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Single or Distributed Inverter for Position Independent Inductive Power Transfer: Comparison of Solutions

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1 Extended Abstract

Industrial automation plants rely on machinery and tools for a wide range of processes and applications. Lots of interest has been devoted to Wireless Power Transfer (WPT), which can remove the limitations of wires, wear, and allow to transfer power to vehicles [1], industrial movers or even implants. Inductive power transfer can transfer considerable amounts of power with high efficiency and to distances of few times the size of the coils.

An important feature of moving WPT system is the ability to deliver consistent performance over different positions, while maintaining high efficiency and constant output voltage. In this work we propose and compare two methods for wireless power transfer to moving objects, where both employ an array of transmitters, and a sliding receiver (see Fig. 1). In both systems the geometry of the receiving coil is optimized with reference to the transmitting coils [2] to allow a constant coupling coefficient. Only two transmitters are active and series connected at each time.

The system with the single inverter, therefore employing an ac feed, is conceptually the simplest, having only to connect the two transmitters in series. It is suitable for high powers and low frequencies, less than 100kHz, because the effects of the feed and switches parasitics would affect the resonance, therefore the ability of maintaining constant operations.

The use of distributed inverters, therefore employing a dc feed, adds complexity but provides a complete system, which can scale in length and frequency without any theoretical bound. Two transmitters are activated at each time with a synchronous clock, whereas two Load Independent Class EF inverters act as current sources and force a virtual series connection of the two coils. The receiver is a class E rectifier numerically optimized to provide a constant output voltage, independent of the position and of the dc load.

The real prototypes will be presented and compared using measured data.

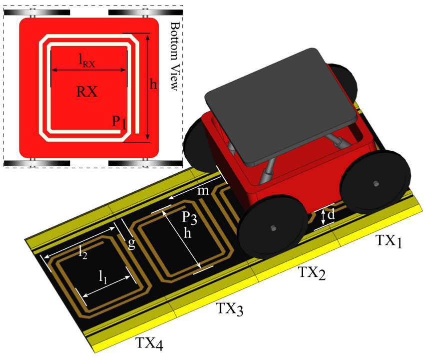

Figure 1. Dimensions of the designed and measured prototype (mm): $l_1 = 20$, $l_2 = 30$, $h = 40$, $d = 10$, $l_{RX} = 28.5$, $g = 3.5$.

References

[1] C.-S. Wang, O. Stielau, and G. Covic, "Design considerations for a contactless electric vehicle battery charger," *IEEE Transactions on Industrial Electronics*, vol. 52, no. 5, pp. 1308–1314, oct 2005.

[2] A. Pacini, F. Mastri, R. Trevisan, A. Costanzo, and D. Masotti, "Theoretical and Experimental Characterization of Moving Wireless Power Transfer Systems," in *2016 10th European Conference on Antennas and Propagation (EuCAP)*. Institute of Electrical and Electronics Engineers (IEEE), apr 2016, pp. 1–4.