INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Coupling Efficiency Improvement and Power Transfer Enhancement in Wireless Power Transfer System for Electric Vehicle Charging Applications

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SHORT ABSTRACT

In recent years, wireless power transfer (WPT) technology is gaining popularity for electric vehicle (EV) charging. This technology has advantages such as safety, reliability, ease of charging, and robustness over a conventional plug-in charging system. In the WPT system, transmitter and receiver coils (loosely coupled) play an essential role in power transfer. Since the power transfer happens through air-medium, the high leakage inductance results in reduced coupling coefficient (*k*). This reduced *k* decreases power transfer capability and transmission (coil-to-coil/coupling) efficiency. The transmission efficiency is also affected due to the varying nature of the load during battery charging (i.e., change in the equivalent load resistance due to change in the battery's state of charge). In this context, to improve the transmission efficiency, an experimental study is performed while charging the battery bank using a series-parallel compensated WPT system, and an expression of optimum operating frequency is derived for improving the transmission efficiency. Furthermore, the power transfer capability and transmission efficiency (performance parameters) are enhanced by improving factor *k*. At first, *k* of unipolar air-core coils is improved by doing modifications in the design of the coils. For this, a unipolar coil arrangement method for improving *k* compared with conventional coils of the same self-inductance and outer dimensions is proposed. Moreover, a 3-D analytical model is developed to calculate the magnetic fields and *k* faster than 3-D finite element analysis and is verified using the simulation and experimental results. Then, a novel (and simple) ferrite arrangement of unipolar rectangular (and square) coils is proposed to minimise the weight and volume of the ferrite while maintaining *k* in comparison to the traditional ferrite arrangement method. All proposals have been verified with the developed prototypes.