Coil geometry models for power loss analysis and hybrid inductive link for wireless power transfer applications

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Abstract

This paper presents a hybrid inductive link for Wireless Power Transfer (WPT) applications. Achieving better power transfer efficiency over a relatively wider distance across coils is the prime objective in most of the WPT systems, but often suffers from power loss in the near field area of inductively coupled coils. One of the reasons for this power loss is the pattern of the magnetic field produced by the source coil used in the WPT system. Mostly the nature of magnetic field produced by the source coil is distributed radially over the coil, in which the produced magnetic field is not fully utilized. Achieving better efficiency and load current by reducing power loss is the main driving force of this work. One of the viable methods to reduce the power loss is by increasing the field intensity thereby redirecting the flux lines flow to be directional. With this aim, three coils such as solenoid, spiral and conical are designed and simulated to determine the magnetic field strength using Finite Element Method. The conical coil produces the highest self-inductance of 8.63 A mu H and a field strength of 1.542 Wb with the coil thickness of 3.20 mm. Then, WPT system is demonstrated with the inclusion of Maximum Power Point Tracking algorithm for improving efficiency. The schematic of flux generation of both in the transmitter and receiver sections are demonstrated and analyzed graphically. The efficiency of both simulation and experimental measurements are matched well with similar progression. The effect of parameters (angle, distance, and load resistance) on the efficiency is explored. The outcomes conclude that the inductive coupling has achieved 73% (average case) power transfer wirelessly over a distance of 5 cm with an input voltage of 5 V and 5 MHz frequency.

Keywords

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KeyWords Plus: TRANSFER SYSTEM; DESIGN; EFFICIENCY

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