Multi-Coil Wireless Power Transfer System for Electric Vehicles

Manjunath Machnoor[(1)], Erik Saturnino Gámez Rodríguez [(1)], and Gianluca Lazzi [(1)]
(1) University of Utah, Salt Lake City, UT 84112

During the last decade, interest in large-scale adoption of Electric Vehicles (EVs) has surged considerably. This interest has been sparked primarily by the implementation of strict environmental regulations in the U.S. and around the globe, the increased public awareness about climate change and long-term implications of the utilization of fossil fuels. Nonetheless, electric vehicle adoption has been relatively slow since current EVs still suffer from rather long charging times and somewhat limited travel range when compared to traditional vehicles.

Several promising technologies to remedy some of the limitations of EVs are being considered: among these, Wireless Power Transfer (WPT) meant to provide convenient, on-demand, recharge of the battery of EVs (for example, in parking lots or even while in motion) is one of the most promising. Wireless Power Transfer is traditionally accomplished through inductive coupling technology; conventionally, this technology relies on a stationary transmitter coil to transfer power from the source to a receiving coil by means of inductive coupling (two-coil system). A strict set of requirements has to be met to achieve high power transfer efficiencies with this technology: for example, misalignment between the transmitter and receiver coils has to be tightly controlled (less than 10 cm according to SAE J2945 standard). Additionally, safety concerns limit the amount of the power than can be transmitted and, therefore, arbitrarily fast charging cannot be achieved.

In this work, we explore the use of multi-coil systems to charge efficiently an electric vehicle battery. Unlike conventional two-coil systems, the transmitter coil system consists of multiple standard coils alongside or concentric to a driver coil: we demonstrate that such system can lead to higher tolerance to misalignments and lower emissions when to the conventional two-coil Wireless Power Transfer. The additional degrees of freedom offered by multi-coil systems allow for the implementations of designs that outperform conventional 2-coil systems in all practically encountered real-life situations.