High Efficiency Wireless Charging of Electric Vehicles

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Abstract: Wireless power transfer technology offers significant improvement in convenience and electric safety for electric vehicle (EV) charging. Our research aims at novel designs that considerably reduce size and cost while increasing the coupling coefficient and improving the misalignment capability. We will first introduce the basics of wireless power transfer followed by discussion of a double-sided LCC topology which further enhances the system efficiency. Experiments show that tens of kilowatts of power transfer can be achieved over 200mm distance with an efficiency of 97% (DC-DC), and an alignment tolerance of up to 300mm. We will then discuss the capacitive power transfer (CPT) for EV charging applications. It has been an established myth that good efficiency and stability of control was only possible at low power levels (in the tens of watts) and with low transfer distances (in the millimeter range) for CPT. We have shown that it is possible to achieve excellent efficiencies at the power level and distance applicable to EV charging, breaking the established myth, enabling a paradigm change on EV charging, and making low cost wireless power transfer from science fiction to reality. A double-sided LCLC-compensated topology was proposed. A 2.4kW CPT system was designed with four 610mm × 610mm aluminum plates at a distance of 150mm. The experimental prototype reached a DC-DC efficiency of 90.8% at 2.4kW output power. The CPT system provides a much lower cost and better misalignment capability then inductive wireless power transfer.