error from various applications.

For the EV charger design case based on our techniques, we achieved efficiency >99%, power density >10kW/L, with frequency up to 1MHz. We will firstly introduce the configuration of the proposed software-defined EV energy conversion system. Secondly, several design cases, such as the single/three-phase grid connection, DC battery connection, a EV charger that can be reconfigured for 3 phase / 1 phase / split phase and motor connection, are illustrated in details with the control and switching strategies. Thirdly, the hardware design and magnetic component considerations are presented.